

Portfolio Construction and Risk Management in Practice: Evidence from Emerging Economies

*A thesis submitted to the University of Hyderabad
in partial fulfillment of the requirements for the award of*

DOCTOR OF PHILOSOPHY
IN
ECONOMICS

By
FATEMEH KIASSI
Registration No. 16SEPH02



SCHOOL OF ECONOMICS
UNIVERSITY OF HYDERABAD
HYDERABAD-500046 (INDIA)

December 2022

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Thesis Supervisor
Prof. S. Raja Sethu Durai



**SCHOOL OF ECONOMICS
UNIVERSITY OF HYDERABAD
HYDERABAD-500046 (INDIA)**

December 2022

DEDICATED TO

The Soul of my Father

My Mother

My Beloved Husband & Children



**School of Economics
University of Hyderabad
Hyderabad-500046, India**

DECLARATION

I, Fatemeh Kiassi, hereby declare that this thesis entitled “**Portfolio Construction and Risk Management in Practice: Evidence from Emerging Economies**” submitted by me under the guidance and supervision of Prof. S. Raja Sethu Durai of University of Hyderabad, is a *bonafide* research work, which is also free from plagiarism. I also declare that it has not been submitted previously in part or full to this University or any other University or Institution for the award of any degree or diploma. I hereby agree that my thesis can be deposited in Shodganga/INFLIBNET.

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CERTIFICATE

This is to certify that the thesis entitled “Portfolio Construction and Risk Management in Practice: Evidence from Emerging Economies” submitted by Ms. Fatemeh Kiassi bearing registration number 16SEPH02 in partial fulfilment of the requirements for award of Doctor of Philosophy in the School of Economics is a bonafide work carried out by her under my supervision and guidance. The thesis is free from plagiarism and has not been submitted previously in part or in full to this or any other University or Institution for award of any degree or diploma.

The candidate has satisfied the UGC Regulations of publications and conference presentations before the submission of her thesis. Details are given below.

A. Publications:

1. Fatemeh Kiassi. (2022). Portfolio construction and performance evaluation: Evidence from India and Iran. *Theoretical and Applied Economics*, Vol XXIX, No 4(633), 217-230.

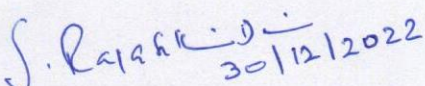
B. Presentations in conferences:

1. Presented a paper: “Portfolio construction and performance evaluation: Evidence from India and Iran” in: XXVI International Conference on Business, Economics, Law, Language & Psychology, at Bali, Indonesia, 18-19 December 2022.
2. Presented a paper: “Portfolio construction and performance evaluation: Evidence from India and Iran”, in: National Seminar on 75 Years of Indian Economy, at Department of Economics, Satavahana University, Karimnagar, Telangana, 9-10 November 2022.

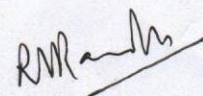
Further, the student has passed the following courses towards fulfillment of coursework requirement for Ph.D. during August – December 2016.

Course Code	Course Title	Credits	Pass/Fail
EC-801	Advanced Economic Theory	4	Pass
EC-802	Social Accounting and Data Base	4	Pass
EC-803	Research Methodology	4	Pass

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Finally, I would like to add that I am alone responsible for the errors and omissions in the study and none other may be blamed for it.

Fatemeh Kiassi

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Portfolio Construction and Risk Management in Practice: Evidence from Emerging Economies

Abstract

The present study attempted to analyse the actual extent of adoption of sophisticated portfolio models by real world practitioners (fund managers) from two large emerging economies viz. India and Iran. We leverage the survey approach used by Amenc et al. (2011) for analysing the portfolio managers in Europe. The consolidated data from survey points to awareness among fund managers both in India and Iran about the existence of advanced portfolio techniques and measures. But it is observed on average the fund managers use less complicated models both in India and Iran. In terms of metrics for performance evaluation, the fund managers are using the popular measures. The widely used measures in Indian and Iranian firms are Sharpe ratio, Treynor ratio, and Jensen's alpha. Further, the portfolio optimisation techniques of Indian firms include sophisticated and non-sophisticated ones. While in case of Iranian fund managers, they use of sophisticated measures for ex-post performance evaluation is higher than their Indian counterparts. The results from logistic multivariate regression analysis, it is observed in general that none of firms' characteristics (Type, Type of service, Size of Asset under Management, and Country of Origin) has any impact on firms' approach in not considering adoption of sophisticated techniques and measures. A comparative study between India, Iran, Brazil (as examples of emerging economies) and Europe (as example of developed economy) using secondary data from earlier studies suggests that overall, Iranian firms tend to use less unsophisticated methods in portfolio construction and performance evaluation than Indian firms. The efficiency analysis of the mutual funds in India and Iran using data envelopment technique reveals that firms in India stand to gain efficiency by adopting sophisticated techniques and metrics for portfolio management, while Iranian firms stand no gains in adopting the same. The results from the current study provide an overall perspective on the nature and scope of complexities in the portfolio models offered by the academic literature and their adoption by practising fund managers in emerging economies.

Keywords: Portfolio Management, Performance Evaluation, Portfolio Construction, Risk, Portfolio Practitioners, Data Envelopment Analysis, Asset Management,

JEL Classification: C52, G11

Chapter 1. Introduction, Background and Objectives

1.1 Introduction

In this Chapter, we have discussed the need of this study by identifying what are the research gaps and how do we bridge those gaps through the current research. We defined objectives of the study, and have discussed the research design, population, sample of the population, sampling methods used, biases in sample, questionnaire used and methods and techniques applied for analysis of collected data. Further, we also have highlighted limitations and shortcoming of the current study and justified how this study is still essential in clarifying the statement problem/research questions.

1.2 Motivation of this study

In the recent decades, due to the advances in Modern and Postmodern Portfolio Theories (MPT and PMPT), most of investors prefer to give the responsibility of making investment decisions to Asset Management Companies (AMNs) or other financial institutes to benefit from their professionalism and to reduce the risk of losing their capital, derived from their lack of financial literacy and/or their time constraints.

Investment management, in order to meet institutes and individuals' risk and return appetites, tries to optimize the problem of channelizing funds in an organized way. However, the question is that to what extent financial institutes construct their portfolio applying advanced quantitative techniques provided by academia and to what extent they use their intuition and experiences or other qualitative practices.

The motivation of this study was initially the work of Ament et al. (2011) where the portfolio construction and risk management in Europe was surveyed. They found out that even though the academic literature provided rigorous methods of portfolio construction and risk management, professionals even in large firms, still use basic and ad hoc methods in

constructing their portfolios. Nearly half respondents from large firm fail to assess extreme risks such as tail risk or downside risk. They also found out that for the performance measurement, average returns unadjusted for risk is a popular method among the practitioners. And the next common performance measure is to compare their performance in a peer group that does not always reflect the risk taken by portfolio managers accurately. Their results show that majority of respondents prefer unsophisticated methods.

In extension of their work, Lee, S.C. and Eid Junior, W. (2018) conduct a field survey among asset management companies in Brazil to find out to what extent Brazilian financial market practitioners adopt quantitative techniques suggested in academic literatures. Their finding shows that the gap between models presented in academic literature and practitioners in the field of asset management is significant.

1.3 Need of the study and Research gap

Markowitz Portfolio selection (1952) is a normative theory which guides a rational investor to find the “Efficient frontier”. However, according to Meltzer and Clarkson (1960) “A positive theory describes and predicts the investment behaviour of individuals under certainty”. Therefore, understanding the actual behaviour of financial practitioners in constructing portfolios under their management and managing the relevant risk is of outmost importance.

Several studies have compared modern portfolio theory to its application in practise and discovered a significant gap between the two. According to Fabozzi et al. (2007, pp. 16-17), mostly those firms which have already employed tools for automated forecast generation or some kind of risk control rules are able to utilize the promising portfolio optimization provided within the mean-variance framework. Due to this shortcoming, portfolio construction in many firms is based on qualitative rather than quantitative practice. Michaud (1989, pp. 33-36) explains the constraints and challenges of using mean-variance optimizers in practice and call

this as "Markowitz Optimization Enigma". Despite of numerous research works introduced by academia to improve techniques of portfolio construction and risk management, the extent of deployment of such advance techniques in the investment decisions is ambiguous.

Schröder (2013) gives the shortcoming of conventional asset allocation models and claims that although models which allow incorporating investment constraints have been developed by financial economists, pioneered by seminal works of Robert Merton in 1970s. However, it seems that the needs of retail investors are not considered in the conventional asset allocation models. Hence, he conducted a survey among private wealth managers in Europe advising private wealthy investors and observes that it is not not obvious to what extent retail investors benefit from such advanced models. The findings of this survey indicate that private wealth managers in Europe are aware of the limitations of statistic models of portfolio selection. However, they do not used dynamic models in their practices due to complexity of dynamic models. Engle (2004) also confirms the failure of using dynamic models in practice. In a contrary approach, Brooks et. al (2019) attributes the divisions between academic and practitioner finance, to the shoulders of scholars of finance in one hand, in failing to address real-world problems and to the 'elite' journals which need to utilize all their means and play a central role in providing positive contributions to the field by encouraging researches which are distinguished in methodological approach, theoretical development that brings new insights from other disciplines such as psychology or history.

A close look at the available literature on Asset Allocation theories and practices reveals that:

- (i) Most of the previous studies conducted to survey and examine the impact of academic research on financial industry are in areas such as product innovation, corporate finance, capital budgeting, etc., and not much studies were carried out in Portfolio Construction and Performance Measurements
- (ii) Although there are evidences of such surveys in developed countries, there has not been much empirical work to test asset allocation practices in emerging

economies. In this background, considering the above observations, it is felt this study is essential and intends to fill the gap from an emerging economy perspective.

1.4 Statement of the Problem

The statement problem of the current study could be succinctly stated as below:

“To what extent models and techniques of portfolio construction, risk management and performance evaluation provided by Modern and Post-Modern Portfolio Theories are applied by investment practitioners in emerging economies and what are the gaps between these practices between emerging economies and European countries”.

1.5 Objectives of the study

Based on the above problem statement, the study analyses the use of the financial models by the fund managers in emerging economies. Accordingly, the objectives of this study can be stated as follows:

- To examine the approach and methods of Portfolio Construction applied by financial investment institutions in India and Iran.
- To compare the portfolio construction methods used by the financial institutions in India, Iran, Brazil and Europe.
- A Comparative study on the performance measurement and efficiency of AMCs in India and Iran based on their method of portfolio construction.

1.6 Research Design and Methodology

1.6.1 Research Design

This study is basically considered as quantitative research aiming to explore real practices of asset management practitioners in financial institutions, and further to identify the existing gaps between those practices and the academic financial literature and models that have been

provided by modern and post-modern portfolio theories. To better understand such gaps, a survey is chosen to best serve the purpose of this study.

We leverage the questionnaire deployed by Amenc et al (2011) for survey in Europe. The questionnaire is very comprehensive and covers the main theories and models of investment and portfolio management. Hence, not many modifications have been made in our survey questionnaire. Further, only the denomination of assets under management has been localized and was changed from Billion Euro to Crore Indian Rupee in case of India and Billion Iranian Rial for Iran, to make it more convenient for respondents of two countries to select the correct option based on their currency.

The questionnaire is organized in three parts. In the first part, the characters and details of respondents such as respondent name, company name, company contact details, the principal area of activity, size of asset under their management, the role of respondent in the company, and type of investment services they are offered were sought.

The second part dealt with the risk measurement practices undertaken by the respondents. They are given a wide range of options possibly applied by them in the process of constructing portfolios and are asked about what measures they use. There was an option of “other” if the utilized measure was not included in the given options. Moreover, the respondents were asked about the techniques they applied to estimate the covariance matrix and how they dealt with extreme risks and estimation errors.

The third part was about performance evaluation measures applied by practitioners to find out how they measured absolute and relative performance of portfolios under their management as well as fund managers’ performance. The survey questionnaire in English is given in Appendix 1 and the same questionnaire in Farsi is given in Appendix 2.

Moreover, Secondary data from Eid and Junior (2018) survey in Brazil, and those of Amenc et al (2011) survey in Europe were extracted and compared with results of our survey in India and Iran in order to reach meaningful results. For this purpose, the Pearson's Chi square test is used.

Lastly, a sub-sample of the oldest equity funds managed by the respondents in India and Iran were selected and analysed via Data Envelopment Analysis (DEA) software to understand the efficiency of performance of funds and as well as to find out to what extent the sophistication of models applied impacts the efficiency of mutual funds practices in India and Iran.

1.6.2 Sampling Design

The population of this study were Asset Management Companies listed in Association of Mutual fund India (AMFI) and Financial Information Processing Center of Iran (FIPIRAN) in case of India and Iran respectively. At the time of survey, there were 44 companies listed in AMFI and 70 companies listed in FIPIRAN offering asset management services. The list of Indian and Iranian companies are given in Appendix 3 and 4.

In case of Iran, data is sorted based on mutual funds schemes instead of list of institutions. Therefore, in order to find out number of financial institutions, the list of funds was extracted from FIPIRAN portal, and then clustered as per companies managed them. We reached to a number of 196 mutual fund schemes, managed by 70 companies, at the time of data collection.

A simple random sampling was used for selecting the participants in this study. This method was chosen to give participants an equal chance of being selected. Name of Companies was written out in piece of paper which was folded and put in a basket. After thorough shuffling, an element was selected and recorded. Accordingly, the sample of the population in this study stood at 25 Asset Management Companies from India and 22 financial institutions from Iran.

1.6.3 Sampling Biases

One of the biases in sampling design might be related to the selection of target respondents. Although there are large numbers of wealth management firms offering asset management services to their clients, only limited proportion are listed in regulatory bodies.

However, we believe that limiting this survey to the listed institutions could be justified considering the time and challenges it involves if one decides to include all financial institutions that are active in the field of investment management. Hence, we limited this survey to the companies listed by Association of Mutual Fund India (AMFI) and those listed in the website of Financial Information Processing Center of Iran (FIPIRAN).

1.6.4 Statistical Design

The Type of data collected in this study can be considered as both primary and secondary data. The primary data was collected through the above-mentioned questionnaire from the asset managers of the listed financial institutions in the sample. Further, secondary data is extracted from Amenc et al. (2011) and Lee and Eid (2018) incorporated in the current study to reach meaningful results.

1.7 Organization of the Thesis

The present thesis is structured as follows. Initially in Chapter 1 we introduced the details about portfolio selection theory in practice. Then we moved on to explaining the purpose of the present study and how it attributes to better understanding of the gap between models of portfolio theories presented in academia and their use in actual investment management practices. We have identified what are the research gaps and how do we bridge those gaps through the current research. We also have discussed the research methodology detailing the sampling method used, why it is used, what are biases in sample. In Chapter 2 we talk about the literature review and how past researchers have tried to improve the modern portfolio

theory and overcome its limitations by introducing more advanced and sophisticated measures and techniques of portfolio optimization, risk management and performance evaluation.

