International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online)
Vol. 5, Issue 1, pp: (806-813), Month: April - September 2017, Available at: www.researchpublish.com

Comparison of Returns and Risk Using Markowitz and Sharpe's Model

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Abstract: **Many researchers have worked on traditional Markowitz model and Sharpe's Single Index model individually to analyze the returns, but very less attempts have been made to examine the efficiency of returns obtained by comparing these two models individually. The current study is to identify the level of deviation in returns by comparing these two models and to check if the results obtained are constant or not. The measurement of beta will help the investor to quantify the systematic risk and unsystematic risk associated with the particular investment.**

This study is conducted on the stocks which are listed is S&P BSE SENSEX (Automobile, banking and pharmaceuticals sectors) are taken. The study is undertaken for a period of 6 years starting from 1st January 2011 till 31st December 2016 where yearly closing balance are taken for the purpose of computation of risk and return.

Keywords: **Beta, Markowitz, returns, systematic risk, unsystematic risk Sharpe's Single Index.**

1. INTRODUCTION

Stock exchanges is a marketplace which is organized, either by the association or alternative organization, which involves in trading of securities in the form of purchasing and selling of shares. The stock markets are exposed to huge internal risk and external risk. NSE and BSE are the leading stock exchanges in India there are other stock exchanges apart from this which are registered. In India SEBI is the regulatory body which monitors the stock exchanges. During last decades Indian stock market has undergone huge changes. Stock market is interesting as it involves challenging, dynamic environment, and there is an existence of uncertainty. Directions of securities cannot be predicted as they are much volatile.

Objectives of the study:

1. To compare the returns using Markowitz model and Sharpe's Single Index Model.
2. To rank the stocks based on the returns of Markowitz Model and Sharpe's Single Index Model.
3. Identify the deviation in return between Markowitz Model and Sharpe's Single Index Model.
4. To compute the portfolio risk and return and identify the deviation as per Markowitz Model and Sharpe's Single Index Model.

Duration of the study:

To analyse the return and risk of companies, 6 years of data is taken. (i.e., 1st January 2011 to 31st December 2016).

2. REVIEW OF LITERATURE

1. Raghavan (2000):

The author commented on the risk perception and parameters. The author says that the measuring of risk goes along with the return measurement. He states that the risk can only be controlled or minimized but cannot be eliminated thoroughly. There are certain risks which have to be taken in order to get adequate returns. The authors states that the returns can be maximized by considering greater financial and operating risks, but the external factors like environmental risks may not increase the returns instead they act as a barrier for returns and risk decisions. The author concludes that the investors who wish to retain certain level of risks within the desired level must be able to practice in the daily operations.

2. Shanmugasundram and Benedict (2013):

Deliberate risk influenced in the Indian Sectoral indices and Nifty. They found risk association in varied with time period. They had designated five Sectoral indices from NSE and Nifty Index for 8 years from 2004 to 2012. For the study t-Test and ANOVA was carried out to find out the risk alteration amid the sectors and Nifty.

3. Markowitz (1952):

In his theory he developed the basic portfolio theory, describing a linear relationship between risk and return, and proved to be useful for portfolio and asset management.

4. Sangeetha and Dheeraj (2007):

In their study they considered the risk return relation using market and accounting based information and found that risk calculated on the accounting information source was not expressively captured by the market but financial risk had significant influence.

5. Markowitz (1952, 1959):

Described the Modern Portfolio Theory for the first time. The portfolio botheration was formulated as a best of mean, accepted returns and variance, apery risk associated of a portfolio of assets. The theorems on captivation connected variance, maximizing the accepted return and captivation connected return, aspersing about-face led to the accumulation of an able frontier, which is acclimated by the investor, based on the risk preference, to accomplish the best of adapted portfolio. The Markowitz mean variance conception paved way for assay of new ambit in Portfolio research. Affirmed the above acceptance of the Markowitz's access to portfolio assay is that investors are basically risk-averse. This agency that investors have to be accustomed college allotment in adjustment to acquire college risk. Markowitz again developed an archetypal of portfolio analysis. The three highlights of this archetypal are normally; the two accordant characteristics of a portfolio are its accepted return and some admeasurement of the burning of accessible allotment about the accepted return; rational investors will be called to authority able portfolios, those that aerate accepted allotment for a accustomed akin of risk or, alternatively, abbreviate risk for a accustomed akin of return.

6. Tobin (1958):

The author states that it is suitable to study the agreement of an optimal portfolio of chancy stock, that usually estimates of upcoming the allotment and accepted covariance cast of accepted returns.

