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Original Article

Performance of Optimum Sharp Portfolio and CAPM Portfolio for Sustainability of Small Investors

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Abstract

Purpose: Investment growth is essential for the prosperity of an economy. Saved money is used for investment. It is scarce in a country like India. So, optimal use of this saved fund is required. Markowitz stated that the best use is possible by creating a diversified portfolio to minimize risk. Ordinary people have limited funds and knowledge of the stock market. So diversified portfolio should be formed by purchasing a minimum number of stocks. **Objective:** The objective of this research analysis is to form optimum portfolios by using different methods. They are compared to know the best one which can provide the maximum return per unit of risk by using the minimum number of stocks in the portfolio formation. The uniqueness of this research is to identify numeric advantages in optimum portfolio formation from an Indian context. **Methodology**: Analysis is based on daily price movement data of the Nifty 50 index. An optimum portfolio is formed first by using the Sharp optimum portfolio method, where stocks are selected on the basis of cut-off rate C with weight factor Xi. Then selected stocks of the Sharp model are combined by using the CAPM beta diversification technique. Risk minimizing weight factors are used here. These two portfolios are compared to judge the minimum risk achievement with the low volume of stocks. **Result:** Optimum portfolio performances are compared again with actual data from next year. From this research analysis, beta diversification was found to be the best option. **Conclusion:** More than two years of analysis can give solidarity in the conclusion.

Keywords: *Portfolio; Investment; CAPM; Beta; Optimization*

Introduction:

The growth of an economy depends upon the increase in the gross domestic product along with the improvement in the quality of life (Botha *et al.*, 2020). It requires a continuous increase in net investment as stated by Prof. Schumpeter. Prof Keynes has mentioned in his famous book on money and Banking that people saved a portion of their income after consumption. That saved money is channelized into the economy for investment. The business sector borrows such money and introduces further inputs to business. Thus, the investment grows. According to Masoud (2013) and Srinivasan (2012), the economic development of a country largely depends upon industrial and commercial activities. They have emphasized the importance of the stock market in this context. Stock market channelizes surplus funds of investors to the stock issuer (Fauzi & Washyudi 2016). Thus, stock market in the modern economy plays a significant role as an important source in providing the necessary capital for carrying out industrial and commercial activities (Farahi, 2020).

In recent years, the number of individual investors is growing, they are known as small investors. According to Baumann and Trautmann (2012), they have some constraints like transaction cost, integral transaction units, the maximum number of different stocks they can afford, the maximum weight of different stocks, dividends, etc. Taking these constraints in mind, investment is optimized. They invest for maximizing returns subject to the fulfillment of these restrictions (Baumann & Trautmann, 2012).

Review of Literature:

Investment in stock market is subject to risk. Different factors affecting this market can create loss. H. Markowitz (1952) has developed a first-time theory on investment. He has formulated Mean-variance (MV) model. It has shown the estimation of expected return (yield) and risk (standard deviation). These two variables are directly related. So, for selecting the right stocks for investment, return per unit risk is ascertained. The stock having the highest cofactor is selected for investment. Markowitz has also suggested the concept of portfolio formulation by using different stocks of diversified nature (Lee, Cheng & Chang (2016). It will reduce company-specific unsystematic risk to almost zero (Goetzmann *et al.*, 2014)). Finally, he has explained, the development of optimum portfolio that can maximize the utility of an investor. On the basis of the Mean variance (MV) model, Sharpe, (1964) and Lintner (1965) developed a model known as the Capital asset Pricing Model (CAPM). In this model, the risk-free bond is added to optimum portfolio of risky stocks to form a Capital market line. An investor by moving along this line can improve his satisfaction level and achieve a new optimum portfolio. This model has assumed equal borrowing and lending rates. Sharp and Lintner also introduced the concept of beta calculation to form Security Market Line (SML). It can be used for estimating the expected return of an individual stock. However, the Marhowitz Model (1952) of optimum portfolio is a single period quadratic programming problem. So, when the number of stocks included in the portfolio is on the higher side, estimating the covariance matrix becomes very difficult. For overcoming this limitation, Sharp, (1963) has formulated a single index model known as 'portfolio optimization'. It has reduced calculations from [N(N-1)/2] to 3N+2. Also, this model has simplified the calculation of beta value (Mondal, 2013)). Konno & Yamazaki (1991) proposed the mean-absolute deviation model (MAD) as a substitute for the MV model. It can yield the same result as the MV model with normality distribution. EsmaeIli, Souri and Mirlohi, (2020) has stated that 1st and 2nd moment lose efficiency if the CAPM model fails the normality test. 3rd and 4th moments are required here for portfolio optimization. Rossi, (2016) has stated that CAPM is favoured for its simplicity. But non availability of complete information in the market, investment in individual stock instead of portfolio and holding of undiversified portfolios by investors reduces its effectiveness. Yang, (2021) made a comparative study on CAPM and Sharp ratios. He observed that two models are simple and easy to understand. But they have made too many simplifications and lead to inaccurate results.