In Chapter 3 we have presented the finding of our survey and compare the descriptive statistics of India and Iran to find out to what extent the portfolio managers are adopting sophisticated techniques in their practices in both portfolio construction and performance evaluation. The statistical analysis of the survey results using SPSS16 software are also presented in this chapter. In Chapter 4 we have discussed about traditional, modern, and post-modern portfolio theories and the respective risk measures and risk estimation techniques provided by them. Moreover, we compared the results of surveys conducted in India, Iran, Brazil, and Europe.

In Chapter 5 we introduced Data Envelopment Analysis (DEA) and its application in measuring the efficiency of mutual funds by reviewing the relevant literatures. We also carried out an DEA analysis of a sub-set of equity funds of our sample from India and Iran to find out their efficiency and how the adoption of sophisticated/non-sophisticated techniques justify these results. Chapter 6 provides the conclusion and summary of the findings of our study. Moreover, we have added the limitations and future scope of research of the current study.

Chapter 2. Literature Review

2.1 Introduction

In this chapter, a literature review of the Traditional Portfolio Theory (TPT), Modern Portfolio Theory (MPT) and Post-Modern Portfolio Theory (PMPT) is carried out to present the risk measures and volatility estimation models invented by researchers in each theory. Further, there is a strand of studies that analyse and examine the securities portfolio management theories and their applications in various areas of interest. To begin with we present the historical evolution of the portfolio theories. We then present the review of various risk and volatility measures used in portfolio models. Finally, a review of the studies on portfolio construction is presented.

Lekovic (2021) reviewed the historical evolution of portfolio theories through three phases: Traditional Portfolio Theory (TPT), Modern Portfolio Theory (MPT) and Post-Modern Portfolio Theory (PMPT). The theoretical framework and assumption of these three phases of portfolio theories is presented hereunder.

2.2 Traditional Portfolio Theory

Traditional Portfolio Theory (TPT) evolved through two phases, according to Lekovic (2021). From the beginning of 20th century till 1993, the investment management field relied subjectively only on skills and abilities of individuals without any scientific techniques to support the judgements made. However, from 1934 to 1952, this approach was replaced by a more scientific approach where investment entities, could it be individuals or institutions, focused on analysing and scrutinization of the fundamental characteristics of stocks through analysing financial statements to find out the best securities with the higher rate of return.

For estimation of expected return, financial analysts used different forms of fundamental analysis. Dividend Discount Model and Residual Income Model were among the most popular

analysis used for estimation of expected returns. John B. Williams in his book (1938) originated Dividend Discount Model (DDM) for estimation of expected return. It implies that the expected return from a stock can be estimated by calculating the present value of all the future cash flows. These future cash flows are known as dividends and usually are paid out to shareholders in specified tenures based on the company policies and agreements with shareholders. Gordon Growth Model is a generalized version of DDM proposed by Gordon (1962).

The concept of diversification in the traditional framework was limited. It aimed to only select as much outperforming stocks as possible and add them into the portfolio to enhance the return. In other words, the stocks were analysed through the common fundamental analysis and were selected based on their absolute returns and added to the portfolio. In addition of absolute return measure, the excess return of the stock compared to the market indexes was also considered in TPT at the time of portfolio construction.

2.3 Modern Portfolio Theory

Modern portfolio theory (MPT) is opposite to traditional Portfolio theory in philosophy. It is created by Markowitz (1952) who looks at investment and understands the market as a whole and not as aggregation of unique and individual securities. Allocation of portfolio weight and its risk are important aspects under MPT. In this theory investment is described statistically. MPT describes it in terms of long-term return and short-term volatility. Further, the volatility in a negative direction is considered as a risk in modern portfolio theory.

Under MPT it is assumed that every investor has a different risk appetite. MPT aims to recognize the accepted level of the risk appetite of a particular investor and the maximize the expected return with that risk (Elton and Gruber, 1997).

Every investor ideally wishes to create an investment that provides a high return with no risk. In the reality, it is impossible to find such an investment that provides a high return with no

risk (Elton and Gruber, 1997). Not surprisingly, many analysts try to develop a theory that is similar to perfect investments but none of them is as popular and strong as MPT. Modern portfolio theory provides a very strong theoretical background to create a portfolio that is strong and closely associated with investor's expectations of accepted risk and expected returns.

To some extent, it is not possible to minimize the risk when investment is made in single security. However, this is possible once an investment is made in different asset classes. It reduces the risk of putting all the investment into one basket. Since different firms have some specific factors of risk (idiosyncratic factors) one can reduce the overall risk of a portfolio by diversifying the investment among various asset classes. Portfolio risk continuously decreases with an increase in the number of assets in a portfolio. However, the risk of a portfolio cannot be nullified even if with a large number of securities are included in the portfolio, as the securities are likely to be affected by some macroeconomic or market affected factors. (Bodie et al., 2004).

In traditional portfolio management, diversification essentially was an investment made in different security types like shares market, Bond Market, etc. Diversification works because the improbability of return of each asset securities interacts differently with each other. The key element is to understand how this interaction of uncertainty of security reacts and up to what extent it affects the overall return. This movement of different assets moves either in different directions or in the same direction. The performance of an asset in a particular portfolio depends on how these assets react to the market situation. This called correlation. The risk of a portfolio depends on a correlation among assets in that varied portfolio. Every asset of a similar sector tends to follow the market in the same manner. So, if it is a recession period in a market, the entire assets belonging to a similar sector will go down. This is what correlation states.

Another measure of risk Calculation is Covariance. The problem is determining whether the returns from the various assets move in parallel or in opposite directions. The covariance and correlation coefficient are the measurements used to solve this problem. The covariance is calculated similarly to the variance, but instead of measuring the difference between an asset's expected value and its actual value, it measures the extent to which the returns from different assets reinforce or offset each other. Those investments can be said successful which gives the best risk-return reward and Portfolio management theory helps to maximize the relationship of risk-reward (Bodie et al., 2004).

In Markowitz theory of portfolio selection, investors are assumed to be rational individuals aiming to increase return of their investment at a given level of risk or minimize the risk of their investment at a given level of return. Utility functions or indifference curves are normally used to represent the investor's preferences. By assuming that the investor is risk-averse and the utility function is quadratic, indifference curves can be derived in the form of convex curves in expected return-standard deviation space.

Many research studies on portfolio optimization have concentrated on methods for implementing the portfolio theory. The Markowitz model has been criticised because its application requires computation of covariance of each security with the other securities. In addition, the construction of efficient frontier needs lengthy calculations which may not add value for investors. In the Markowitz model the inputs required for portfolio analysis for N securities involve N expected returns, N variances of returns and $N*(N-1)/2$ covariance terms or correlation coefficients as measure of interrelationship between the returns on assets considered; therefore, in total, $N(N+3)/2$ pieces of information are required. Theoretically, the Markowitz model is considered as a superior approach in constructing the optimal portfolio. However, it has hardly become an operational tool for portfolio managers and investors, since this model requires a large number of inputs and involves the computational complexity.

Several algorithms have been developed to produce solutions based on the mean–variance model. In addition, various research studies have been carried out to simplify Markowitz’s assumptions in an attempt to make the model operational. The Sharpe single index model is one of the prominent results of these simplifications requiring fewer inputs and computational simplicity.

2.4 Post-Modern Portfolio Theory

The modern portfolio theory assumes investor as a rational entity whose aim is to maximize his return of investment over time. In this theory risk is defined as the dispersion from the mean or average and it is called variance or volatility. It is a statistical model with some unrealistic assumptions. Behavioural finance, on the other hand reveals that not all dispersions from the mean are considered as risk from investors’ point of view. On contrary, positive dispersions are assumed to be the good surprises defining the premium gained because of the investment. Therefore, the meaning of risk has been changed over time and new measures of risk have been introduced. In this new definition of risk, the downside risk measures are defined as the risks of not obtaining the minimum desired level of expected return.

Another problem of portfolio selection theory lies in maximization of errors existed in inputs i.e., returns, variance and covariances of assets (Phillip Jorion,1992). In the classical approach, expected returns, risks and correlations are measured from historical data and entered into a portfolio optimizer as the inputs. This cause substantial estimation errors in case of wrong inputs or existence of outliers. The paper suggests a simple simulation method for measuring estimation error in an international context.

Lee and Junior (2018) extended Amenc et al. (2011) survey conducted a similar survey among asset management companies in Brazil. They collected data from 78 companies which were distinguished in terms of their origin, affiliation to banks, etc. To analyse the collected data,

they used multiple regressions using ordinary least square (OLS), they conducted Pearson's chi-square independence tests, and used a PROBIT model. They reviewed major literature in MPT (Modern Portfolio Theory) and PMPT (Post-Modern Portfolio Theory) including four main categories i.e. measuring market risk, covariance matrix estimation, distribution of returns, and measurement of estimation risk and developed eight hypotheses for assessing the aptitude of assets management companies in Brazil .

However, some studies show that the Mean-Variance theory is still applicable in some particular cases. Pablo Ciudad et al. (2016), for example, analysed the performance of mean-variance optimized equity portfolios for retail investors, in different financial markets including 22 countries/indexes from which they compute optimized portfolios and then held until the next rebalancing period when they repeat the process. By analysing the mean-variance portfolios in monthly, quarterly, semi-annual and annual intervals, they conclude that monthly rebalanced portfolios do not necessarily outperform annually rebalanced portfolios. Their findings suggest that using mean-variance optimization helps retail investors in enhancing their portfolio performance more than actively-managed or indexed funds offered by fund management firms without bearing applicable fees charged by index funds such as ETFs. They concluded that mean-variance optimization is a useful and valid tool to help those retail investors who do not have sufficient and adequate knowledge and expertise to analyse financial markets and financial instruments available to them.

In a recent paper, Markowitz (2010) reviewed the fundamentals of portfolio theory and examined its applications in terms of studying the actual behaviour of an investor in contrast to the earlier assumption of investors to behave rationally. Based on the arguments provided in the paper, he concluded that the risk premium promised for taking risk is not accrued by investors in Capital Asset Pricing Model (CAPM).

Markowitz's theory of portfolio selection which was the first quantitative framework in the field. However, due to the computational limitation of his time this theory is confined to only a symmetric problem by imposing restrictions such as normality of return distribution and treating both upside and downside dispersion around the mean unfavourable. Myles E. Mangram (2013) in his paper presents an in-depth overview of complex mathematical models and suggests a simplified computer-based 'short-cuts' using Excel for this complicated problem.

Markowitz's theory is based on single investment horizon i.e. investor makes decision only on gains and losses at the time $t+\Delta t$. At the beginning of the investment period the investor allocates his wealth in different asset classes and assigns non-negative weight to each asset class. The weights sum to 1 which indicates budget constraint. During the investment period each asset gains a random expected return. At the end of the period, his wealth has been changed by weighted average of returns. This one-period framework is generally referred to as myopic or short-sighted behavior. Aside from the single-period models, there is a discipline of finance known as continuous-time finance. The fundamental works of Black and Scholes (1973) and Merton (1976) are the milestones in continuous-time finance (1973b). Further, a recent study by Chi Seng Pun (2018) analysed time-consistent Mean-Variance portfolio selection with only risky assets and showed that time-consistent Global M-V (GMV) strategies are theoretically and empirically superior to myopic Global M-V (GMV) strategies.

2.5 Modification of Markowitz Mean-Variance Theory

The Markowitz model is based on some unrealistic assumptions such as not allowing short selling (only positive weights are accepted), assuming a rational investor, assuming a normal distribution, not considering the transaction costs, assuming that investors hold the investment till the end of its tenure, and efficient market assumption. However, in the real-world scenarios

such assumptions do not stand, and investors face many practical constraints such as cardinality constraints, floor and ceiling constraint, transaction cost to name a few. Therefore, it is important to take such constraints into account to achieve the investment objectives

The Markowitz model was modified by Black (Black, 1972) to allow short-selling (negative weights of assets). The Black model simplified the portfolio decision making to an extent that it made it possible to replicate any efficient portfolio by knowing a limited number of efficient portfolios. By assuming a riskless asset, the efficient line becomes a straight line or a linear relationship between return and volatility rather than a parabola curve. This model is known as Tobin model named after its proposer (Tobin, 1965). In this model the process of selection of optimal portfolio can be divided into two steps: the first step is identification of tangency portfolio irrespective of the investor's risk preference and the next step is selection of the optimal portfolio according to investor's risk preference.

Researchers have further developed new portfolio optimization models using other higher moments than mean and variance. Studies such as Jurczenko et al. (2006) constructs a portfolio optimisation model with the higher moments of return distribution including mean, variance, skewness and kurtosis without allowing short-sale constraint. Davies et al (2009) analysed hedge funds using higher moments and found a substantial difference between taking into account skewness and kurtosis in portfolio than merely considering the first two moments i.e., mean and variance.

Hochreiter (2007) used Genetic Algorithm (GA) for portfolio optimization. The author considered a framework that replace the mean by expected return and used Standard Deviation, Value at Risk (VaR) and Conditional Value at Risk (CVaR) as measures of risk in the process of portfolio optimization. He found a mixed results and showed that portfolio combinations differed greatly in terms of the risk measure used. Similarly, Gaivoronski and

Pflug (2004) developed a mean-VaR portfolio optimization problem and found that the Mean-VaR efficient portfolio differs significantly from the mean-CVaR and mean-variance portfolios. As a result, mean-CVaR and mean-variance frontiers only provide a poor approximation of the mean-VaR frontier. However, mean-CVaR and mean-variance may be better approximations of each other than mean-VaR. Therefore, the recent advances in portfolio theory cited above, attempted to address the shortcomings and limitations of the classical models, and have considered the realistic constraints to be consistent with the real financial market conditions. Thus, resulting a new strand of theories and models known as Post-Modern Portfolio Theory.

2.6 Covariance Matrix and Estimation Error

In order to estimate portfolio risk, it is necessary to estimate covariance matrix. A covariance matrix consists of variance of each asset in the portfolio as well as covariances of all pairs of assets existing in the portfolio. In the portfolio optimization practices, expected returns and covariance matrix need to be estimated using quantitative methods. There are various methods for estimation of covariance matrix. The classical method includes sample mean and covariance matrix in which the historical data over a selected period are collected and the sample mean and sample covariance matrix will be calculated accordingly. This method is cumbersome and non-intuitive method for large portfolios and faces the issues of error multiplier. However, there are several techniques introduced in financial literature to address this issue, such as putting constraints on portfolio weights, constructing Global Minimum Risk Portfolio, Black-Litterman and Bayesian techniques, and portfolio resampling.

Shrinkage and Bayesian methods allow incorporation of uncertainty of expected return and risk in the portfolio optimization process, therefore provide more realistic models. For example, Black and Litterman (1990) combined investor views with market equilibrium. In this model,

if the confidence in the view considered to be zero, they end up holding market portfolio as given by CAPM model. However, by putting the investor view into account, the resulting expected returns will deviate from the market equilibrium and imply the investor views.

Introducing more sophisticated methods for estimation of expected return and covariance matrix results in more estimation errors and model risks. This, consequently leads to less efficient portfolios which perform poorly, especially for out-of-sample results. Therefore, it is of outmost importance to deal with estimation errors effectively.

Jorion (1991) compared the historical sample mean, Bayesian estimator and a CAPM-based estimator, found that historical sample covariance leads to the worst forecast and out-of-sample performance and is outperformed by shrinkage estimators. Also, an active portfolio based on the CAPM produces the best results among others. Another study by Nathaphan and Chunnachinda (2010), employed six different estimating strategies to examine the ex-post portfolio performance, and showed that shrinkage estimators incorporating the single index model outperform other traditional methods of portfolio selection.