7. Sharpe (1963):

The author attempted to abridge the action of abstracts input, abstracts tabulation, and extensive a solution. The author as well developed a simplified substitute of the Markowitz archetypal that reduces abstracts and computational requirements. Although Markowitz archetypal was deceptively affected its austere limitation was the adult and aggregate of plan was able-bodied above the Markowitz model.

8. Michaud (1989):

Said that Markowitz enrichment is not adapted in practice, admitting its abstract success due to the conceptually ambitious attributes of the theory; the actuality that a lot of investment companies are not structured to use a mean-variance enhancement approach.

9. Affleck-Graves and Money (1976):

The cardboard assured that the Markowitz access produces after-effects which are decidedly above to those acquired application an basis model. Thus, in practice, the broker adulatory to use a risk-return access to portfolio alternative should strive to administer the basal Markowitz formulation. If this is impossible, a basis archetypal may be used, but it is fatigued that the after-effects acquired may be ever conservative. However, if the absolute bulk to be invested is actual large, appropriately banishment a low high apprenticed to be imposed on the bulk invested in any security, again the basis models may be acclimated with abundant added confidence.

10. Omet (1995):

The author suggested that the two models are similar. SIM standard can be used, which is added applied than the Markowitz standard in upbringing ASE able frontier.

11. Terol(2006):

The author stated that the Markowitz standards are the accepted standard which proposes to break in the alternative problem of the portfolio by bold that the bearing of security market in the approach which can be identified by the accomplished asset data. However it is not easy to ensure the accuracy because of the various barriers for the portfolio selection. As for the SIM model, it contains down-covered betas gathered by not only from statistical abstracts but as well from able knowledge.

12. Niranjan (2013):

The author makes an attempt to have a deeper insight in the idea in order to insert in Sharpe's single index model and by using this model an optimal portfolio is constructed, by taking BSE SENSEX as the benchmark index and by taking in the daily indices along with the daily prices of the securities that are taken in this study from the period of April 2001 till March 2011. The author has said that construction of optimal portfolio investment is much easier and comfortable by using Sharpe's Single Index model then by using Markowitz's model. According to the author influential contribution Sharpe argues that there is a similarity in efficient portfolio construction between SIM and Markowitz's Model, this model determines the extent of risky a security is exposed to, if such securities are held in as a well – diversified. The author has made this study for a small sample of 21 selected securities it can also be made for a large sample in order to fetch more accurate result.

Table 1: Showing Return, Risk, Beta and Alpha of selected stocks:

NAME OF THE COMPANY	RETURNS * (%)	RISK	BETA	ALPHA
Maruti Suzuki	30.228	38.877	1.926	18.899
Bajaj Auto	12.77	17.984	0.585	9.329
HDFC Bank	6.936	44.90	2.204	- 6.024
Sun Pharma	27.525	40.344	0.885	22.320
Lupin Pharma	24.025	28.208	1.094	17.591

***(6 years average return has been taken for the study)**

Table 2: Computation of portfolio returns as per Markowitz model

Name of the company	Weight	Returns	Portfolio return
Maruti Suzuki	0.2	30.228	6.0456
Bajaj Auto	0.2	12.77	2.554
HDFC Bank	0.2	6.936	1.3872
Sun Pharma	0.2	27.525	5.505
Lupin	0.2	24.025	4.805
		Portfolio Return	**20.2968 %**

Note: Here equal weight i.e., 0.2 is considered for calculation of portfolio return.

Table 3: Computation of Covariance as per Markowitz model

Covariance between	Value
Maruti Suzuki and Bajaj	408.6716
Maruti Suzuki and HDFC Bank	1600.154
Maruti Suzuki and Sun Pharma	866.7405
Maruti Suzuki and Lupin	798.6768
Bajaj Auto and HDFC	455.7223
Bajaj Auto and Sun Pharma	298.8304
Bajaj Auto and Lupin	143.986
HDFC Bank and Sun Pharma	1175.93
HDFC Bank and Lupin	743.2379
Sun Pharma and Lupin	615.6325

Table 4: Computation of Correlation between stocks:

Name of the companies	Correlation = $\frac{COV_{12}}{\sigma_1 * \sigma_2}$	Correlation
Maruti Suzuki and Bajaj	408.672/(38.876*17.984)	0.585
Maruti Suzuki and HDFC Bank	1600.154/(38.876*44.90136)	0.917
Maruti Suzuki and Sun Pharma	866.741/(38.876*40.244)	0.553
Maruti Suzuki and Lupin	798.677/(38.876*28.2075)	0.728
Bajaj Auto and HDFC	455.722/(17.984*44.90136)	0.564
Bajaj Auto and Sun Pharma	298.830/(17.984*40.244)	0.412
Bajaj Auto and Lupin	143.986/(17.984*28.2075)	0.284
HDFC Bank and Sun Pharma	1175.930/(44.90136*40.344)	0.649
HDFC Bank and Lupin	743.238/(44.90136*28.2075)	0.587
Sun Pharma and Lupin	615.633/(40.344*28.2075)	0.541

