Evaluation of an all-Equity Portfolio Employing the Distinctive Approaches of Markowitz and Sharpe

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Abstract

The enormity of research carried out in the field of investments is bewildering. The twin factors that have contributed to this phenomenon are rapid advancements in Portfolio theory and proliferation of computational tools aiding both investment practitioners and researchers alike.

Notwithstanding this observation, the present research note seeks to employ the two most profound approaches advocated in the realm of Portfolio analysis. The approaches are traceable to the seminal contributions made by Harry Markowitz and William Sharpe, both of whom are recipients of Nobel Prize in the field of Economics. The rapid strides made in the area of investments are largely traceable to the above Portfolio approaches.

The endeavour of the present note is to enable the readers to gain an appreciation of these two distinctive approaches as applied to an all equity Portfolio[2] comprising of securities chosen from distinct sectors of the Indian economy. The

[2]The all-equity Portfolio comprises of five securities chosen from different sectors viz., Information technology, Banking, FMCG, Oil & Gas, and Automobile.

reader will appreciate that in comparison to Markowitz's approach, Sharpe's Portfolio framework[3] *captures the essence of Portfolio evaluation. While readers' concurrence to this observation, which has already been well established and documented is not surprising, the present note makes a refreshing attempt to validate the held notion using a real-world illustration.*

The paper is divided into the following sections. The introductory part seeks to capture the core ideology of Portfolio management, which is followed by brief discussion of the underlying approaches of Markowitz and Sharpe. This is followed by the employment of the above approaches to an all-equity Portfolio with an objective to compare and contrast the results obtained therein. The final section reflects concluding thoughts on the aforesaid topic.

Keywords: *Portfolio return, Portfolio risk, Diversification, Systematic & Unsystematic risk*

Introduction

Extensive literature available in the realm of Portfolio management posits that investors' interests are best served when their investments are diversified. Early proponents

[3]While much of the Portfolio literature surrounds the traditional framework presented by Harry Markowitz, there is significant dearth of studies focusing on application of Sharpe's approach to Portfolio return and risk. This contrasts with the significant attention given to the Capital Market Theory that forms the basis for the ubiquitous concepts of capital market line and security market line.

of diversification argue that a well-diversified Portfolio bears the following characteristics:

a) Maximization of return for the same degree of risk.

b) Deriving constant return for reduction in the degree of risk.

When investors are able to achieve either of the two w.r.t Portfolio investment, they have essentially attained the most desirable position. Investors thus have to make efforts in devising Portfolio that meet the above criteria. While the concept of Portfolio and the concomitant benefit of diversification were not entirely esoteric to the investing community of earlier generations, it was not until the development of formal Portfolio theory by legendary academics like Harry Markowitz and William Sharpe that led to the proliferation of activities both in the field of research and practice alike. The seminal contribution made by these theories were primarily responsible for the birth of several specialized investment houses that sought to offer professionally managed Portfolio services to both institutional clients as well as individual investors.

Markowitz Approach to Portfolio Management

Professor Harry Markowitz formalized the theory of Portfolio by delineating the benefits accruing to the measures of risk and return from a well-diversified Portfolio as against the benefits arising from an undiversified Portfolio. This was achieved by making extensive usage of mathematical modelling that sought to explain the degree of relationship between securities forming a Portfolio. One of the earliest statistical measures that were highlighted in the theory pertained to *'covariance'* and *'coefficient of correlation'*. He argued that to the extent that the returns between the securities forming a Portfolio were inversely related, the benefits of diversification get maximized. A correlation coefficient of -1 was ideal. The rationale underlying this notion may be appreciated by considering a two-security Portfolio where the candidate securities represent diverse industries say, Banking and FMCG. Given that the Banking industry is influenced by the prevailing economic cycle, the FMCG is sector is largely attributed to be defensive remaining insulated from the vagaries of economic cycles. In such a scenario, observing a correlation coefficient that is far from perfect is not uncommon.

It is important to note that while much of the discussion surrounding the Portfolio return and risk encompassing the Markowitz framework is ex-ante in nature, given the practical difficulties associated with predicted data, the utility of the model is also found when applied on ex-post data.

From an ex-ante point of view, Portfolio return and risk are described by the equations given below.

$$\overline{R}_p = \sum_{i=1}^{n} X_i R_i \qquad \text{Eq. 1.1}$$

where

R_p = Return from Portfolio

X_i = Weight associated with security i

R_i = Expected return from security i

Assuming that the above construct reflects a two-security Portfolio, Portfolio risk is given by the expression shown below.

$$\sigma_p = \sqrt{X_1^2\sigma_1^2 + X_2^2\sigma_2^2 + 2X_1X_2\sigma_1\sigma_2 r_{12}} \quad \text{Eq. 1.2}$$

where

$ó_p$ = Standard deviation of Portfolio

$X_{1,}$ = Weight of security 1

$ó_1$ = Standard deviation of security 1

X_2 = Weight of security 2

$ó_2$ = Standard deviation of security 2

r_{12} = Correlation coefficient between returns of security 1 and 2

Markowitz pointed out that a Portfolio where r = -1 and such that the weights are assigned in a manner that

$$r_{12} < \frac{\sigma_{\text{smaller security, say security 1}}}{\sigma_{\text{larger security, say security 2}}} \qquad \text{Eq. 1.4}$$