Jorion (1992), suggested a simulation approach to tackle the estimation errors presented in Markowitz Mean-Variance framework. Therefore, he compared two optimal portfolios of foreign bond and that of US bonds. The foreign bond portfolio was optimized using a simulation technique. In this process, mean and covariance matrix are computed based on historical data and the optimization are performed while taking into account the investment objective and constraints. Next, a random sample of N joint returns is drawn from the multivariate standard normal distribution. Then the mean and covariance based on the random sample returns are estimated. The optimization procedure is ran based on this simulated sample. These steps are repeated till an optimal portfolio is obtained which has acceptable precision. Later dropping those portfolios with lower return to risk ratios at 5% significant level and it was claimed that remaining portfolio would represent the original portfolio. The selected

portfolio's Sharpe ratio was compared to two benchmarks namely US bond index and World bond index and F-test is done. The results concluded that that internationally diversified portfolio outperforms the US bond index. However, no evidence showed that the selected optimal portfolio through simulation process would outperform the global index.

2.7 Factor Models

Another approach to estimate the covariance matrix is to use multifactor models. Sharpe (1963) used the factor model to estimate the covariance matrix, which drew the attention of researchers. CAPM is a single factor model which considers only Market risk as a factor. In this model beta is the only risk factor which indicates the sensitivity to excess market returns. Multifactor models consider other factors than beta to demonstrate risk premia.

The capital asset pricing model (CAPM) is a single-factor model or market model that takes into account the asset's sensitivity to non-diversifiable risk (also known as systematic risk or market risk), which is often represented in the financial industry by the quantity beta (β), as well as the market's expected return and the expected return of a theoretical risk-free asset. Based on the portfolio theory, a risk-averse investor can build a portfolio which is a combination of market portfolio and a risk-free asset. This portfolio lies on a line which is known as Capital Market Line (CML). The CAPM introduces Security Market Line (SML) suggesting a linear relationship between a security's expected return and its volatilities. Therefore, it is possible to estimate assets' returns by estimating their sensitivities to the market portfolio which is given by ' β '.

Asset Pricing Theory (APT) eliminates arbitrage opportunities through its multifactor model. Active portfolio management was pioneered by Treynor and Black in 1973. By introducing uncertainty about the model parameters, Black and Litterman (1991, 1992) refined their concepts. Later, Fama and French (1993) introduced three-factor model and explained that

there are two more factors other than the market systematic risk that affect the expected return of a portfolio. These two factors are the size factor and the value factor. The size factor is measured by stock price times number of shares. The value factor is the book to market value. They empirically proved that their suggested factors can explain average return of stocks and bonds. Chan et al. (1999) confirmed the effectiveness of three-factor model in case of Minimum Covariance Portfolio (MVP). Campbell (1996) recognized the importance of “human Capital” and suggested that adding this factor to multi-factor models results in better prediction of return estimation.

Some of the well-known multi-factor models are listed below:

- Fama-French three-factor Model (1993): which considers Size (market capitalization) and Book/Price (Value) factors along with Market risk factor (β).
- Carhart four-factor Model (1997): added momentum factor to Fama-French three-factor model, which is the volatility of price changes in an asset. i.e., loser vs. winners)
- Low volatility (Haugen and Heins, (1972)): low-volatility stocks have higher returns than high-volatility stocks in most markets studied
- Quality Factor: Kewei Hou et al. (2015) proposed a new four-factor asset pricing model that explained many anomalies that neither the Fama-French three-factor model nor subsequent the four-factor models could explain. Q-factor model considers the difference between the return of a portfolio of high return-on-equity (ROE) stocks and a portfolio of low ROE stocks.
- Factor Mimicking Portfolio: is a portfolio whose returns are the returns of the factor.
- SMB (Small minus Big) is designed to give a portfolio that is long and small stocks, shortened big stocks, and the difference between them is basically the return of the factor.

Fama and French (2015) introduced five-factor model by adding two more risk factors namely profitability and investment to the three-factor model (Size, Value and Sensitivity to systematic risk) and found some anomaly of average return. In a successive study, Fama and French (2016) used five-factor model to explain how the profitability factor (RMW) and the investment factor (CMA) justify abnormal behaviour of average returns. RMW is defined as the difference in returns between firms with strong (high) and weak (low) operating profitability, and CMA is defined as the difference in returns between firms that invest conservatively and firms that invest aggressively. Fama and French (2017) tested Fama and French (2015) internationally by studying North America, Europe, Japan, and Asia Pacific. They also looked at local versions of the models, where the returns and factors were from the same region. They showed that local versions of Fama-French three-factor model fails to capture the relationships between average returns and profitability or investment. On the other hand, internationally tested three- factor and five- factor models did not perform well in the test of regional portfolios. Kubota and Takehara (2018) tested Fama and French (2015) five-factor model to evaluate the pricing structure of firms in Tokyo Stock Exchange firms from January 1978 to December 2014 did not find any evidence in favour of five-factor model over the studied period.

2.8 Deviation from Normality

Since Markowitz, the normal distribution has been the most favoured starting point in portfolio creation (1952). The normalcy assumption may be found in most financial models. Bachelier is credited as being the first to use the normal distribution in finance (1900). Further, the usage of Brownian motion in banking is another reason for the normal distribution's appeal. Although Norbert Wiener originally introduced Brownian motion in 1923, Osborne is the first to use it in finance (1959). Samuelson (1969) and Merton (1969) produced a slew of continuous-time finance findings (1969). The normal distribution is the most significant distribution in

probability because of the central limit theorem. In the case of equity returns, a similar phenomenon may be observed.

One of the underlying assumptions of portfolio selection in Markowitz framework is that the asset returns are normally distributed. However, in real scenarios return distribution is asymmetric in many cases and shows fat tails and higher moments. In other words, actual time series returns on different asset classes are not normally distributed implying that a normality assumption is just a simplifying assumption. Normal distribution assumption indicates that there is a very little probability that asset returns take on very large positive values or very large negative values. However, in actual scenarios there are often large deviations of returns from normality. Hence, the Gaussian distribution cannot adequately represent financial data with fat tail (Sun et al. al,2019).

Furthermore, the closer the return distribution matches a normal distribution, the lower is the frequency of the returns. Therefore, annual returns can be reasonably forecasted as usual. Daily returns, on the other hand, cannot be expected to be normal statistically. Mandelbrot and Fama (1963) were among the first to express reservations about the normalcy assumption of asset returns (1965). Since then, a slew of new publications has been surfaced on the subject.

To overcome this problem, it is necessary to consider higher order moments of return distribution particularly skewness and kurtosis rather than only focusing on mean and variance. Skewness is the measure of asymmetry of distribution which is related to the third central moment of the return distribution normalized by the variance of the distribution to the power of 1.5. (Or to standard deviation to the power of 3). If a distribution has a negative skewness, then the probability of getting an outcome below the mean is higher than the probability of an outcome above the mean, and the opposite is true in case of positive skewness. In 1985,

Azzalini developed a skewed version of the normal distribution. In general, the t distribution obtains a normal distribution as the parameter ‘v’ approaches infinity.

Kurtosis is defined as the fourth central moment of return distribution and shows the thickness of the tail of the distribution normalized by dividing standard deviation to the power of four. Gaussian distribution has a very thin tails decreases very sharply to zero, which implies that the probability of getting very large negative or positive returns is very small with a kurtosis equal to 3. Any distribution with kurtosis greater than three is a fat tail distribution. The results of a skewed normal distribution are unsatisfactory because fat tails are not considered. Hence, it is more important to include heavy-tails in the return distribution than skewness, which implies an extension of the normal distribution with fat tails.

$$S(R) = \frac{E[(R - E(R))^3]}{[Var(R)]^{3/2}}$$

$$K(R) = \frac{E[(R - E(R))^4]}{[Var(R)]^2}$$

Johnson, Kotz, and Balakrishnan are standard references for continuous distributions (1995a, 1995b). Many distributions are overlooked because of their unfavourable characteristics. Because of their shape, the Laplace and exponential distributions were not considered; Since its mean was not established, the Cauchy distribution was not considered. Prices are modelled using log-normal, gamma, inverse Gaussian, chi-square, Weibull, beta, and F distributions, but not returns. Many books have been written about asset return skewness and kurtosis values. They all claim that real-world return series are distorted and leptokurtic. Therefore, we are looking for distributions with skewed tails or fat tails.

2.9 Evolution from Variance to more sophisticated measures of risk

Markowitz portfolio theory considers variance as a measure of risk. Basically, the variance is defined as dispersion around the mean which considers both positive and negative deviations from the mean as undesirable outcome and weighs both in the same manner while, in reality only left side of return distribution is undesirable. Roy 1952 first introduced the concept of ‘safety first’ to the investment literature in order to develop a practical framework which assumes that the first and foremost objective of an investor would be the safety of their principal by setting a minimum acceptable return that preserves the principal. Therefore, an investor prefers a portfolio with lower probability of going below the ‘disaster level’ or ‘target return’. He also introduced reward to volatility ratio while considering the disaster level and stated that investors seek to maximize the reward to volatility ration defined as $\frac{r-d}{\sigma}$ where r is expected return, d is disaster level and σ stands for the standard deviation.

One of the underlying assumptions of portfolio selection in Markowitz framework is that the asset returns are normally distributed. However, in real scenarios return distribution is asymmetric in many cases and shows fat tails and higher moments. Therefore, a better measure of risk is required. To overcome this limitation, Markowitz (1959) introduced “Semi-Variance” which considers only the downside of return distribution as a measure of risk. The advantage of using the mean-semi-variance criterion in portfolio selection over the mean-variance model was highlighted by Hogan and Warren (1972). Bawa (1975) and Fishburn (1977) introduced Lower Partial Moment which is a generalization of semi-variance. Lower partial moment (LPM) is a set of moments that is used to estimate downside risk in finance. It, therefore, is the risk associated with losses and considers the moments of asset returns that fall below a certain minimum acceptable level of return τ which is referred to as ‘benchmark market level’ or ‘disaster level’. Bawa (1978) demonstrated the applicability of the downside risk to higher

order. Lee and Rao (1988) suggested a new asset pricing model using the Mean-LPM framework that used semi-variance and semi-deviation to measure risk.

Rom and Ferguson (1994) and Roman and Mitra (2009) argued that while in Mean-Variance framework the volatility is a symmetric measure of risk that treats all uncertainty the same, in the real world is just the opposite; only in bear market should volatility avoided, and in a bull market we should seek as much as volatility as possible.

Value at Risk (VaR) is a regulatory measure of risk that entered the financial lexicon in the early 1990s (see GA Holton, 2002 (9)). First, the US security and Exchange Commission (SEC), based on the market historical data, calculated a 0.95 quintile of the amount of money a firm might lose over a one-month period which later referred to as VaR. This new risk metric imposed by regulations, such as the UK Securities and Futures Authority 1992 “portfolio” value-at-risk measure, Europe’s 1993 Capital Adequacy Directive (CAD) “building-block” value-at-risk measure and the Basel Committee’s 1996 value-at-risk measure based largely upon the CAD building-block measure, to banks and financial institutions in order to track and report the market risk exposure of their portfolios. VaR estimates the predicted maximum loss at a specified probability level (for example 90%, 95% or 99%) over a certain time horizon (for example 10 days or one month).

There is voluminous literature analyzing the mean-VaR model for portfolio selection in comparison to classical Mean-Variance models depicting some advantages and drawbacks. For instance, Alexander and Baptista (2002) and examined the economic implications of using mean-VaR in compared to mean-Variance and found out that the higher variance portfolio might have less VaR. Thus, an efficient portfolio that globally minimizes VaR may not exist. They showed that it is possible for some risk-averse agents to end up choosing portfolios with greater standard deviations if they switch from using variance to VaR as a measure of risk and

concluded that regulators should be aware that VaR is not a unique improvement over variance as a measure of risk. In a subsequent study Alexander and Baptista (2004), imposed Value-at-Risk (VaR) and Conditional Value-at-Risk (CVaR) constraints to the mean-Variance portfolio selection and compared them for both highly risk-averse and slightly risk-averse agents and obtained similar results.

Kaplanski and Kroll (2002) analyzed the validity of VaR in comparison to the traditional measures of risk and found out that the VaR family is at least as good as other measures of risk for decision making purposes. However, they showed some drawbacks of imposing VaR constraint. For instance, the congruence of Mean-VaR criterion with the expected utility theory is only observed in the presence of normality (or log-normality) assumption, which makes it applicable only in the case of irrational utility functions. For all non-normal distributions, Mean-VaR criterion may screen out alternatives which are considered superior by risk-averse individuals. Furthermore, they suggested that Accumulative-Value-at-Risk (AVaR) is superior to both regular VaR and the traditional risk measures. Roman and Mitra (2009) discussed alternative models for portfolio selection by incorporating those risk metrics that penalize only the downside part (adverse) and not the upside (potential) of the return distribution, such as Lower Partial Moments (LPMs), Value-at-Risk (VaR) and Conditional Value-at-Risk (CVaR).

2.10 Estimation of Value at Risk (VaR)

There are at least four standard methods for calculation of VaR which are the most commonly used for calculation of VaR. Each method has its own strengths and weaknesses. Parametric approach assumes normal distribution for returns whereas non-parametric approach doesn't assume any particular return distribution. Monte Carlo methods are computationally difficult by simulating random scenarios.

2.10.1 Historical volatility (non-parametric)

In this method the distribution of historical changes in the value of current portfolio is considered by taking the sample of returns and excluding the $\alpha\%$ of the worse outcomes and then focusing on the remaining worse outcomes. As there are no underlying assumptions on the return distributions and it is dependent on historical data, the estimation of VaR is very sensitive to the sample period in this method, therefore, it is prone to sample risk. This approach assumes that the historical data is a good indicator of future returns. Although this a simplified and easy to implement approach, it would not be applicable in the time of financial crisis and economic turbulences.

2.10.2 Variance-Covariance (Parametric Gaussian)

In order to overcome the limitation of non-parametric method, parametric method which assumes a particular assumption about the return distribution is introduced. In this approach a statistical model is made and the parameters of return distribution are estimated. Variance-Covariance method is the simplest parametric method of calculation of VaR which assumes a Gaussian distribution. In other words, it assumes the returns are normally distributed. Hence, it requires to estimate only expected (average) return and standard deviation. So, one needs only to look at the α quantile of standard deviation. Therefore, the alpha quantile of the standard normal distribution gives the estimate of value at risk (VaR). The following equations relate Z_α which is the notation of the one-sided alpha quantile of return distribution and Z_α is an outcome so that there is only α percent chance of getting outcome below Z_α . So, if asset returns are actually normally distributed, then we get the standard normal distribution for which we know for example that there are only five percent chances that they would go below minus 1.65 for example in terms of value for that standardized Gaussian distribution.

$$\int_{-\infty}^{z_{\alpha}} \frac{1}{\sigma\sqrt{2\pi}} \exp\left[\frac{-x^2}{2\sigma^2}\right] dx = \alpha$$

$$\text{Prob}\left[\frac{R_p - \mu_p}{\sigma_p} \leq z_{\alpha}\right] = z_{\alpha}$$

$$\text{VaR}_{\alpha} = -(\mu + z_{\alpha}\sigma)$$

$$z = \frac{x - \mu}{\sigma}$$

This approach is simple and straightforward, but the problem is that the Gaussian assumption is not a good assumption for return distribution because normal distributions are very thin in the tails while many return distributions in real world show fat tails. Hence, it basically underestimates the value at risk.