Computation of portfolio risk as per Markowitz model:

$$\sigma_p = \sqrt{(w_1 * \sigma_1)^2 + (w_2 * \sigma_2)^2 + (w_3 * \sigma_3)^2 + (w_4 * \sigma_4)^2 + (w_5 * \sigma_5)^2 + (w_6 * \sigma_6)^2} + (2 * w_1 * w_2 * \sigma_1 * \sigma_2 * cor_{12}) + (2 * w_1 * w_3 * \sigma_1 * \sigma_3 * cor_{13}) + (2 * w_1 * w_4 * \sigma_1 * \sigma_4 * cor_{14}) + (2 * w_1 * w_5 * \sigma_1 * \sigma_5 * cor_{15}) + (2 * w_2 * w_3 * \sigma_2 * \sigma_3 * cor_{23}) + (2 * w_2 * w_4 * \sigma_2 * \sigma_4 * cor_{24}) + (2 * w_2 * w_5 * \sigma_2 * \sigma_5 * cor_{25}) + (2 * w_3 * w_4 * \sigma_3 * \sigma_4 * cor_{34}) + (2 * w_3 * w_5 * \sigma_3 * \sigma_5 * cor_{35}) + (2 * w_4 * w_5 * \sigma_4 * \sigma_5 * cor_{45})$$

Portfolio risk $= \sqrt{}$ (0.2*38.87673)^2 + (0.2*17.984)^2 + (0.2*44.90136)^2 + (0.2*40.34415)^2 + (0.2*28.20758)^2 +
(2*0.2*0.2*38.87673*17.984*0.584519) + (2*0.2*0.2*38.87673*44.90136*0.905923) +
(2*0.2*0.2*38.87673*40.34415*0.55261) + (2*0.2*0.2*38.87673*28.20758*0.728309) +
(2*0.2*0.2*17.984*44.90136*0.557742) + (2*0.2*0.2*17.984*40.34415*0.411868) +
(2*0.2*0.2*17.984*28.20758*0.283836) + (2*0.2*0.2*44.90136*40.34415*0.641535) +
(2*0.2*0.2*44.90136*28.20758*0.579937) + (2*0.2*0.2*40.34415*28.20758*0.540972)

Portfolio risk = √819.577

Portfolio risk (σ_p) = 28.63

Markowitz model findings

Portfolio Return	**20.2968**
Portfolio Risk	**28.63**

SHARPE SINGLE INDEX MODEL:

Table 5: Computation of individual stock return as per Sharpe single index model:

Return = $\alpha + (\beta * R_m) + e_i$

Name of the company	α	β	R_m	RETURN
Maruti Suzuki	18.899	1.927	5.880	30.227
Bajaj Auto	9.329	0.586	5.880	12.773
HDFC Bank	-6.024	2.204	5.880	6.936
Sun Pharma	22.320	0.885	5.880	27.525
Lupin Pharma	17.591	1.094	5.880	24.025

Table 6: Computation of Systematic Risk as per Sharpe single index model:

Systematic risk = $(\beta * S.D_m)^2$

Name of the company	β	S.D	β*S.D	Systematic Risk
Maruti Suzuki	1.927	18.452	35.550	1263.774
Bajaj Auto	0.586	18.452	10.809	116.830
HDFC Bank	2.204	18.452	40.668	1653.901
Sun Pharma	0.885	18.452	16.335	266.819
Lupin Pharma	1.094	18.452	20.188	407.573

Table 7: Computation of unsystematic risk as per Sharpe single index model:

Unsystematic Risk = Total Variance – Systematic Risk

Name of the company	Total Variance of stock	Systematic risk	Unsystematic Risk
Maruti Suzuki	1511.400	1263.774	247.626
Bajaj Auto	323.424	116.830	206.594
HDFC Bank	2016.01	1653.901	362.109
Sun Pharma	1627.650	266.819	1360.831
Lupin Pharma	795.668	407.573	388.095

Table 8: Computation of Total risk as per Sharpe single index model:

Name of the company	Systematic risk	Unsystematic risk	Systematic + Unsystematic	Total risk
Maruti Suzuki	1263.774	247.626	1511.400	38.877
Bajaj Auto	116.830	206.594	323.424	17.984
HDFC Bank	1653.901	362.109	2016.01	44.90
Sun Pharma	266.819	1360.831	1627.650	40.344
Lupin Pharma	407.573	388.095	795.668	28.208