While these revelations are certainly enlightening for investors primarily looking to derive the benefits of diversification, Markowitz approach has certain implicit weaknesses that might render decision making less effective. Notwithstanding the merits of the Markowitz approach, subsequent writers highlighted two critical shortcomings.

a) The Portfolio approach propounded by Markowitz lays claim to computation of total risk. While celebrating the need for diversification on the strength of inter-relationship between securities, the model fails to take the component of risk that cannot be diversified. Assuming that an investor has access to specialized services of a qualified Portfolio manager in the absence of funds constraint, it should be possible for every investor to engage in diversification. Thus, investors are not deterred by diversifiable risk as they can be minimized if not eliminated. However, the undiversified risk haunts ordinary investors and specialized Portfolio managers alike.

b) Another limitation that weakens the model is the sheer amount of data crunching involved. Employment of Markowitz model necessitates computation of covariance and coefficient of correlation between humungous numbers of securities. While the model does not pose any computational challenge while working with two or three-security Portfolio, the same becomes daunting as the number of securities increase in a Portfolio. Clearly, in real-life scenarios, imposing any limit on the number of securities does not augur well for an investor. Even accepting that in the wake of advancements in computing technologies, the challenges posed in terms of computations are minimized, one fails to understand the utility derived from the process.

While the Markowitz model has its ardent following, the above limitations does not necessarily push the theory into obscurity but rather only paves for further improvements that might be incorporated in the model.

Sharpe's Approach to Portfolio Management

Inspired by the seminal work of Prof. Harry Markowitz, another brilliant Financial Economist Prof. William Sharpe suggested a modified approach to Portfolio theory. The improvisations suggested in the model sought to overcome the inherent weaknesses of the Markowitz model. The approach advocated by Sharpe lays emphasis on placing maximum attention on the undiversified risk influencing a Portfolio. The undiversified risk also known as systematic risk affects all securities and Portfolio combinations of different securities.

The model also does away with the humungous computations involved in the Markowitz approach (involving calculation of covariance and coefficient of correlation between several securities). The main tenet held here is that returns on securities tend to mirror the sentiments reflected by the market. Market in turn is influenced by host of factors including political uncertainty, economic policies, and threats to national security among others. The risks arising from these scenarios are virtually uncontrollable and thus get reflected under the systematic component of the total risk.

Sharpe laid emphasis on statistical measure representing *'Beta'* to determine the degree of systematic risk. With the beta of market given as 1, for every beta of security, it is possible to identify the degree of responsiveness of security's returns to the returns of the market. For instances the returns of security with a beta of 0.9 will move to the extent of 90% of the returns of the market (i.e., if the market moves up (down) by 10%, the security's returns will move up (down) by 9%).

While concurring with the idea of degree of diversification exhibited by a Portfolio, Sharpe's approach seeks to decompose the risk into diversifiable and undiversified (systematic) components.

Under the Sharpe's approach to Portfolio theory, the Portfolio return and risk are computed as given below.

$$\mathbf{R_P = \sum_{i=1}^{N} X_i\,(\alpha + \beta I)} \qquad \text{Eq. 2.1}$$

Where

R_p = Return on Portfolio P

X_i = Weight assigned to security i

á = Intercept of the equation

â = Slope of the equation/Coefficient of the independent variable

I = Expected return on Market Index

The Portfolio risk is given by the following equation

$$\sigma_p^{\,2} = \left[\left(\sum_{i=1}^{N} X_i \beta_i\right)^2 \sigma_m^{\,2}\right] + \left[\sum_{i=1}^{N} X_i^{\,2} e_i^{\,2}\right] \qquad \text{Eq. 2.2}$$

The above approaches are now applied on an all equity Portfolio to compare and contrast the two approaches to Portfolio theory delineated above.

Application of Markowitz and Sharpe Approaches to an all Equity Portfolio

While the approaches highlighted above give the theoretical underpinnings, in order to derive the practical essence of the same, it is necessary to apply them on a real-life Portfolio[4] and observe the results. With this objective, an equity Portfolio was constructed comprising of five securities representing different industries. The industries chosen are distinct in nature to ensure that the earnings arising from any of the two industries are not positively correlated to each other.

The table below presents all the pertinent data for all the five securities that serve as relevant input for the application of the above models.

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[4] The rationale for restricting the portfolio to five securities stems from the fact that empirical evidence provides that a well-diversified portfolio comprises of five to eight securities. In keeping with the objective of diversification, the portfolio constructed here comprises of securities representing diverse industries enabling an investor to realize the benefits of diversification. Here, the research note uses the five-security portfolio to demonstrate the conceptual inadequacies of Markowitz model which are overcome by the portfolio approach laid out by Sharpe's model.