2.10.3 Parametric Non-Gaussian

In this approach the Gaussian assumption of return distribution is released as the return distributions are mostly not normally distributed and often show fat tails. However, the return distribution is assumed to be of another sort such as the pareto distribution, the student distribution, Loggamma, etc., and then the estimation of risk variables is undertaken. No matter which type of return distribution is assumed, this method also suffers from specific model risk. For example, it is possible that a t-student distribution is assumed but in the reality the returns do not follow a t-student distribution therefore, the viability of the estimated parameters would be doubtful.

2.10.4 Cornish-Fisher (Semi-parametric)

It is a semi-parametric approach which does not impose any specific assumption about the return distribution, but relates the alpha quantile of non-gaussian distribution to alpha quantile of Gaussian distribution by giving the following equation:

$$\tilde{z}_\alpha = z_\alpha + \frac{1}{6}(z_\alpha^2 - 1)S + \frac{1}{24}(z_\alpha^3 - 3z_\alpha)(k - 3) - 1/36(2z_\alpha^3 - 5z_\alpha)S^2$$

Where S and K are skewness and kurtosis of the return distribution respectively. If the skewness is zero and the kurtosis is equal to 3, then it is a normal distribution and the value at risk is same as it is estimated in the parametric Gaussian method. But if it is not the case, as it is in many cases, Cornish-Fisher equation gives the modified VaR which estimates more negative outcomes than the parametric methods.

$$\text{VaR}_{\text{mod}}(1 - \alpha) = -(\mu + \tilde{z}_\alpha \sigma)$$

2.11 Relative Risk-Adjusted Return Measures

As the name indicates risk-adjusted return calculates the return on investment after taking to account the risk of investment. There are various risk-adjusted measures driven from modern to post-modern portfolio theories. In other words, there would be different risk-adjusted returns based on the risk measure considered.

- Sharpe ratio is a measure of risk-adjusted return which is excess return divided by standard deviation as the portfolio risk. When two assets are compared to a common benchmark, the one with a higher Sharpe ratio provides a higher return for the same risk. The Sharpe ratio is a common measure of calculating risk-adjusted return, but it only stands when the return of assets follows a normal distribution.
- Treynor (1965) proposed a risk-adjusted ratio which is the excess risk from the risk-free rate divided by market beta. Therefore, it takes the systematic or market risk into account.

Higher Treynor ratio indicates that an investor has earned high returns on all of the market risks he has taken.

- Jensen's alpha proposed by Jensen (1968) is another risk-adjusted performance measure which is driven from the CAPM. Alpha is the excess return of a portfolio over a benchmark. Jensen's alpha is the excess return of a portfolio above the return estimated by CAPM.
- Treynor and Black (1973) proposed another performance measure known as information ratio. It is a ratio of a portfolio's excess return relative to a benchmark divided by its tracking error.
- Modigliani and Modigliani (M-square) is another modern portfolio performance ratio which indicates the return that a fund would have if its risk was equivalent to market risk. Unlike other performance measures, M2 is expressed as % of return.
- There are some performance ratios, which are based on post-modern portfolio theory. For example, Sortino ratio takes downside risk into account, therefore indicates the ratio of portfolio gain considering its downside risk. Downside risk is the risk of a portfolio's return to fall below a targeted return.
- Return relative to VaR, on the other hand, considers value at risk as a measure of risk and calculated the excess return obtained divided by its VaR.

2.12 Reviews on Portfolio Construction

Yunchol Jonga (2012) considered an interval portfolio selection problem based on the satisfaction index. The researcher proposed an approach to reduce the interval programming problem with uncertain objectives and constraints into a standard linear programming problem with two parameters. The researcher also showed a simulation process to help the researcher find an efficient portfolio.

Shrivastava et al. (2013) used a genetic algorithm method to generate the optimum weights of the stocks. To predict the price of the stock a graph theory has been used. They proved that their proposed method provides a positive outcome in BSE.

Rakesh Gupta and Basu (2009) analysed portfolio construction and estimated dynamic of correlation of stock market return using DCC GARCH Model and an efficient portfolio has been tested based on generating a higher return than a market return. They considered daily and monthly market data of 10 industry sectors in a period of ten years and concluded that there is a possibility for investors to increase their risk primum and outperform the market.

Abonongo John et. (2017) applied matrix approach to construct an optimum portfolio. For this purpose, they used data on the closing monthly price of 13 stocks from the Ghana Stock Exchange (GSE) in a period of 2004-2015. The efficient portfolio has been constructed by applying a minimum threshold limit which is a global minimum portfolio.

A thesis written by Erik Nordin (2012) discussed portfolio construction through the black-Litterman concept. In this thesis author compared the Mean-Variance portfolio with Black Litterman Portfolio. Five diversified indices have been used by the author to construct a portfolio. The performance of this portfolio has been calculated through Sharpe ratio and Information Ratio and then the performance has been evaluated. The author concluded that Black – Litterman Portfolio outperforms Mean-Variance Portfolio.

Affleck-Graves and Money (1976) compared two widely used methods of portfolio construction that are Markowitz and Sharpe's Index Method. They observed that Sharpe's model improved incrementally with every added index. The study also found that portfolio construction using the Markowitz model limits maximum weight allocation to 40 percent in any security. It was also discovered that for each possible target return, there is a unique portfolio of assets that will provide the required return with the least amount of variance.

Bower and Wentz (2005), research and compared Markowitz and MAD (mean absolute deviation) Methods of portfolio construction under the title, “Portfolio Optimization: MAD vs. Markowitz”. To achieve the set objective author created a portfolio with stocks and Bond from S & P 500. The author applied the Mean-Variance Model of Markowitz and MAD model to determine the allocation of weights. Then the author compares the return of the portfolio using parametric and nonparametric tests. The research concluded that neither MV nor MAD produces a better return than each other as there was little significant difference in return of both the methods but the MAD method is comparatively easy to calculate as it consists of a very simple method of calculations.

Yuwono and Ramdhani (2017), Compared Sharp’s single index Model and Markowitz Model with the title, “Comparison Analysis of Portfolio Using Markowitz Model and Single Index Model: Case in Jakarta Islamic Index”. The author carried out this research on the Indonesia Stock exchange to construct an optimal portfolio. Performance of both optimum portfolios has been compared based on Sharpe, Taynor Ratios and Wilcoxon test have been applied. The result shows that there is no significant difference between the Portfolio return of Markowitz Minimum Variance Portfolio Methods and Return from Sharpe’s single index model.

Rajan Bahadur Paudel and Sujana Koirala (2018), undertook research to identify best portfolio construction strategies based on Markowitz and Sharpe Models in provide a better return in Nepalese stock exchange. The study found that a portfolio constructed based on both the Model provides a higher return in the Nepalese stock market.

Meir Statman 2004, worked on a behavioural portfolio theory. The author stated that the average investor holds only 3 to 4 stocks in his portfolio and hence diversification puzzle can be solved through Behavioural portfolio theory. According to him, an investor creates a portfolio in pyramid style in which the bottom side is for downside risk shield and the top side

is designed for upside opportunity. And to achieve their aspirations, investors fill the top layer with either lottery or with undiversified portfolios. The study observes that these two models perform lower than the mean-variance portfolio.

Melkumian and Melkumian (2009) discussed portfolio size and welfare losses for Investors. A concept of proportionate opportunity cost has been used to compare n-asset optimal portfolio consisting of 26-assets. The researchers argued that highly risk-averse investors incur very small or no diversification cost. Researchers also stated that risk-averse investors invest most in safe assets and hence few stocks are needed to achieve optimum diversification.

Subha and Bharathi (2007) examined the investment performance of fifty-one open-ended mutual fund schemes from October 2004 to September 2005. They used CNX Nifty as a benchmark portfolio to compare its performance with the performance of the sample schemes. They applied Treynor (1965), Sharpe (1966) and Jensen (1968) alpha measures to evaluate the performance of mutual funds. They found mixed performance of sample schemes as the results of Sharpe ratio indicated good performance by majority of the schemes, the results of Treynor ratio exhibited good performance by only few schemes. They observed that Jensen alpha measures were positive for 98% of the funds which indicated that the funds had superior performance relative to benchmark. They concluded that the performance of mutual funds in the sample was acceptable during study period.

Raju and Rao (2009) studied the performance of sixty Indian mutual fund schemes from April 2000 to March 2005. They used BSE Sensex and NSE Nifty as market proxies. They employed Treynor and Mazuy (1966) and Henriksson and Merton (1981) models to evaluate market timing ability of the fund managers. They found that as per Treynor and Mazuy model, more than 56% and 52% of selected schemes with BSE Sensex and NSE Nifty respectively turned out to be negative performers and as per Henriksson and Merton model, more than 61% and

67% of the schemes with BSE Sensex and NSE Nifty respectively turned out to be negative performers. They concluded that a majority of the selected mutual fund scheme managers were not seriously engaged in any market timing activities and relied mainly on stock selection skills.

Duggimpudi et al. (2010) evaluated the performance of seventeen Indian equity diversified mutual funds from 2000 to 2009. They used BSE Sensex as a benchmark index and applied Treynor (1965), Sharpe (1966) and Jensen (1968) techniques. They found that funds in the sample performed better than the market according to Treynor and Sharpe techniques. They also found that Jensen alpha measures for all funds were positive. They concluded that all mutual funds in the sample outperformed the market during the study period.

Kaur (2011) evaluated the performance of ten Indian open-ended equity mutual funds for the period 2008-2010. He analysed the managerial performance on the parameters of diversification, market timing ability and stock selection skill. He used BSE Sensex index as a benchmark and applied Treynor (1965), Sharpe (1966) and Jensen (1958) measures. He employed Treynor and Mazuy (1966) model to test the market timing ability and Fama (1972) measure to test selectivity skills of mutual fund managers. He found that majority of funds had better performance than the market according to Treynor and Sharpe measures. His results exhibited significant positive alpha value for six out of ten mutual funds. He found that the mutual funds in the sample were not well diversified, and they had positive but low stock selection and market timing skills.

Prasad and Srinivas (2012) examined the performance of seventeen equity mutual funds in India over the period of April 2000 to March 2010. They used BSE Sensex index as a benchmark and applied Treynor and Mazuy (1966) and Henriksson and Merton (1981) models to evaluate market timing ability of fund managers. They found that majority of fund managers were successful in timing the market and could earn returns in excess of the market.

Dhar (2013) evaluated the investment performance of eighty Indian mutual fund schemes in terms of selectivity skills of fund managers from May 2000 to March 2012. He applied unconditional and conditional Jensen models. He incorporated three public variables to Jensen (1968) model for conditioning the alphas and betas of funds. Incorporated variables are dividend yield of market index, short term Treasury bills yield and growth rate of index of industrial production as a proxy for the performance of the real economy. He found fifty-six schemes had positive alphas as per the unconditional Jensen (1968) model but among them, just twenty schemes were significant. According to conditional version of Jensen model he observed fifty five schemes had positive alphas and among them just eighteen schemes were significant. He concluded that around twenty five percent of fund managers in the sample possessed superior selectivity skills based on both unconditional and conditional Jensen models.

Therefore, from the survey of the literature it is becomes evident that the portfolio theories have evolved over time and have increased tried to address the shortcomings observed in earlier approaches. However, as model sophistication increased over time, the real-life adoption of the same by the practising fund managers both for portfolio selection and performance measurement seems to be varied. As mentioned in the introduction chapter, only some studies analyse the aspect of adoption of high-end theoretical models in actual practise by the fund managers in advanced economies. More so in an emerging market context, only a few studies attempt to study this aspect. Hence, in this study, we aim to address this gap in literature and provide evidence on the adoption of portfolio selection and performance measures by portfolio managers.

Chapter 3. Portfolio Construction, Risk Management and Performance Evaluation Evidence from India and Iran

3.1 Introduction

This chapter provides the findings of the study (survey) conducted among asset management companies and financial institutions in India in Iran to examine portfolio construction, risk management and performance evaluation techniques adopted by practitioners. A questionnaire base on Amenc et al (2011) survey was disseminated among participants and generated responses from institutions based in India and Iran. A sample of companies listed in Association of Mutual fund India (AMFI) and Financial Information Processing Center of Iran (FIPIRAN) were selected. At the time of survey, 44 companies were listed in AMFI and 70 companies were listed in FIPIRAN offering asset management services.

The sample of the population stood at 25 Asset Management Companies from India and 22 financial institutions from Iran, representing 56.8% and 31.4% of the respondents respectively. The respondents are asked about their practices in risk management and performance evaluation and are given different options which almost cover most of the available methods in the portfolio management field from the least sophisticated ones to the most sophisticated ones.

This chapter represents the results of our survey. First, the descriptive statistics extracted from the responses are given and the results are inferred and interpreted accordingly. In the second part, the results of Multivariate logistic regression analysis to ascertain the influence of firm level and other relevant characteristics like size, investment strategy, nature of business on the use of advanced or sophisticated portfolio construction, risk management and performance evaluation techniques adopted by practitioners is presented.

3.2 Descriptive Statistics and Analysis

3.2.1 Summary statistics of the population of the survey

The respondents are asked about their practices in risk management and performance evaluation and are given different options which almost cover most of the available methods in the portfolio management field from the least sophisticated ones to the most sophisticated ones. Table 3.1 and 3.2 gives unsophisticated options available to choose for each question. Therefore, it is assumed that participants adopt non-sophisticated techniques for a particular category if they select any of the given options in Table 3.1 and Table 3.2. Later, based on their responses, we conclude that to what extent they apply sophisticated/non-sophisticated techniques in their practices.