Maiti and Balakrishnan (2020), indicated that a substantial portion of stock returns are explained by the debt-to-equity ratio. Jain & Singla (2021) applied multi-factor models to test asset pricing models of the Indian security market. He observed that the five-factor model incorporating leverage and liquidity in CAPM, Fama, French three factor model, can provide higher explanatory power.

Next considered the number of shares in optimum portfolio. Mbithi, (2014) carried out research work in Nairobi Stock Exchange. It shows the number of shares varies from 18 to 22 shares in optimum portfolio. Lee, Cheng and Chang (2016) observed that the CAPM model is very suitable in the Malaysian stock exchange as it can reduce the unsystematic risk to almost zero. As far as research work in India is concerned, Chauhan (2014) constructed a portfolio using the top 10 stocks of Nifty. He observed that Sharp optimum portfolio is the simplest method of calculating optimum portfolio. Nalini, (2014) considered 15 stocks of various sectors from BSE sensex. It was observed that risk can be reduced by diversifying portfolio. Only 4 stocks are selected for inclusion in optimum portfolio. Gopalakrishnan (2017) in his study of 13

Asia-Pacific J.Mgmt. Tech. Volume 2(4) 07- 16

actively traded scripts of the NSE IT index. He concluded that a significant relationship exists between IT Index and S&P Nifty 50 index. Tanuja and Srivastava (2017) formed a Sharp index model from Nifty 50 stocks. The method of constructing optimum portfolio has been explained in detail in his article. On the basis of Banking Sector, Sharp Index model was formed by Dr. Aloysius Edward and Jagadish (2020). It shows that only 5 top private banks are considered in optimum portfolio.

Purpose

As the savings of small investors are very limited, it requires the best utilization for value maximization. They want to optimize return subject to a given risk. (Baumann & Traumann, 2011). Also, they want to get this result by investing in small numbers of securities. All these are needed for survival in the market. Many empirical works have been undertaken on portfolio formation. But work with the Indian stock market is limited. Further, no such empirical research was found where different optimizing portfolio methods are analyzed side by side to conclude the best method which will provide this numeric advantage. The purpose of this research work is to construct portfolios using CAPM and the Sharp single index method. Performances are compared to draw a conclusion on numerical superiority in portfolio formation.

Methodology:

Secondary data has been used in this research work. Stock performance is indicated by price movement. Tanuja and Srivastava, (2017) has carried out an empirical study on Nifty 50 stocks. It can be used by individuals and institutes in constructing a diversified portfolio. Stock market index is considered the best possible diversified portfolio that can be formed from listed shares. The selection process adopted by stock exchange in developing portfolio for indexation has made it possible. Thus, index portfolio is considered a portfolio of zero unsystematic risk. Only systematic risk is in existence in this portfolio. Due to this reason beta value of the market index is 1. Thus Nifty 50 index is a well-diversified portfolio with zero unsystematic risk. Further total number of shares in it is 50. This sample size is greater than 30. So as per central limit theory, population can be considered as normally distributed.