Table I *: Securities forming the Equity Portfolio*

Industry	**Security**	**Weight**
Information Technology (IT)	Infosys	0.2
Banking	ICICI Bank	0.2
FMCG	Hindustan Unilever (HUL)	0.2
Oil & Gas	ONGC	0.2
Automobile	Tata Motors	0.2

Table II : *Significant Statistical parameters for securities forming the Equity Portfolio*

Sl. No	Security	Mean return	Std. devtn	Beta	System--atic risk	Unsys-tematic risk
1	Infosys	0.0300%	1.76%	0.84	0.009%	0.022%
2	ICICI Bank	0.1200%	2.28%	1.70	0.0369%	0.0151%
3	HUL	0.2100%	1.40%	0.35	0.0016%	0.018%
4	ONGC	0.0300%	1.55%	0.76	0.0074%	0.0166%
5	Tata Motors	0.2600%	2.65%	1.57	0.0315%	0.0388%

(Source: Computed data)

Table III : *Comparison of Portfolios on parameters of Risk and Return involving different combinations of securities*

Parameter	Combination I (Single security Infosys)	Combination II (Two security – Infosys + ICICI Bank)	Combination III (Three security Infosys + ICICI Bank + HUL)	Combination IV (All five security)
Portfolio return	0.0300%	0.07500%	0.1300%	0.1300%
Portfolio risk	1.7600%	1.7300%	1.2900%	1.3500%
Systematic risk	0.0090%	0.0206%	0.01039%	0.01392%
Unsystem--atic risk	0.0220%	0.0093%	0.0062%	0.0044%
Ratio of Portfolio risk to Portfolio Mean	58.67	23.04	9.99	10.42

(Source: Computed data)

From Table III, we observe that Sharpe's approach serves the decision maker better by breaking down the total risk into systematic and unsystematic components. In contravention to Markowitz approach, the investor need not be excessively worried about the interrelationships between securities by comparing the values of coefficient of correlation between different sets of securities. This leads to significant saving without losing the rigor of the analysis.

With the break-up of the total risk available under the Sharpe's approach, the investor needs to focus only on the systematic component of the Portfolio risk while choosing the most optimal combination.

The following interesting inferences emerge from the analysis as reflected in Table III.

1. With the increase in number of securities added to a Portfolio, the unsystematic risk decreases gradually from 0.022% (in case of single-security Portfolio) to 0.0044% (in case of all five-security Portfolio).

2. The total Portfolio risk for Combination IV is marginally higher at 1.35% as compared to Combination III at 1.29%. This is evidenced due to the increase in systematic risk which more than offsets the decrease in unsystematic risk. This is observed as the investor in Combination IV though adds additional security representing different industry (in this case, automobile), with an eye on reducing the unsystematic risk, the systematic component is enhanced because of the high beta value carried by the additional security (observe that the beta of Tata Motors is high at 1.57).

   It should be clear to the investor that *beyond a point, it is meaningless to continue to add securities into a Portfolio merely to reduce the unsystematic risk*. This may not necessarily lead to an overall reduced total Portfolio risk as the securities that might be added carry high beta values. Thus, the need for an investor to be sensitive to the changes in systematic risk assumes significant degree of importance.

3. The investor will also observe that amongst all the combinations, Combination III helps in maximizing the interests of an investor, which is evidenced by the lowest ratio of Portfolio risk to return implying that for every one unit of risk, Combination III yields more value than Combination IV.

Summary & Conclusions

This research note sought to compare the two popular approaches propounded by Prof. Harry Markowitz and Prof. William Sharpe. While the Markowitz approach seeks to capture the total Portfolio risk, the approach lends the computational process cumbersome by asking the investor to compute an excessively large number of values of coefficient of correlation. Even then, the approach does not enhance the utility for an investor as ultimately the emphasis is restricted to reduction of overall Portfolio risk by minimizing the undiversified or the unsystematic risk.

Making improvisations into the Markowitz model, Sharpe's approach helps an investor to clearly identify the components of the total risk into systematic and unsystematic components. The approach also makes significant saving in terms of computations by restricting on the number of values of coefficient of correlation by focusing on the interrelationship between the returns of security and the returns of the market. Sharpe's major contribution hinges upon the merit that it is systematic risk that deserves far greater attention than the total Portfolio risk on the strength of reduced unsystematic risk as propagated by the Markowitz model.

The above models were applied on an all equity Portfolio comprising different securities representing distinct industries. The notion held by Sharpe's approach is emphatically validated as it is observed that an investor does not really benefit by mindlessly adding number of securities with an eye to reduce the unsystematic risk. As long as the security is carrying high beta value, the decrease in unsystematic risk is more than offset by the increase in systematic risk leading to enhanced overall Portfolio risk.

While much of the financial literature has been dedicated towards building upon the seminal works done by the earliest proponents of Portfolio Theory, the present research note seeks to validate the already established notion with the help of a real-life illustration, enabling discerning enthusiasts of traditional Finance to appreciate the theoretical underpinnings in a refreshing manner.

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