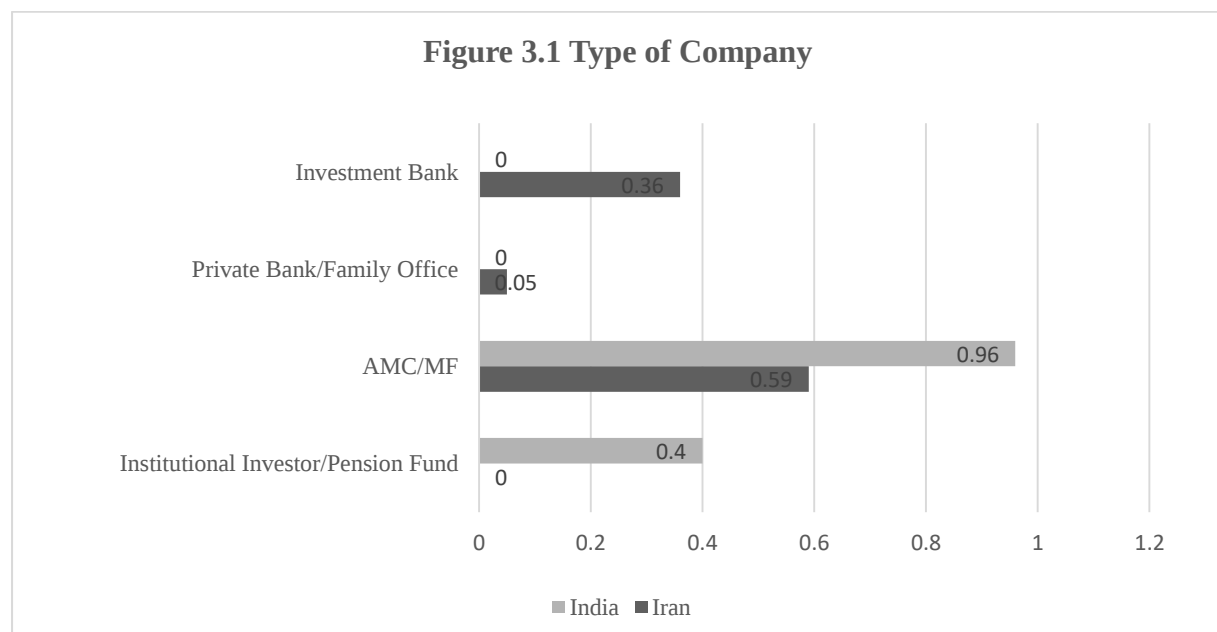
Table 3.1 Non-sophisticated risk measures/techniques in the process of portfolio construction

Portfolio Construction	
Measures and techniques	Non-sophisticated answers
Absolute risk measures	No No/Average risk
Relative risk measures	No No/Tracking error
Covariance matrix estimation	Sample Covariance
Extreme risk calculation	Do not account for it Do not account for it/Normal distribution VaR
Estimation risk	Weight constraints

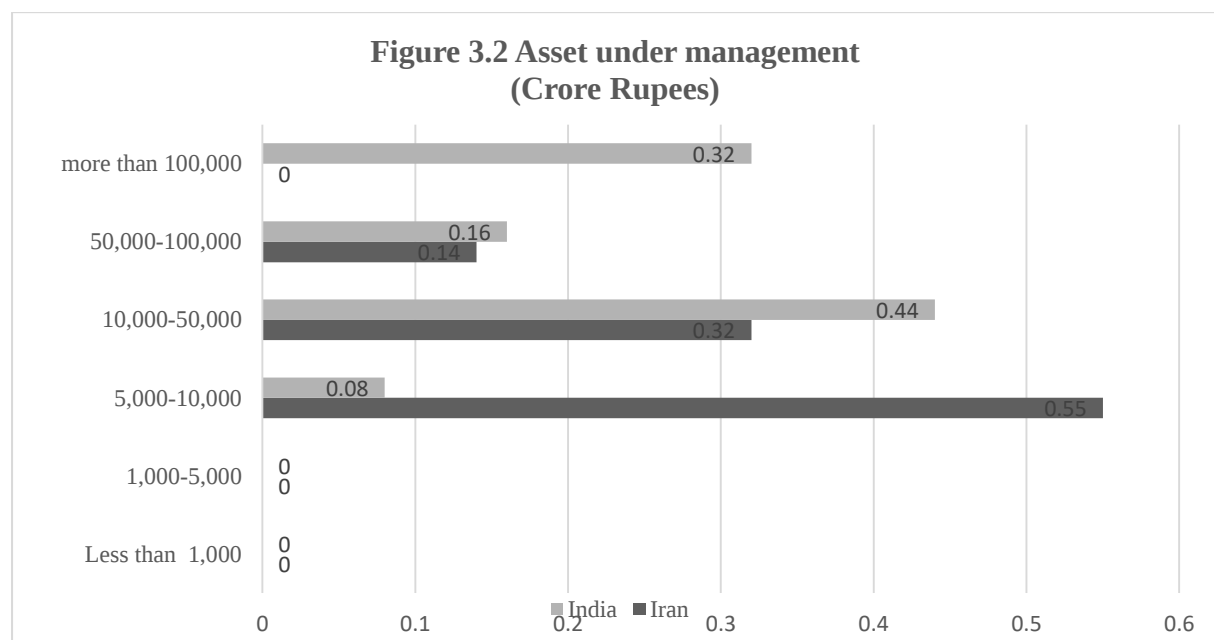
Table 3.2 Non-sophisticated measures/techniques in the process of portfolio performance evaluation

Performance Evaluation	
Measures and techniques	Non-sophisticated answers
Absolute performance evaluation	Sharpe ratio
	Average excess return
	Sharpe ratio/Average excess return
Relative performance evaluation	Average excess return
	Information ratio
	Average excess return/information ratio
Manager's alpha	Peer group

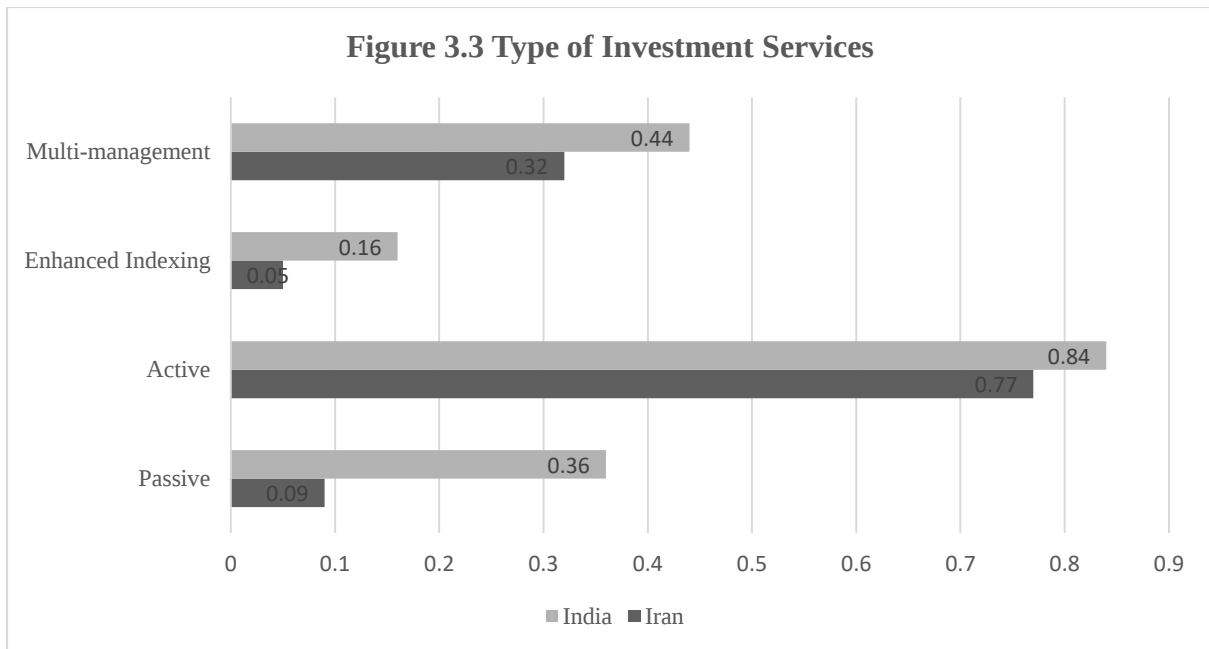
As shown in the Figure 3.1, majority of respondents are Asset Management Companies (AMCs) in both India and Iran with a share of 96% and 59% respectively. Investment Banks constitute 36% of the participants in Iran.



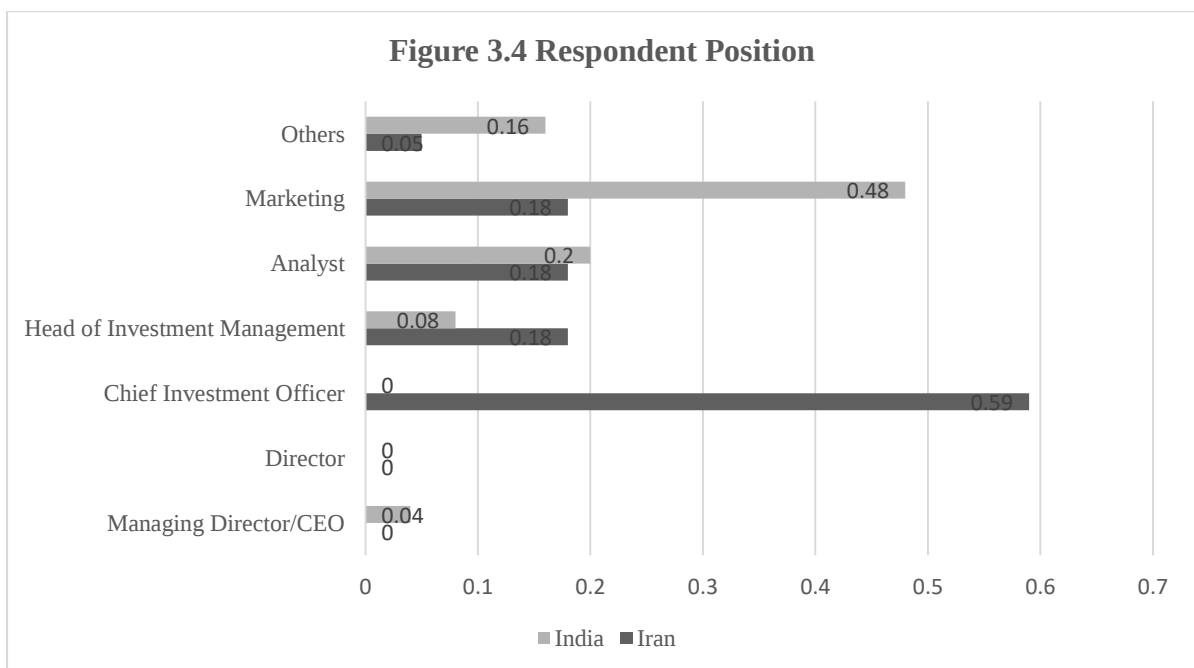
As it is indicative in Figure 3.2, the size of asset under management in India is significantly higher compared to Iran. 55% of companies in Iran manage assets between Rs. Cr. 5,000 to 10,000 and no respondents in Iran has asset more than Rs. Cr. 100,000 under their management. In India, on the other hand, only 8% of respondents' portfolios are between Rs. Cr. 5,000-10,000 and about one-third of respondents have portfolios more than Rs. Cr. 100,000 under their management.



We also asked our respondents about the type of services their companies offer. The options cover the whole range of investment strategies including passive strategies, actively- managed strategies, multi-management (active and passive management), and enhanced indexing strategies. Evidently, majority of respondents (more than three fourth's) in both countries offer actively managed investment services as shown in Figure 3.3. On the other hand, enhanced indexing strategies seem not to be popular among practitioners in both countries.



The role of respondents in their respective companies are questioned and presented in the Figure 3.4. As it shows, most of the senior executive such as Managing Director/CEO, Chief Investment Officer, Head of investment management provided most of responses we received from Iranian companies. In India, on the other hand, Marketing positions account for nearly half of the responses. The responses from analysts account for less than one-fifth of responses received from Iran and one-tenth in case of India.



3.2.2 Absolute Risk Measures

Modern portfolio theory emphasizes on considering both risk and return while constructing a portfolio. Although several risk measures have been introduced from the inception of the portfolio theory, the question is that to what extent the concept of risk is incorporated in the process of portfolio construction by investment management practitioners. Therefore, the respondents are questioned whether they set absolute risk measures when implementing portfolio optimization and which measures of risk they use.

As table 3.3 Shows 14% and 4% of respondents from Iran and India do not count for risk measures in the process of portfolio construction. While variance/volatility is the most common used measure among both respondents from Iran and India, other risk measures such as tail risks and downside measure of risk seem to be less-common measures in both countries. Semi-deviation/LPMs are the second most popular risk measure among Indian mutual funds accounting for 40% of responses. In contrast, tail risk measures such as VaR/CVaR get lesser consideration of only 4% among Indian respondents.

Table 3.3 Adoption of Absolute Risk Measures by practitioners in India and Iran

Absolute Risk Measures	Iran	India
No	0.14	0.04
Variance/Volatility	0.64	0.52
VaR/CVaR	0.18	0.04
Semi-deviation/LPMs	0.09	0.40
Others	0.05	0.00

3.2.3 Relative Risk Measures

Regarding the risk measures relative to a benchmark as it is shown in the table 3.4 the statistics are corresponding to those of absolute risk objective. 50% of respondents from Iran and 44%

in India consider tracking error volatility in their portfolio construction process. Indian companies consider downside risk relative to a benchmark as twice as respondents from Iran. Tail risk relative to a benchmark is less common comparatively by respondents from both countries. It may imply that practitioners are judged relative to some benchmark so that they have to consider the risk measures compared to some broad market index.

Table 3.4 Adoption of Relative Risk Measures by practitioners in India and Iran

Relative Risk Measures	Iran	India
No	0.14	0.04
Tracking Error relative to a benchmark	0.50	0.44
Tail risk relative to a benchmark	0.18	0.12
downside risk relative to a benchmark	0.18	0.36
Others	0.05	0.04

3.2.4 Covariance Matrix Estimation

Regarding the estimation of covariance matrix, the respondents are given a variety of options including the use of sample covariance matrix, specifying a model with explicit factors such as single-factor model, constant correlation approach, or multi-factor forecast, specifying implicit factor models such as use of Principal Component Analysis (PCA), and use of optimal shrinkage techniques (Table 3.5). Also, they are given option “other” in case they use other methods for the estimation of covariance matrix other than the given options. The responses indicate that using models with explicit factors seems to be the dominated method amongst others. The second most common option is using the traditional sample covariance matrix in both countries.

Therefore, majority of respondents in India and Iran apply either sample covariance matrix or models with explicit factors jointly or individually. On the other hand, implicit factor models

and optimal shrinkage techniques seem to be less familiar to the respondents, especially in case of Iran. Also, somehow surprisingly, 27% of respondents in Iran declared that they do not account for covariance matrix estimation in the process of portfolio construction which may imply that corresponded respondents adopt naive approach towards construction of portfolio under their management.

Table 3.5 Methods of Estimation Covariance Matrix

Estimation of Covariance Matrix	Iran	India
Sample Covariance Matrix	0.27	0.36
Explicit factors models	0.45	0.52
Implicit factors Models	0.05	0.12
Optimal Shrinkage techniques	0.05	0.16
No/Others	0.27	0.04

3.2.5 Extreme Risk Measures

There are at least four standard methods for calculation of VaR which are the most commonly used for calculation of VaR. Each method has its own strengths and weaknesses. Parametric approach assumes normal distribution for returns whereas non-parametric approach doesn't assume any particular return distribution. The respondents are asked how they calculate extreme risks. As shown in table 3.6, majority of respondents use simple VaR based on normal distribution technique to calculate extreme risks of their portfolios. Taking all together, more than half of the respondents in both countries either do not account for extreme risk measures or use VaR based on normal distribution method for calculation of extreme risks. One might imply that respondents' approach towards extreme risk is non-sophisticated.

However, the results show that almost a quarter of respondents calculate VaR based on models that take higher moments of return distribution into account, sophisticated methods such as

Cornish-Fischer semi-parametric approach, thus estimate more negative outcomes by considering the fat tails of return distributions.