This research work is based on secondary stock market data. Nifty50 Index of National stock exchange has been used. All 50 stocks are included in this analysis. The daily closing price of these stocks are used here for the period April 20 to March 21. Also, daily closing Index value of this period is taken. On the basis of these data, two portfolios are formed by using the Sharp model and by combining the CAPM model with the Sharp optimization model. Then results are compared side by side to draw conclusion. Also, the results are tested from actual market data for period April 21 to September 21 to test the validity of result.

Markowiz Theory

Today investors are operating in a risky environment where decisions are taken from more than one alternative situation that can occur in the future investment market. However, the probability of their occurrence can be estimated. So, the expected return of alternatives is calculable. Markowitz has suggested the comparison of expected return with risk for arriving at the best possible investment decision. Risk is estimated by using the mean deviation technique known as standard deviation. Formulas are-

$$E(R) = \mu(R) = P_1R_1 + P_2R_2 + ... + P_nR_n$$

$$= \sum_{i=1}^{n} P_iR_i$$

$$\text{Risk} = \sigma_X = [P_1(R_1 - \mu_X)^2 + P_2(R_2 - \mu_X)^2 + ...$$

$$+ \quad {}_n(R_n - \mu_X)^2]^{\frac{1}{2}}$$

Usually, high return is associated with high risk. Therefore, the investment decision is taken from risk-return trade-off i.e., cofactor. It is estimated by dividing the expected return by the expected risk. Units with higher cofactor are selected for investment.

Types of risk: Broadly risk can be divided into two groups. They are:

Unsystematic Risk: Here the source of risk lies within the organization. Examples are low productivity, inefficiency, labour unrest, wrong marketing strategy, etc. Organizations can avoid it by taking appropriate diversification of investment.

Systematic risk: It includes reasons lying outside the organization. They will affect all firms in the economy.

As stated in the Markowitz Model, investor has to invest in different shares so that unsystematic risk can be reduced to almost nil. From this diversified portfolio, the benefit of one share can neutralize the loss from others. However Systematic risk will exist, but it tends to become stable. The model has suggested the following formula for measuring return and risk of a portfolio with two shares.

$$\text{Yield} = E(P) = \mu_P = W_1\mu_1 + (1 - W_1)\mu_2$$

$$\text{Risk} = \sigma_P = \left[W_1^2\sigma_1^2 + W_2^2\sigma_{22} + 2W_1W_2\sigma_{12}\right]^{\frac{1}{2}}$$

In the above formula symbols used are-

μ_i = expected return of stock 'i'

σ_i = risk of security 'i'

σ_{ik} = covariance of security 'i'and'k'

w_i = weight factor of security 'i'

These formulas can be extended to n securities portfolio -

$$\text{Portfolio return} = w_1\mu_1 + w_2\mu_2 + \dots + w_n\mu_n = \sum_{i=1}^{n} w_i\mu_i$$

$$\text{Risk} = \sigma_P = \sum_{i=1}^{n}\sum_{j=1}^{n} W_i W_j \sigma_{ij}$$

$$= \left[\frac{1}{n^2}\sum_{\substack{i,j=1\\ i=j}} \sigma ij + \frac{1}{n^2}\sum_{\substack{i,j=1\\ i\neq j}} \sigma ij\right]^{\frac{1}{2}}$$

The first part of this Portfolio risk indicates unsystematic risk. Its limit is zero as the number of shares included in portfolio tends towards infinity.

$$\frac{1}{n^2}\sum_{\substack{i,j=1\\ i=j}}^{n} \sigma ij = \frac{1}{n^2}\sum_{i=1}^{n} L = \frac{1}{n^2} \times nL = \frac{L}{n}$$

$$\therefore \text{If } n \to \infty \text{ then } \lim_{n\to\infty}\frac{L}{n} = 0$$

Similarly, the second part of the portfolio risk formula indicates systematic risk. It tends to become a constant as shares in the portfolio is infinity.