Table 9: Computation of Portfolio returns as per Sharpe single index model:

Name of the company	Weight	Returns	Portfolio return
Maruti Suzuki	0.2	30.227	6.045
Bajaj Auto	0.2	12.773	2.555
HDFC Bank	0.2	6.936	1.387
Sun Pharma	0.2	27.525	5.505
Lupin Pharma	0.2	24.025	4.805
		Portfolio Return	**20.297**

Table 10: Computation of portfolio beta:

Name of the company	Weight	Individual beta	Portfolio Beta
Maruti Suzuki	0.2	1.926	0.3852
Bajaj Auto	0.2	0.586	0.1172
HDFC Bank	0.2	2.204	0.4408
Sun	0.2	0.885	0.177
Lupin	0.2	1.094	0.2188
		Portfolio Beta	**1.339**

Computation of systematic risk:

Systematic risk= (market variance*beta)^2

Systematic risk= (18.45199*1.339147)^2

Systematic risk= (24.70992705)^2

Systematic risk= 610.5805

Table 11: Computation of unsystematic risk:

Name of the company	Weight	Individual risk	Weight * risk	Unsystematic risk
Maruti Suzuki	0.2	38.877	7.7754	60.456
Bajaj Auto	0.2	17.984	3.5968	12.936
HDFC Bank	0.2	44.90	8.98	80.640
Sun	0.2	40.344	8.0688	65.105
Lupin	0.2	28.208	5.6416	31.827
			Unsystematic risk	**250.964**

Computation of total risk:

Total risk=Systematic risk + Unsystematic risk

Total risk= √610.5805+250.964

Total risk= √861.5445

Total risk = 29.35

Table 12: Comparison of returns between Markowitz model and Sharpe single index model.

Name of the company	Markowitz model	Ranking	Sharpe single index model	Ranking
Maruti Suzuki	30.228	1	30.227	1
Bajaj auto	12.77	4	12.773	4
Hdfc bank	6.936	5	6.936	5
Sun	27.525	2	27.525	2
Lupin	24.025	3	24.025	3

INTERPRETATION:

From the above table it is clear that there is no deviation in individual return according to both Markowitz model and Sharpe single index model. Both the model represent same no value in returns.

Table 13: Comparison of risk between Markowitz model and Sharpe single index model.

Name of the company	Markowitz model	Ranking	Sharpe single index model	Ranking
Maruti Suzuki	38.877	3	38.877	3
Bajaj auto	17.984	5	17.984	5
Hdfc bank	44.901	1	44.901	1
Sun	40.344	2	40.344	2
Lupin	28.208	4	28.208	4

Table 14: Comparison of portfolio return and risk between Markowitz model and Sharpe single index model.

	Markowitz model	Sharpe Single Index model
Portfolio return	20.2968	20.297
Portfolio risk	28.6618	29.35

INTERPRETATION:

Table shows that the portfolio return is same in both Markowitz model and Sharpe Single Index Model and there is slight deviation in value of portfolio risk.

Overall it can be concluded that Markowitz model and Sharpe Single Index Model proved same value in terms of individual return and risk. More over there is no deviation in portfolio return and portfolio risk as per both the model. This proves that researcher can use either Markowitz model or Sharpe Single Index Model to analyze the risk and return of the stock.

3. CONCLUSION

The research proves that there is no deviation in the value of individual return and risk as per Markowitz model and Sharpe Single Index model. Even the portfolio return and risk are same. But however, Markowitz model seems to be easy for calculating individual return and portfolio return. But Sharpe Single Index model simplifies the process of computation of portfolio risk. This is because in Markowitz model, computation of covariance is time consuming. When there are more number of stocks it become difficult to compute the covariance between all the companies

As several models are available to evaluate the return and risk of securities and portfolio, an attempt was made to compare two models i.e., Markowitz model and Sharpe Single Index model to check whether these model give same return and risk when checked separately. This research is applied for selected stocks and the research proves that both the models give almost the same value for both individual return and risk and also portfolio return and risk.

It can be concluded that Sharpe model is best suited to calculate portfolio risk as Markowitz model requires the computation of covariance's between stocks to identify the risk of portfolio and more the number of stocks more the pain to identify the covariance. This drawback has led to use of Sharpe Single Index model to compute the portfolio risk.

Apart from Sharpe Single Index model and Markowitz model there are many techniques like CAPM, Efficient portfolio set, efficient frontier, SML and CML Model which can be included in the further study to compare the returns with all available models.

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