Table 3.6 Methods for Calculation of Extreme Risk

Extreme Risk Calculation	Iran	India
No	0.09	0.08
VaR based on Normal Distribution	0.50	0.44
VaR based on Higher Moments	0.23	0.24
VaR based on Extreme Value Theory	0.14	0.12
CvaR	0.05	0.12

Other less commonly used methods are VaR based on extreme value theory and CVaR respectively. The extreme value theory (EVT) is an advanced technique and refers to those events with an extremely rare probability of occurrence and a catastrophic impact, such as financial market turmoil. The results show that over 10% of respondents in both countries are aware of EVT and calculate VaR base on it. Conditional Value at Risk (CVaR), also referred to as expected shortfall, calculates the probability of portfolio losses beyond the VaR is applied by less respondents in both countries and participants from Iran seem to be either less aware of such measures or not adopting CVaR (tail VaR) in their practices.

3.2.6 Estimation Error

Next, the respondents are asked how they deal with the estimation error i.e., uncertainty about the estimated parameters that are used as inputs in portfolio optimization. As table 3.7 indicates imposing constraints on the portfolio weights is the most common used method. It counts for nearly 70% of respondents from Iran and above 30% of respondents from India. Other techniques such as Global Minimum Risk Portfolio or Black-Litterman/Bayesian Techniques seem not to be known or applied by respondents in Iran and only 5% of respondents use portfolio resampling to deal with estimation error. In India, on the other hand, about one-fourth

of respondents use Global Minimum Risk Portfolio and the same proportion use portfolio resampling to deal with estimation error. The results show that not only Indian institutions take error estimation into account more than Iranian companies, but they also use more sophisticated techniques than simply impose constraints on portfolio weights.

Table 3.7 Estimation Error

Estimation Error	Iran	India
Constraints on portfolio weights	0.68	0.32
Global Minimum Risk Portfolio	0.05	0.28
Black-Litterman/Bayesian Techniques	0	0.08
Portfolio Resampling	0.05	0.25
Other	0.23	0.08

3.3 Performance Evaluation

The risk-adjusted performance measures, which evaluate the average excess return obtained in the managed portfolio considering the risk taken by the portfolio manager, are used to evaluate the ex-post performance of the portfolio.

3.3.1 Portfolio Absolute Performance

Initially respondents are asked which absolute risk-adjusted ratios they use. As indicated in table 8, Sharpe ratio and Treynor ratio are the most widely common measure in both countries. This result is corresponding to the fact that volatility and factor models are widely used in the process of portfolio construction. The other commonly used performance measure is average return in excess of risk-free rate which does not count for the risk taken. As it is indicated in table 3.8, applying Sharpe ratio and/or average return in excess of risk-free rate confirms that respondents use non-sophisticated methods. It is used by 56% of respondents in India and 23% of respondents in Iran.

Table 3.8 Portfolio Absolute Performance

Absolute Performance	Iran	India
Sharpe Ratio	0.59	0.64
Treynor Ratio	0.59	0.28
Sortino Ratio	0.27	0.04
Measures based on VaR	0.09	0.28
Average return in excess of risk-free rate	0.23	0.56
Other	0.14	0.04

Surprisingly, Sortino ratio which considers semi-variance as risk adjustment is used by 27% of respondents from Iran which indicates the awareness of the respondents of the post-modern financial theories. This ratio is used by only 4% of respondents in case of India. Measures based on VaR are used by 9% of respondents in Iran and 28% of respondents in India, which implies the emphasize on tail risks by Indian institutions.

3.3.2 Portfolio Relative Performance

Assuming that the performance of a fund manager would be evaluated against a benchmark, the respondents are asked about the relative performance measures. The results are shown in table 9. Jensen's alpha extracted from CAPM is among the most widely used methods in both countries follows by using the naïve average return difference with a broad market index, which does not consider about the risk taken. Next most widely measure is the information ratio which considers the standard deviation of tracking error as the risk measure. It is used by 36% of respondents in India and 18% of respondents from Iran.

Table 3.9 Portfolio Relative Performance

Relative Performance	Iran	India
M-squared (Modigliani&Modigliani)	0.14	0.04
Graham-Harvey Measures	0.05	0.00
Jenson's alpha	0.59	0.52
The Information Ratio	0.18	0.36
Adapted information Ratio/ VaR-based measure	0.05	0.00
Tail risk of tracking error	0.05	0.00
Average Return difference with a broad market index	0.50	0.44

3.3.3 Managers' Alpha Measurements

Finally, the respondents are asked how they analyse manager's alpha which is the return in excess of a "normal" return on a reference portfolio. Alpha is, in other words, the "abnormal" return. As table 10 Shows, 72% of respondents in India consider absolute performance in a peer group to analyse the manager's alpha. This might not be the best approach as peer groups sometimes are not good proxies because risk exposures can vary greatly from one managed portfolio to another (Amenc 2011). Comparatively peer group analysis is less commonly used by respondents from Iran (only 23% of respondents).

Table 3.10. Managers' Performance (Alpha)

Manager's alpha	Iran	India
multifactor models	0.05	0.12
single-factor models, such as CAPM	0.36	0.64
return-based style analysis	0.32	0.24
Absolute performance in a peer group	0.23	0.72
Other	0.09	0.04

Single-factor model which is based on CAPM are widely used by the institutions in both countries. However, alpha from multifactor models is not a common approach among respondents of both countries. According to Amenc et.al (2011) this indicate that practitioners are reluctant to use other multifactor models, probably because the ongoing debate in the asset-pricing literature about the right risk factors. In contrast, return-based style analysis which is a specific case of multi-factor models and facilitate the decomposition of the excess return into various risk factors, is among the widely used methods in calculating the manager's alpha with 32% and 24% of respondents from Iran and India respectively.

3.3.4 Comparing the results base on Sophistication/Non-sophistication Criteria

In the table below, we summarized the outcomes of the survey and commented whether practices in India and Iran are sophisticated or non-sophisticated accordingly.

Table 3.11. Summary of Findings

Methods	Comments	Sophistication/ non-sophistication
Absolute risk	Variance/volatility dominates in both countries, participants from India are well aware of downside risk measures in the process of portfolio optimization	Mostly adoption of non-sophisticated measures. India seems to be more sophisticated than Iran setting downside measures in the process of portfolio optimization.
Relative risk	Tracking error dominates in both countries, however respondents from India are relatively more aware of downside risk measures relative to a benchmark than participants from Iran	Mostly adoption of non-sophisticated measures. India seems to be more sophisticated than Iran.
Covariance matrix	explicit factors models seem to be the dominant method in both countries. Participants from India seem to adopt	Mostly adoption of sophisticated measures.

Methods	Comments	Sophistication/ non-sophistication
	Implicit factor models and Shrinkage techniques more than participants from Iran.	India seems to be more sophisticated than Iran
Extreme risk	either do not account for extreme risk measures or use VaR based on normal distribution	Non-sophisticated techniques are adopted by majority of respondent in both countries. However, some respondents in both countries adopt sophisticated techniques.
Estimation error	imposing constraints on the portfolio weights is the most common used method (nearly 70% of respondents from Iran and above 30% of respondents from India).	Overall, non-sophisticated techniques dominated. India adopts more sophisticated techniques than Iran.
Absolute performance	Sharpe ratio and Treynor ratio are the most widely common measure	Non-Sophisticated methods dominated in both countries.
Relative performance	Jenson's alpha the most widely used methods in both countries follows by using the naïve average return difference with a broad market index	Relatively Sophisticated. Well aware of market model.
Managers' alpha	Single factor model, return based analysis and absolute performance in a peer group dominate in both countries.	Non-sophisticated methods are mostly applied by participants in both Iran and India. India seems to be less sophisticated.

3.4 Multivariate Logistic Regression Results

The descriptive statistics gives a clear picture on the nature of sophistication adopted by the practitioners for portfolio construction, risk management, and performance evaluation. However, this does not explain or suggest the influence of factors that are likely to have an impact of the choice of methods and techniques used by practitioners. Hence, to gauge the impact of the factors or characteristics that are likely to influence or explain the choice of sophisticated methods and techniques by the practitioners, we carry out a logistic regression exercise.

We adopt the framework suggested in Amenc et al. (2011). The researchers adopted a logistic regression framework to test the influence of firm level and country characteristics on the nature of portfolio construction techniques, risk management methods, and performance evaluation metrics used by fund managers in European countries.

To this end we leverage the information collected in the first part (part A) of the survey (questionnaire) which captures the firm and practitioner level data. For this purpose, the respondents are categorized based on the information provided in the first part of the questionnaire which captured responses to the three main questions as given below:

- What is the type of firm responding to the questionnaire?
- What type of investment services the respondent firm offers?
- How much is the asset under management of the respondent firm?

We considered the answers to these questions as along with country the respondent firm belongs to as the independent variables. Therefore, in overall we categorized our independent variables into Type of Firm, Type of Services, Size of Firm and Country and later we assigned dummy values to them. The respondents, therefore, are defined as below dummies based on the responses we received.

- Type of firm:

Type dummy equal to 1 for Investment Banks, 2 for Asset Management Firms and 3 for Private Banks.

- Type of services:

Type of service dummy equal to 1 for No Active, 2 for No Passive and 3 for Diversifies. No passive indicates that the respondent adopts other strategies than passive investment strategy. No active implies that the firm offer other investment services than active, and diversified means that the respondent either offer more than one services or provides multi management products which is known as Fund of Fund (FoF).

- Size of firm:

Regarding the size of the firm, we categorized the respondents as per the asset under their management (we merged the given options given in the question in Lakh Crore India Rupees and adjusted it based on the same denomination in case of Iran. Our dummy values for Size variable are 1 for asset under management less than 0.05 Lakh Crore Indian Rupees, 2 for 0.05-0.5 Lakh Crore Indian Rupees and 2 for more than 0.5 Lakh Crore Indian Rupees.

- Country location:

For the Country variable we considered it as a dummy variable equal to 1 in case of India and 2 in case of Iran.

We later categorized our dependent variables based of the sophistication or non-sophistication of methods and techniques applied. The lists of unsophisticated techniques are given in Table 3.1 and Table 3.2. The dependent variables are binary in nature, which is adoption of non-sophisticated methods or adoption of sophisticated methods. The logistic regression is estimated using SPSS 16 software and the results are collated. The focus of the current exercise is to understand the likely influence of firm level characteristics capture in the questionnaire.

However, a caveat is in order that we are cognizant that a multitude of factors other than the characteristics capture above (at the firm level) might be influencing the nature of sophistication used by practitioners. Notwithstanding this, for brevity we discuss the summary results from the logistic regression framework for each segment viz. risk measures, covariance matrix, estimation errors, and performance evaluation metrics separately to gauge the likely influence of firm level characteristics on the nature of sophistication adopted by the practitioners.

3.5 Findings of Multivariate Logistic Regression Analysis:

3.5.1 Absolute Risk Measure:

To understand the impact of independent variables (Size, Type, Type of Service, and Country) in adoption of sophisticated or non-sophisticated absolute risk measures we ran a logistic multivariate regression analysis in two steps. First, we considered our dependent variable to be equal to 1 if the respondents do not account for any absolute risk measures (i.e., they selected option No) and 0 otherwise. The results shows that all the coefficients are insignificant indicating that type of firm, type of services they offer to investors, their country of origin, and the size of asset under their management do not affect the approach of firms in not considering the absolute risk measures in portfolio optimizations. We ran another regression analysis for those firms which either do not set any absolute risk objective or consider non-sophisticated (variance or volatility) absolute risk measure in portfolio optimization. The results also suggest that none of firms' characteristics has any impact in firms' approach on using non-sophisticated absolute risk measures.

3.5.2 Relative Risk Measures

In next regression analysis we examined those firms that do not account for relative risk measures in order to find out whether any of characteristics impact such firms to not take into

account the relative risk measures. In this case also, it is observed that all the coefficients are insignificant indicating that region, type of service, asset under management and country of origin do not have any impact on firms' approach on not accounting for relative risk measures in portfolio optimization. Further, the characteristics of the firms are analysed to understand whether they have any impact on behaviour of firms in either not accounting relative risk measure into account or adopting considering tracking error relative to a benchmark which is a non-sophisticated measure of relative risk. It is observed that those firms which offer no active type of service have higher odds to set tracking error as a relative risk objective in portfolio optimization compared to those which offer no passive or diversified type of service.

3.5.3 Estimation of Covariance Matrix

Estimation of covariance matrix through calculating sample covariance matrix is considered as a non-sophisticated method. For understanding whether any characteristics have an impact in the firm approach on adoption of this non-sophisticated model we ran a multivariate logistic regression analysis. It is observed that all the coefficients are insignificant and have no impact on firms' approach to use non-sophisticated method i.e., sample covariance matrix.

3.5.4 Extreme Risk

We tried to explain the impact of different independent variables related to type, type of services, assets under management and country of origin in firms' decision about methods to be used to capture the extreme risks which is the probability of return distribution to fall below a certain level known as disaster level or target level. We ran regression analysis first considering those firms not accounting for extreme risks in order to find out whether any of firms' characteristics is accountable for not considering extreme risks. It is observed that coefficients for all the variables are insignificant and indicating that none of the characteristics of firms have any impact on firms decision about not taking extreme risks into account.

Another regression analysis considers those firms that either do not account for extreme risk or calculate VaR based on assuming normal distribution of returns. This is again considered to be a non-sophisticated approach. It is observed that firms having lesser asset under management have more odds to calculate the extreme risk measure using value at risk based on normal distribution. However, it is observed that firms with no active type of service are more likely to calculate the extreme risk measure by value at risk based on normal distribution than the firms with diversified as type of service.

3.5.5 Estimation Risk

Dealing with estimation error in the process of portfolio optimization is a difficult task which acquires knowledge and expertise as well as well-established quantitative tools. Imposing weights on the portfolio weights is considered to be the least sophisticated technique among others. In this part we ran a multivariate logistic regression analysis to find out whether any impact on fund managers' decisions to adopt non-sophisticated models to address the problem of estimation errors. It is observed that firms from India are less likely to adopt non-sophisticated models than Iranian firms. In other words, Iranian firms have higher odds to deal with estimation risk using weight constraints than the Indian firms. The effect of other factors is insignificant and has no impact the way firms deal with estimation risk. It can be concluded that firms are independent in this matter no matter what the type of services are, and how much is assets under their management. These factors do not have any impact on adopting non-sophisticated techniques by firms to tackle the problem of estimation risk.

3.5.6 Portfolio Absolute Performance

Sharpe ratio is considered to be relatively unsophisticated risk-adjusted ratio which indicates risk premium by considering standard deviation as a measure of risk. Average excess return, which is the excess return of investment minus the risk-free rate is also considered to be a non-

sophisticated method to evaluate a portfolio performance. For understanding the impact of firm's characteristics on adoption of non-sophisticated methods in evaluation of their portfolio performance, we ran three multivariate regression analysis.

First, we considered those firms which use Sharpe ratio as a measure of performance evaluation, second time we studied those firms which consider the average excess risk to understand the portfolio performance. Lastly, we perform regression analysis for those firms which consider Sharpe ratio or average excess return. It is observed that country of origin, asset under management, type of companies and type of services they offer have no impact on the behaviour of firms to measure the absolute performance using Sharpe ratio. Similarly, for the firms using Sharpe ratio only to measure the absolute performance.