$$\frac{1}{n^2}\sum_{\substack{i,j=1\\ i\neq j}}^{n} \sigma ij = \frac{1}{n^2}\sum_{i,j=1}^{n} n(n-1)\sigma_{ij} = \frac{n-1}{n}\sum_{i,j=1}^{n}\sigma_{ij} = 1 - \frac{1}{n}\sum_{i,j=1}^{n}\sigma_{ij}$$

$$\therefore \lim_{n\to\infty}\sum \sigma ij - \lim_{n\to\infty}\frac{1}{n}\sum \sigma ij = \bar{\sigma} ij$$

Markowitz has shown that investors by combining 15 or more shares can obtain this diversification benefit. Maximum benefits will be availed for the first 15 combinations. Then the benefit becomes negligible. H Salami and A Salim (2021) studied the systematic risk of wheat production in Iran provinces. His objective is to show how the risk of one province is compensated by others. He observed uncompensated risk in many provinces with low-level yield per hectare and high-level average cost in the long run it is expected that they will be replaced by higher yield crops.

However, portfolio build-up with similar types of securities will not give effective result. Investors must consider securities of diversified nature. Markowitz model has suggested beta value of stock for proper diversification. It shows the relation between changes in return of share index with the change in return of concerned share. Here stock index is considered as best diversified portfolio available in the stock market.

Stock market deals with all listed shares. New issue and subsequent buy and sell of such securities are carried out through this market. Each market has developed more than one index. It consists of limited numbers of securities from the listed items. But securities are selected in a manner to represent the price movement of the entire market. Due to this reason, the market index is considered a diversified portfolio where unsystematic risk is zero. So, index risk includes only systematic factors.

Beta value of a security can be positive or negative. A positive beta value will mean, that security return is positively related with index return. If beta value is 1.2 then, 1% increase in index return will increase share return by 1.2%. Similarly, a negative beta value will indicate the opposite relation between security return and index return. Finally, at beta value 1, both security return and portfolio return will change by equal percentage.

In selecting securities for portfolio, investors can look into the beta value with wide differences. A positive beta value security combined with negative value security can give the best result.

Sharp Optimum Portfolio model

The main limitation of the Markowitz model is calculation of unknown's increases in a multiplicative manner. Sharp's single indexed optimum portfolio model (1963) can solve this problem. It is based on the following assumptions-

-Expectations of all investors are homogeneous.

-In determining risk and return of each stock, same period's data are considered.

-Existing Economic and Business conditions have major impact on movement of stock price.

-Index with which securities returns are linked has been constructed from the stocks of same market.

Symbols used in this model are-

$r_i = \text{Expected Return of Stock i}$

$\alpha_i = \text{Intercept of share i.It indicates return from stock when market index return is zero.}$

$R_m = \text{Return from Market index}$

$\beta_i = \text{Slope of stock i}$

$e_i = \text{error term}$

Here formula equity risk is-

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2$$

$\sigma_m^2 = \text{Variance of market index return}$

$\sigma_{ei}^2 = \text{Covariance of error value}(e) \text{ and security return}$

Portfolio return of N shares is-

$r = \sum_{i=1}^{N} \text{Xi } [\alpha_i + \beta_i R_m]$

Xi is weight of i th share in the portfolio

Portfolio variance formula is-

$$\sigma_R^2 = \left[(\sum_{i=1}^{N} X_i \beta_i)^2 \sigma_m^2 \right] + \left[\sum_{i=1}^{N} X_i^2 e_i^2 \right]$$

In this model, Sharp has initially selected some stocks for inclusion in optimum portfolio. It is ascertained from cut off C value. Then selected shares are combined in Xi proportions. To form optimum portfolio.

Calculations

1. Calculation of optimum portfolio in Sharp method:

(a) **Daily return calculation**: Considered Nifty50 Index stocks. The Daily closing price of all 50 shares included in this index is taken for the financial year 2020-21.

Used daily closing price data to calculate following figures-

Daily percentage return. Formula is-

$$= \frac{\text{Closing price 't'} - \text{Closing price '}(t-1)}{\text{Closing price of day }(t-1)} \times 100$$

(b) **Mean value of daily percentage return:** It is computed. Here daily returns are added and then the total has been divided by 248 days to get the mean value. It has been computed for all 50 shares of Nifty50 Index.