It is observed that firms from India are more likely to measure the absolute performance using average excess returns than the firms belong to Iran. Impact of other factors remains insignificant indicating that they no impact on deciding the way the absolute performance is measured.

Using odd ratio for the firms using sharp or average excess returns to measure the absolute performance, similar conclusions can be drawn. Firms from India have higher odd ratio in favour of Sharpe or average excess returns methods to measure absolute performance than the firms belonging to Iran. Impact of type of service and asset under management are insignificant.

3.5.7 Portfolio Relative Performance

For understanding the impact of firm's characteristics on firms' approach in selecting non-sophisticated measures of relative performance, we ran three multivariate regression analysis with three different scenarios and the odd ratio for measure of relative performance are arrived.

- firms that use average excess return relative to a benchmark as relative performance measure
- firms using information ratio as a relative performance measure
- firms using information ratio or average excess returns relative to a benchmark as relative performance measure

However, it is observed that coefficients are insignificant in all three specifications indicating that the impact of country of origin, type of service and other factors is insignificant in selecting the method to measure the relative performance.

3.5.8 Managers' Alpha

Finally, we are keen to understand that whether deciding to measure a fund manager's performance through non-sophisticated approaches like analysis their performance in a peer is influence by any four characteristics of the company. The results suggest that the country of origin has an impact in selecting an unsophisticated approach (peer group analysis) and that firms from India are more likely than firms from Iran to analyse managers performance in a peer group. Impact of other factors is insignificant.

3.6 Conclusion

In this chapter, we examined portfolio construction, risk management and performance evaluation approach of Indian and Iranian asset management companies through a survey. Later, the collected data was analysed descriptively and by using a multivariate logistic regression analysis. The descriptive analysis reveals that Indian respondents seem to adopt various sophisticated measures in addition to the non-sophisticated ones in the process of portfolio optimization. On the other hand, it seems that respondents from Iran use more sophisticated measures to evaluate the ex-post performance than respondents from India.

The multivariate logistic regression analysis reveals that in most cases the characteristics of firms do not have any impacts in adoption of particular non-sophisticated methods in both portfolio construction and performance evaluation. However, in the following cases the characteristics of firms play a role in firms' approach towards adoption of non-sophisticated methods in portfolio optimization and performance measurement,

- Those firms offering no active service tend to adopt tracking error relative to a benchmark as a non-sophisticated relative risk measures in portfolio optimization.
- Relatively smaller firms with lesser asset under their management, and firms that do not offer active investment services seem to adopt non-sophisticated approach in calculation of Value at Risk. i.e., they either do not account for extreme risk or calculate value at Risk (VaR) based on models which assume that asset returns are normally distributed.
- Iranian firms have higher odds to deal with estimation risk using non-sophisticated weight constraints technique than the Indian firms.
- In performance part, we observe that firms from India have higher odd ratio in favour of considering Sharpe or average excess returns to measure absolute performance than the firms from Iran.

Chapter 4. Comparative Analysis between India, Iran, Brazil, and Europe

4.1 Introduction

In this chapter we present the results of our survey in India and Iran and compare those with secondary survey results of Eid and Junior (2018) for Brazil and Amenc et al. (2011) for Europe, containing most of the modern and post-modern portfolio risk measures and risk and return estimation models. Finally, we compare the results of these surveys pairwise i.e., India-Iran, India, Brazil, India-Europe, Iran-Brazil and Iran-Europe to compare the rate of adoption of various portfolio construction and risk management, as well as performance evaluation techniques. For this we applied Pearson's Chi square test with 2 degrees of freedom.

4.2 Absolute Risk Measure

Table 4.1 captures the results of Chi square test. It can be observed that firms from both India and Iran use non-sophisticated (Variance/Volatility) measures of absolute risk. The difference in adoption of sophisticated measures (VaR/CVaR) are statistically significant at 1% level. A relatively higher percentage of Iranian firms tend to use tail risk than their Indian counterparts. The difference in the use of sophisticated and non-sophisticated measures of absolute risk between the two countries is statistically significant at 1%, 5% and 10%. Further, there is no statistically significant difference between firms in India and Europe in terms of adoption of non-sophisticated (Variance/Volatility) measures of absolute risk. However, there is statistically significant difference between Europe and India in adoption of sophisticated risk measures of absolute risk at 1% level. Higher percentage of European firms seem to use sophisticated measures (tail risk and downside risk) along with non-sophisticated measures (dispersion risk measures).

Table 4.1 Adoption of Absolute Risk Measures in Portfolio Construction

Absolute Risk Measures	India (%)	Iran (%)	Δ	P-Value	Sig
Variance/Volatility	52	64	-12	0.0025	***
VaR/CVaR	4	18	-14	0.0009	***
Semi-deviation/LPMs	4	9	-5	0.0821	*
	India (%)	Europe (%)	Δ	p-value	
Variance/Volatility	52	45.9	6.1	0.0474	
VaR/CVaR	4	50.7	-46.7	0.0000	***
Semi-deviation/LPMs	4	23.1	-19.1	0.0001	***
	India (%)	Brazil (%)	Δ	p-value	
Variance/Volatility	52	21.8	30.2	0.0000	***
VaR/CVaR	4	2.6	1.4	0.4966	
Semi-deviation/LPMs	4	5.1	-1.1	0.5769	
	Iran (%)	Europe (%)	Δ	p-value	
Variance/Volatility	64	45.9	18.1	0.0001	***
VaR/CVaR	18	50.7	-32.7	0.0000	***
Semi-deviation/LPMs	9	23.1	-14.1	0.0009	***
	Iran (%)	Brazil (%)	Δ	p-value	
Variance/Volatility	64	21.8	42.2	0.0000	***
VaR/CVaR	18	2.6	15.4	0.0005	***
Semi-deviation/LPMs	9	5.1	3.9	0.1423	

$p < 0.01$ (***); $p < 0.05$ (**) and $p < 0.1$ (*)

Furthermore, firms from both India and Brazil use non-sophisticated (Variance/Volatility) measures of absolute risk. However, a relatively higher share of Indian firms tend to use Variance/Volatility measure than their Brazilian counterparts. This difference in the use of Absolute Risk Measure is statistically significant at 1% level (based on Chi square test). Similarly, firms from both Iran and Europe are using non-sophisticated (Variance/Volatility) measures of absolute risk. However, a relatively higher share of Iranian firms tend to use Variance/Volatility measure than their European counterparts. This difference in the use of both sophisticated and non-sophisticated absolute risk measures is statistically significant at

1% level (based on Chi square test). Also, the adoption of non-sophistication risk measures (Variance/Volatility) is statistically significant for firms in Iran and Brazil. However, higher percentage of Iranian firms tend to use Variance/Volatility than their Brazilian counterparts. The difference in adoption of tail risk measures (VaR/CVaR) is statistically significant at 1% level. There is no statistically significant difference between firms from Iran and Brazil in non-adoption of downside risk measures.

4.3 Relative Risk Measures

The Chi square test results of comparative use of relative risk measures is presented in Table 4.2. From the table, it can be observed that there is statistically difference in adoption of tail risk relative to a benchmark between Iran and India. Indian firms adopt non-sophisticated measures (tracking error) at statistically significant level. There is statistically significant difference (at 1%) between India and Europe in setting relative risk measures. Higher share of European firms tend to not account for relative risk measures or use non-sophisticated risk measures (tracking error) than India firms. On the contrary, the Indian firms, tend to use sophisticated measures (Downside risk relative to a benchmark) three times more than European firms. Brazilian firms tend either not to set relative risk measures than India or use non-sophisticated measure (tracking error). There is a statistically significant difference in using downside measure of risk at 1% level.

Higher share of Indian firms use downside risk measures than Brazilian firms. There is no statistically difference in adoption of tail risk measures relative to a benchmark between the two countries. There is statistically significant difference (at 1%) between Iran and Europe in setting relative risk measures. Firms in Europe tend not to set relative risk measures or use non-sophisticated at statistically significant level. Further, there is no statistically difference in adoption of tail risk measures relative to a benchmark between Iran and Europe. Brazilian firms either do not put relative risk measure or using non-sophisticated measures (tracking error) in

setting relative risk measures than their Iranian counterparts. There is no statistically difference in adoption of sophisticated risk measures (Tail risk/downside risk relative to a benchmark).

Table 4.2 Adoption of Relative Risk Measures in Portfolio Construction

Relative Risk Measures	India (%)	Iran (%)	Δ	P-Value	Sig
Not used	4	14	-10	0.0067	***
Used Tracking Error	44	5	39	0.0000	***
Used Tail risk	12	18	-6	0.0498	**
Used Downside risk	36	18	18	0.0001	***
	India (%)	Europe (%)	Δ	P-Value	
Not used	4	33.6	-29.6	0.0000	***
Used Tracking Error	44	79.8	-35.8	0.0000	***
Used Tail risk	12	18.8	-6.8	0.0334	**
Used Downside risk	36	12.7	23.3	0.0000	***
	India (%)	Brazil (%)	Δ	P-Value	
Not used	4	51.3	-47.3	0.0000	***
Used Tracking Error	44	34.6	9.4	0.0091	***
Used Tail risk	12	19.2	-7.2	0.0273	**
Used Downside risk	36	11.5	24.5	0.0000	***
	Iran (%)	Europe (%)	Δ	P-Value	
Not used	14	33.6	-19.6	0.0001	***
Used Tracking Error	5	79.8	-74.8	0.0000	***
Used Tail risk	18	18.8	-0.8	0.6703	
Used Downside risk	18	12.7	5.3	0.0707	*
	Iran (%)	Brazil (%)	Δ	P-Value	
Not used	14	51.3	-37.3	0.0000	***
Used Tracking Error	5	34.6	-29.6	0.0000	***
Used Tail risk	18	19.2	-1.2	0.5488	
Used Downside risk	18	11.5	6.5	0.0388	**

$p < 0.01$ (***); $p < 0.05$ (**) and $p < 0.1$ (*)

4.4 Methods of estimation of Covariance Matrix

There is statistically significant difference between Iran and India in using covariance matrix estimation models at (1% and 5%). This difference shows that higher share of firms from India tend to use non-sophisticated (sample covariance matrix) as well as sophisticated models such as explicit factors models, implicit factor models and optimal shrinkage techniques. The results from Chi square test are presented in Table 4.3.

Most of the firms in both India and Europe use sample covariance matrix which is a non-sophisticated manner. However, there is a statistically significant difference in adoption of non-sophisticated method (sample covariance) at 1% level. European firms tend to relatively use sample covariance method more than Indian firms. Surprisingly, Indian firms tend to use sophisticated techniques such as Optimal Shrinkage Technique relatively more than their European counterparts in the estimation of covariance matrix. Also, there is no significant difference between firms in India and Europe in adoption of (Implicit) statistical models. However, the share of firms of applying such models is relatively low (around 12%) in both India and European countries.

The results of comparison of covariance matrix estimation between India and Brazil reveals that the difference in adoption of non-sophisticated technique statistically significant at 1% level. Lesser share of Indian firms tend to use unsophisticated techniques of estimation of covariance matrix than Brazilian firms. Also, there is statistically significant difference in adoption of optimal shrinkage technique between India and Brazil. Indian firms tend to use sophisticated technique (Optimal shrinkage technique) relatively higher than Brazilian firms.

In case of Iran and Europe, we can see Iranian and European firms have statistically significant difference in using sample covariance matrix and models with explicit factors at 1% level. European firms tend to use higher percentage of sample covariance matrix and lesser

percentage of models with explicit factors. There is a statistically significant difference (at 5% level) between European and Iranian firms in using implicit factor models. There is no statistically significant difference between Iran and Brazil in using sophisticated models such as implicit factor models and optimal shrinkage techniques.

Table 4.3 Covariance Matrix Estimation Techniques in Portfolio Construction

Estimation of Covariance Matrix	India (%)	Iran (%)	Δ	P-Value	Sig
Sample Covariance Matrix	36	27	9	0.0111	**
Models with Explicit factors	52	45	7	0.0302	**
Models with implicit factors	12	5	7	0.0302	**
Optimal Shrinkage techniques	16	5	11	0.0041	***
	India (%)	Europe (%)	Δ	P-Value	
Sample Covariance Matrix	36	59.8	23.8	0.0000	***
Models with Explicit factors	52	29.3	22.7	0.0000	***
Models with Implicit factors	12	12.7	-0.7	0.7047	
Optimal Shrinkage techniques	16	3.9	12.1	0.0024	***
	India (%)	Brazil (%)	Δ	P-Value	Sig
Sample Covariance Matrix	36	53.8	17.8	0.0001	***
Models with Explicit factors	52	19.2	32.8	0.0000	***
Models with Implicit factors	12	3.8	8.2	0.0166	**
Optimal Shrinkage techniques	16	1.3	14.7	0.0006	***
	Iran (%)	Europe (%)	Δ	P-Value	Sig
Sample Covariance Matrix	27	59.8	32.8	0.0000	***
Models with Explicit factors	45	29.3	15.7	0.0004	***
Models with Implicit factors	5	12.7	-7.7	0.0213	**
Optimal Shrinkage techniques	5	3.9	1.1	0.5769	
	Iran (%)	Brazil (%)	Δ	P-Value	Sig
Sample Covariance Matrix	27	53.8	26.8	0.0000	***
Models with Explicit factors	45	19.2	25.8	0.0000	***
Models with Implicit factors	5	3.8	1.2	0.5488	
Optimal Shrinkage techniques	5	1.3	3.7	0.1572	

p < 0.01 (***); p < 0.05 (**) and p < 0.1 (*)

Iranian and Brazilian firms have statistically significant difference in using sample covariance matrix as well as models with explicit factors at 1% level. There is no statistically significant difference between Iran and Brazilian firms in applying sophisticated models such as implicit factor models and optimal shrinkage techniques and less than 5% of respondents in both Iran and Brazil use these methods for estimation of covariance matrix.

4.5 Extreme Risks

There is statistically significant difference between India and Iran in using non-sophisticated models for calculating VaR. Higher share of Indian firms use non-sophisticated (VaR based on normal distribution) models. There is no significant difference between India and Iran in using sophisticated methods such as VaR based on higher moments and EVT. However, there is a significant statistical difference (at 5% level) between the Indian firms that calculate Conditional Value at Risk (CVaR) compared to their Iranian counterparts (Table 4.4 presents the results of the Chi square test). Further, there is no statistically significant difference between Indian and European firms in calculating VaR based on normal distribution (unsophisticated) and applying EVT. However, the difference in using Conditional Value at Risk is statistically significant (at 1% level) and higher share of European firms calculate (CVaR) in their portfolio construction. There is statistically significant difference (at 5%) between Indian and European firms in calculating VaR considering higher moments of return distribution

Similarly, there is statistically significant difference in adoption of VaR based on normal distribution, Higher Moments and CVaR between India and Brazil. A higher share of Brazilian firms calculate VaR based on non-sophisticated methods (Normal distribution). CVaR as a sophisticated measure is used by higher percentage of firms compared to Indian firms. There is a significant difference in applying EVT at 5% level. Less Iranian firms use non-sophisticated models (VaR based on normal distribution) than European firms. The difference

between European and Iranian firms in applying sophisticated models such as CVaR is statistically significant at 1% level.