(c) **Variance of daily percentage return**. Formula is-

$$\text{VAR}(R) = \sum(\text{Ri} - \overline{R})^2/\text{N where} -$$

$\text{Ri} = \text{Percentage of change in daily price of stock 'i'}$

$\overline{R} = \text{Mean value of daily percentage return}$

$N = \text{Total numkber of days}$

Sqare root of variance is standard deviation.

(d) **Beta value of each stock**: The steps followed are-

i. Taken daily closing Nifty 50 index figures for the period 2020-21. Like shares daily Percentage changes in index values are computed. It indicates daily returns from market Indices. Also Mean, Variance and standard deviations computations are made.

ii. Beta value computation requires a degree of association of stock return and index return. The formula is-

$$\beta_i = \frac{\text{Cov}(R_i,\text{R}_m)}{\sigma_m^2} \text{where} -$$

$\text{Cov(Ri,Rm)} = \text{Covariance of 'i'th stocks daily return with market index return}$

$\sigma_m^2 = \text{Variance of index daily return}$

2. Input data of Sharp model: All calculations of point (1) are used as input data, in constructing the Sharp optimum portfolio. In addition, a risk-free interest rate is required. It has been taken from average coupon rates of 5 years government bond for the period April 2020 to March 2021. It is 5.32966% [Source: RBI official published data]

3. Selection of stocks for inclusion in optimum Sharp portfolio: All 50 stocks of Nifty index will not be included. The selection of stocks is based on the C value of individual stocks. Calculation of C values is made in the following manner-

a. Considered mean annual daily return of 50 stocks. They are multiplied by 365 days to get annual return.

b. From annual mean return of all stocks, risk free annual return is deducted, and this deducted value is divided by the beta value of the stocks. i.e.

$$= \frac{\overline{R_i} - Rm}{\beta_i} \text{ where} -$$

$\overline{Ri}$ = Mean annual return of stock "i'

R_f = Risk free annual return

βi = Beta value of stock 'i'

c. Next calculation is systematic return of each stock. Formula is-

$$\text{Systematic Return of stock 'i'} = (R_m - R_f) \times \beta_i$$

d. The system return is deducted from mean annual return to get unsystematic return.

e. Now all 50 shares are arranged from highest to lowest $\frac{\overline{R_i} - R_m}{\beta_i}$ value.

f. Next calculation is systematic and unsystematic variance of each stock. Formulas are-

$$\text{Systematic risk} = \sigma_i^2 \beta_i^2$$

$$\text{Unsystematic risk} = \sigma_i^2 - \sigma_i^2 \beta_i^2$$

g. Formula of Ci value is-

$$Ci = \frac{\sigma_m^2 \left[\frac{\sum (R_i - R_f)\beta_i}{\sigma_{ei}^2} \right]}{1 + \sigma_m^2 \sum \frac{\beta_i^2}{\sigma_{ei}^2}} \text{ where,}$$

σ_m^2 = Variance of market index

R_i = Return of stock 'i'

R_f = Risk free return

β_i = Beta value of stocki

σ_{ei}^2 = Unsystematic risk of stock'i'

h. The calculated Ci value above will increase initially. Then it will attain the highest value C*. After this, Ci values will decrease. Here C* value is cut off C value. Consider all stocks from above C* and stock with C* value for inclusion in optimum Sharp, portfolio.

In 2020-21, the cut-off rate C* is 144.5756. It is found for Ultra Tech Cement Ltd.'s share. All stocks lying above this cut-off C value are included in optimum portfolio. Seventeen stocks are selected in this process. They are listed in Table 1.

Table 1: Selected stocks for optimum portfolio

Sl	Company	C Value
1.	CIPLA Ltd.	16.3087
2.	TATA Consumer Products Ltd.	48.99637
3.	WIPRO Ltd.	67.80223
4.	Divis Laboratory Ltd.	79.60598
5.	Grasim Industries Ltd.	105.6237
6.	TATA Motors Ltd.	117.6855
7.	HCL Technologies Ltd.	124.3168
8.	Adani Ports	130.9012
9.	Infosys Ltd.	135.2271
10.	TATA Steel Ltd.	138.9838
11.	Sun Pharmaceuticals Ltd.	139.8561
12.	JSW Steel Ltd.	142.9550
13.	Tech Mahindra Ltd.	143.7814
14.	Hindalco Industries Ltd.	144.3100
15.	Dr. Reddy's Laboratories Ltd.	144.3706
16.	Mahindra Mahindra	144.5136
17.	Ultra Tech	144.5756

4. Weight factor of Sharp model

Selected shares in sharp model are included at weight Zi. Steps of calculating Zi value is –

a. Calculated $\frac{\overline{R_i} - R_f}{\beta_i} - C*$ of all selected stocks.

b. Multiplied calculated value of (a) with Beta value/unsystematic risk i.e., $\frac{\beta_i}{\sigma_{ei}^2}$. It will give Zi value of all selected stocks.

c. Finally include all 17 stocks in proportion of $\frac{Zi}{\sum Zi}$ where $i = 1,2,3......n$ to form optimum portfolio.

Xi values calculated here are shown in Table 2.

Table 2: X value of selected stocks

Sl	Company	X Value
1.	CIPLA Ltd.	0.1172726
2.	TATA Consumer Products Ltd.	0.1285521
3.	WIPRO Ltd.	0.0806163
4.	Divis Laboratory Ltd.	0.0673737
5.	Grasim Industries Ltd.	0.1245688
6.	TATA Motors Ltd.	0.058046
7.	HCL Technologies Ltd.	0.0769378
8.	Adani Ports	0.0731875
9.	Infosys Ltd.	0.078961
10.	TATA Steel Ltd.	0.0548403
11.	Sun Pharmaceuticals Ltd.	0.0296862
12.	JSW Steel Ltd.	0.0559988
13.	Tech Mahindra Ltd.	0.0329917
14.	Hindalco Industries Ltd.	0.0100491
15.	Dr. Reddy's Laboratories Ltd.	0.0045271
16.	Mahindra Mahindra	0.0037308
17.	Ultra Tech	0.0026601

5. Alternative optimum portfolio using beta diversification concept:

Now optimum portfolio has been constructed differently. It has been formed by combining the Sharp concept with CAPM. First considered 17 stocks selected in Sharp optimum portfolio. Then beta diversification concept is applied in the weight calculation of selected stocks. The procedure is explained below:

a. Selected 17 stocks are arranged in the ascending order of beta diversification. It will help to combine maximum diversification portfolio formation

b. Limitation of the CAPM model lies in the calculation of portfolio risk. It requires the calculation of (n *(n-1))/2 numbers of Covariance along with n number of mean and standard deviation. As n is 17 here, the Number of Covariance here is (17*16)/2=136 along with 17 mean value and 17 standard deviations.

This problem is solved by combining 2 shares at a time to construct a portfolio. The first portfolio formed includes 1st and 17th stocks. Then, each stock is added one by one with the last portfolio until all 17 stocks are included.

c. Inclusion of two shares in portfolios is made on the basis of risk-minimizing weight x and (1-x). Here x is the proportion of one rupee invested in stock 1. Balance (1-x) is invested in stock 2.

The formula of risk-minimizing x value is-

$$x = \frac{\sigma_2{}^2 - \sigma_{12}}{\sigma_1{}^2 + \sigma_2{}^2 - 2\sigma_{12}} \text{ where } -$$

$$\sigma_2{}^2 = \text{variance of stock 2}$$

$$\sigma_1{}^2 = \text{variance of stock 1}$$

$\sigma_{12} =$ covariance of returns of stock 1 and stock 2

d. Now portfolio 2 is formed by adding a share of serial 2 from the top. It is a share of Dr. Reddy's Lab. Instead share of serial 16 can also be considered. The variance of portfolio 1 is considered as the variance of stock 1in portfolio 2. So, Dr. Reddy's Lab is stock 2.

This process continued until all 17 stocks are included. Thus altogether 16 portfolios are formed. It requires 16 covariance calculation instead of 136 as mentioned in the CAPM model.

Thus 16th portfolio is optimum portfolio in this method. The weight of all 17th stocks is considered from this 16th stock. Then using this weight optimum portfolio is developed. The following values are calculated from this portfolio: The weight taken in this combined portfolio are given in table 3.

Table 3: X value of selected stocks

Sl	Company	X Value
1.	CIPLA Ltd.	0.003176
2.	TATA Consumer Products Ltd.	0.004433
3.	WIPRO Ltd.	0.010941
4.	Divis Laboratory Ltd.	0.009556
5.	Grasim Industries Ltd.	-0.01459
6.	TATA Motors Ltd.	0.309433
7.	HCL Technologies Ltd.	0.009486
8.	Adani Ports	0.144589
9.	Infosys Ltd.	0.023643
10.	TATA Steel Ltd.	0.018717
11.	Sun Pharmaceuticals Ltd.	-0.00101
12.	JSW Steel Ltd.	0.299797
13.	Tech Mahindra Ltd.	0.013527
14.	Hindalco Industries Ltd.	0.001285
15.	Dr. Reddy's Laboratories Ltd.	0.004203
16.	Mahindra Mahindra	0.076507
17.	Ultra Tech	0.086299

Results and Discussion:

Important results from optimum Sharp model are -

Table 4: Important results from Sharp optimum model

Daily percentage return of optimum portfolio	0.396125
Variance of optimum portfolio	0.010611
Beta value of optimum portfolio	0.74808526
Portfolio risk (s.d.)	0.10301
Cofactor (return/Risk)	3.8455

In the second optimum portfolio, the combination started with CIPLA and Hindalco. Return and risk of this portfolio with 2 shares are 0.37549959 and 2.03226837respecively. Risk minimizing weights are 0.711958.for CIPLA. Balance 0.288042 for Hindalco. In the second combination, these risks are returned are combined with the risk and return of Dr. Reddy's stock. Finally, the results of the 16th portfolio is-

Table 5: Important results of portfolio formed on Sharp selected stock Using beta diversification CAPM technique.

Portfolio Mean	0.517595
Variance of optimum portfolio	0.01382
Beta value of optimum portfolio	
Portfolio risk (s.d.)	0.117561
Cofactor (return/Risk)	4.4028.

A comparison of the final results of these two portfolios indicates the superiority of the portfolio formed by using the beta diversification CAPM technique. It has a little higher risk, but portfolio return is significantly high. As a result, the cofactor is much higher than in the Sharp model.

This result has been tested on the basis of price data for the first six months of the financial year 2021-22. Results are-

Table 6: Performance of Sharp portfolio and combined portfolio in April to September 21

Description	Sharp Optimum Portfolio	Capm Sharp combined Portfolio	Market Index performance
Mean	0.194247	0.137383	0.140993
Variance	0.031884	0.001225	0.578669
Standard Deviations	0.178563	0.035005	0.760703
Cofactors	1.087832	3.924611	0.185346

Results clearly show that both portfolios have performed better than market index. Among the two portfolios, CAPM Sharp combined portfolio is the best. In a study it has been found that out of the respondents, 68 are not even aware of mutual funds and of the 196 respondents who are aware of mutual funds, only 68 (34.69%) have invested in mutual funds, (Kaur & Bharucha, 2021)

Limitations of study

The above results are derived on the basis of one-year data. This conclusion will be more authentic if some more years performances are added, and the same observations are obtained.

Conclusion:

Although the return and risk of the combined portfolio are minima among the three methods, the cofactor is much better. It is due to a signification reduction in portfolio risk. So, the analysis suggests building up a portfolio by selecting the number of stocks by the Sharp method. Then combine them in CAPM diversification basis by combining shares on the basis of risk-minimizing weights.

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Conflict of Interest:
No conflict of interest is found with this content.

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