Table 4.4 Techniques for calculation of Value at Risk (VaR)

Value at Risk (VaR) Calculation	India (%)	Iran (%)	Δ	P-Value	Sig
Normal Distribution	44	5	39	0.0000	***
Higher Moments	24	23	1	0.6065	
Extreme Value Theory	12	14	-2	0.3679	
CVaR	12	5	7	0.0302	**
	India (%)	Europe (%)	Δ	p-value	
Normal Distribution	44	41	3	0.2231	
Higher Moments	24	16.6	7.4	0.0247	**
Extreme Value Theory	12	8.3	3.7	0.1572	
CVaR	12	22.3	-10.3	0.0058	***
	India (%)	Brazil (%)	Δ	p-value	
Normal Distribution	44	62.8	-18.8	0.0001	***
Higher Moments	24	7.7	16.3	0.0003	***
Extreme Value Theory	12	5.1	6.9	0.0317	**
CVaR	12	29.5	-17.5	0.0002	***
	Iran (%)	Europe (%)	Δ	p-value	
Normal Distribution	5	41	-36	0.0000	***
Higher Moments	23	16.6	6.4	0.0408	**
Extreme Value Theory	14	8.3	5.7	0.0578	*
CVaR	5	22.3	-17.3	0.0002	***
	Iran (%)	Brazil (%)	Δ	p-value	
Normal Distribution	5	62.8	-57.8	0.0000	***
Higher Moments	23	7.7	15.3	0.0005	***
Extreme Value Theory	14	5.1	8.9	0.0117	**
CVaR	5	29.5	-24.5	0.0000	***
p < 0.01 (***); p < 0.05 (**) and p < 0.1 (*)					

Iran and Brazil have statistically significant differences in applying both sophisticated and non-sophisticated methods of calculating VaR. Higher share of Brazilian firms use non-sophisticated models (VaR base on Normal distribution). However, the share of Brazilian firms using sophisticated methods such as CVaR significantly higher than Iranian firms. Iranian firms, on the other hand, apply sophisticated models such as VaR-considering higher moments and EVT than their Brazilian counterparts.

4.6 Estimation Error

There is no statistically significant difference in using Black-Litterman or other Bayesian Techniques between India and Europe. Non-sophisticated (imposing weights) is used by higher share of firms in Europe than India. Using portfolio resampling is statistically significant and adopted by Indian firms more than European firms. Further, Brazil uses non-sophisticated model for dealing with estimation error more than India. There is statistically significant difference in adoption of GMV. Higher share of Indian firms use this technique. There is no statistically significant difference in using Black-Litterman or other Bayesian Techniques. Indian firms apply non-sophisticated models (Portfolio resampling) and there is a significant gap in adoption of this technique.

There is no statistically significant difference between Iranian and European firms in the adoption of non-sophisticated techniques for tackling estimation error. i.e., in both the cases, imposing constraints on portfolio weights is the dominant approach. However, there is statistically difference between the firms in both cases in adoption of sophisticated methods for solving the problem of estimation error in the process of portfolio construction. The results of Chi-square test indicates that substantial proportion of European firms apply sophisticated methods in addressing estimation error.

Table 4.5 Techniques for Estimation Error

Methods used to tackle estimation risk	Iran (%)	India (%)	Δ	P-Value	Sig
Imposing constraints on portfolio weights	68	32	36	0.0000	***
Global Minimum Risk Portfolio	5	28	-23	0.0000	***
Black-Litterman/Bayesian Techniques	0	8	-8	0.0183	**
Portfolio Resampling	5	24	-19	0.0001	***
	India (%)	Europe (%)	Δ	P-Value	
Imposing constraints on portfolio weights	32	67.7	-35.7	0.0000	***
Global Minimum Risk Portfolio	28	17	11	0.0041	***
Black-Litterman/Bayesian Techniques	8	15.3	-7.3	0.0260	**
Portfolio Resampling	24	13.5	10.5	0.0052	***
	India (%)	Brazil (%)	Δ	P-Value	
Imposing constraints on portfolio weights	32	64.1	-32.1	0.0000	***
Global Minimum Risk Portfolio	28	5.1	22.9	0.0000	***
Black-Litterman/Bayesian Techniques	8	7.7	0.3	0.8607	
Portfolio Resampling	24	9	15	0.0006	***
	Iran (%)	Europe (%)	Δ	P-Value	
Imposing constraints on portfolio weights	68	67.7	0.3	0.8607	
Global Minimum Risk Portfolio	5	17	-12	0.0025	***
Black-Litterman/Bayesian Techniques	0	15.3	-15.3	0.0005	***
Portfolio Resampling	5	13.5	-8.5	0.0143	**
	Iran (%)	Brazil (%)	Δ	P-Value	
Imposing constraints on portfolio weights	68	64.1	3.9	0.1423	
Global Minimum Risk Portfolio	5	5.1	-0.1	0.9512	
Black-Litterman/Bayesian Techniques	0	7.7	-7.7	0.0213	**
Portfolio Resampling	5	9	-4	0.1353	

p < 0.01 (***); p < 0.05 (**) and p < 0.1 (*)

Except in case of Black/Litterman or other Bayesian approach for which the difference is statistically significant at 5% level, there is no statistical different between the practitioners' approach towards estimation error in both Iran and Brazil. Both Iranian and Brazilian firms

mostly apply non-sophisticated techniques of imposing constraints on portfolio weights, while there is no statistically significant difference between them. However, there are statistically significant differences between Indian and Iranian firms in dealing with estimation error. Iranian firms use non-sophisticated method of imposing constraints on portfolio weights twice as Indian firms. On the other hands, a higher share of Indian firms apply various sophisticated techniques in dealing with estimation errors.

4.7 Performance Evaluation

There is a statistically significant difference between India and Iran in adoption of various performance measures. Sophisticated measures such as Treynor ratio, Sortino ratio and Jensen's alpha are considered by higher share of Iranian firms. Non-sophisticated performance measures such as Sharpe ratio and absolute return and information ratio are used by higher percentage of Indian firms. M-square measure (non-sophisticated measure) is applied by higher percentage of Iranian firms than Indian firms. In case of Europe and India, the difference in performance measures is statistically significant in most cases except M-square which is statistically insignificant. Using non-sophisticated measures (Sharpe ratio, excess return relative to a benchmark and information ratio) is slightly higher in Europe. There is statistically significant difference in adoption of Jensen alpha between India and Europe and relatively higher share of Indian firms uses this measure. Further, there is statistically significant difference between firms from India and Brazil in performance evaluation. However, Brazilian firms tend to adopt slightly higher share of non-sophisticated measures than Indian firms. The only exception is the use of M-square measure which is statistically insignificant.

There is not statistically significant difference between Iran and Europe in adoption of Sortino ratio. There is statistically significant difference in applying other sophisticated and non-sophisticated performance measures between both Iran and Europe. Higher share of European firms tend to use non-sophisticated techniques such as Sharpe ratio, absolute return,

information ratio and excess return relative to a benchmark than Iranian firms. Treynor ratio and Jensen's alpha which are measures based on market model tend to be adopted by majority of Iranian firms than European firms at a significant level (1%). Except for Information ratio, there is a statistically significant difference between Iranian and Brazilian firms in performance evaluation methods. Higher share of Brazilian firms tend to use non-sophisticated techniques such as Sharpe ratio, absolute return, or excess return relative to a benchmark than Iranian firms. On the other hand, Treynor ratio and Jensen's alpha which are measures based on market model tend to be adopted by majority of Iranian firms than Brazilian firms at a significant level (1%). Sortino ratio which accounts for downside risk is considered by higher percentage of Iranian firms indicating adoption of sophisticated measures of performance evaluation.

Table 4.6 Performance Evaluation

How is Performance evaluated?	India (%)	Iran (%)	Δ	P-Value	Sig
Sharpe Ratio	64	59	5	0.0821	*
Treynor Ratio	28	59	-31	0.0000	***
Sortino Ratio	4	27	-23	0.0000	***
Absolute return	56	23	33	0.0000	***
M-squared (Modigliani&Modigliani)	4	14	-10	0.0067	***
Jenson's alpha	52	59	-7	0.0302	**
Information Ratio	36	18	18	0.0001	***
Excess Return relative to a benchmark	0	5	-5	0.0821	*
	India (%)	Europe (%)	Δ	P-Value	
Sharpe Ratio	64	77.3	-13.3	0.0013	***
Treynor Ratio	28	10.9	17.1	0.0002	***
Sortino Ratio	4	27.5	-23.5	0.0000	***
Absolute return	56	41.5	14.5	0.0007	***
M-squared (Modigliani&Modigliani)	4	3.1	0.9	0.6376	
Jenson's alpha	52	34.1	17.9	0.0001	***
Information Ratio	36	65.1	-29.1	0.0000	***
Excess Return relative to a benchmark	0	31.4	-31.4	0.0000	***

	India (%)	Brazil (%)	Δ	P-Value	
Sharpe Ratio	64	78.2	-14.2	0.0008	***
Treynor Ratio	28	7.7	20.3	0.0000	***
Sortino Ratio	4	14.1	-10.1	0.0064	***
Absolute return	56	65.4	-9.4	0.0091	***
M-squared (Modigliani&Modigliani)	4	5.1	-1.1	0.5769	
Jenson's alpha	52	15.4	36.6	0.0000	***
Information Ratio	36	19.2	16.8	0.0002	***
Excess Return relative to a benchmark	0	75.6	-75.6	0.0000	***
	Iran (%)	Europe (%)	Δ	P-Value	
Sharpe Ratio	59	77.3	-18.3	0.0001	***
Treynor Ratio	59	10.9	48.1	0.0000	***
Sortino Ratio	27	27.5	-0.5	0.7788	
Absolute return	23	41.5	-18.5	0.0001	***
M-squared (Modigliani&Modigliani)	14	3.1	10.9	0.0043	***
Jenson's alpha	59	34.1	24.9	0.0000	***
Information Ratio	18	65.1	-47.1	0.0000	***
Excess Return relative to a benchmark	5	31.4	-26.4	0.0000	***
How is Performance evaluated?	Iran (%)	Brazil (%)	Δ	P-Value	Sig
Sharpe Ratio	59	78.2	-19.2	0.0001	***
Treynor Ratio	59	7.7	51.3	0.0000	***
Sortino Ratio	27	14.1	12.9	0.0016	***
Absolute return	23	65.4	-42.4	0.0000	***
M-squared (Modigliani&Modigliani)	14	5.1	8.9	0.0117	**
Jenson's alpha	59	15.4	43.6	0.0000	***

$p < 0.01$ (***); $p < 0.05$ (**) and $p < 0.1$ (*)

4.8 Managers' Alpha

There is a statistically significant difference between India and Iran in applying both sophisticated and non-sophisticated performance methods for measuring managers alpha (at 1% and 5%). Relatively higher share of Indian firms analyse managers' alpha in a peer group than Iranian firms. Single factor Model (CAPM) and multi-factor models are also more popular

methods of measuring managers' alpha in Indian firm than Iranian firms. However, higher share of Iranian firms apply style analysis to measure alpha (Chi square test results are presented in Table 4.7). There is statistically significant difference between Indian and European firms in methods they apply for measuring managers' alpha. Higher percentage of Indian firms use sophisticated methods such as CAPM along with non-sophisticated ones (peer group analysis). However, higher share of European firms apply sophisticated methods such as multi-factor models and style analysis than Indian firms.

Regarding the managers' alpha, there is a statistically significant difference between Indian and Brazilian firms in adopting sophisticated performance measures such as Single factor model (CAPM) and style analysis. Higher share of Indian firms tend to use CAPM and higher share of Brazilian firms adopt style analysis in calculation of managers' alpha. There is a statistically significant difference (at 10%) between India and Brazil in measuring managers' alpha by using peer group analysis and this method is the most common method in case of both India and Brazil.

Further, there is no statistically significant difference between Iran and Europe in applying sophisticated measure (style analysis) and this measure is commonly used in case of both Iran and Europe. There is a statistically significant difference between both Iran and Europe in applying both non-sophisticated and sophisticated measures. Higher share of European firms use non-sophisticated measure (peer group analysis) than Iranian firms. However, CAPM is applied by higher percentage of Iranian firms and multi-factor models by higher share of European firms. Furthermore, there is no statistically significant difference between Iran and Brazil in applying multi-factor models in evaluation of managers' alpha. Less than 10% of firms from both counties use this method for measuring managers' alpha. However, the difference between Iran and Brazil in applying other performance measures (both sophisticated and non-sophisticated) is statistically significant. Higher share of Brazilian firms use non-

sophisticated measure (peer group analysis) than Iranian firms. Market model (CAPM) is a popular technique in Iranian firms and style analysis the popular one in measuring managers alpha in Iran and Brazil respectively.

Table 4.7 Managers' alpha

Managers alpha	India (%)	Iran (%)	Δ	P-Value	Sig
Multifactor models	12	5	7	0.0302	**
Single-factor models (such as CAPM)	64	36	28	0.0000	***
Performance attribution or style analysis	24	32	-8	0.0183	**
Peer group analysis	72	23	49	0.0000	***
	India (%)	Europe (%)	Δ	p-value	
Multifactor models	12	21.4	-9.4	0.0091	***
Single-factor models (such as CAPM)	64	26.6	37.4	0.0000	***
Performance attribution or style analysis	24	35.4	-11.4	0.0033	***
Peer group analysis	72	56.8	15.2	0.0005	***
	India (%)	Brazil (%)	Δ	p-value	
Multifactor models	12	9	3	0.2231	
Single-factor models (such as CAPM)	64	17.9	46.1	0.0000	***
Performance attribution or style analysis	24	69.2	-45.2	0.0000	***
Peer group analysis	72	66.7	5.3	0.0707	*
	Iran (%)	Europe (%)	Δ	p-value	
Multifactor models	5	21.4	-16.4	0.0003	***
Single-factor models (such as CAPM)	36	26.6	9.4	0.0091	***
Performance attribution or style analysis	32	35.4	-3.4	0.1827	
Peer group analysis	23	56.8	-33.8	0.0000	***
	Iran (%)	Brazil (%)	Δ	p-value	
Multifactor models	5	9	-4	0.1353	
Single-factor models (such as CAPM)	36	17.9	18.1	0.0001	***
Performance attribution or style analysis	32	69.2	-37.2	0.0000	***
Peer group analysis	23	66.7	-43.7	0.0000	***

4.9 Conclusion

In overall, Iranian firms are using less unsophisticated methods in portfolio construction and performance evaluation than Indian firms. Comparing India and Europe shows that Indian firms tend to adopt less unsophisticated and more sophisticated methods in portfolio optimization decisions they make than their European counterparts. However, Brazilian firms seem to apply more sophisticated techniques than Indian firms. In case of Iran, the results show that Iranian firms tend to adopt less unsophisticated and more sophisticated techniques in portfolio construction and performance evaluation than both European and Brazilian firms.

Chapter 5- Efficiency of Equity Funds in India and Iran

5.1 Introduction

This chapter presents the results of efficiency tests conducted using Data Envelopment Analysis (DEA) to examine the efficiency of equity funds in India and Iran and how the adoption of sophisticated and non-sophisticated methods of portfolio construction and performance evaluation affects the efficiency of equity funds in both Indian and Iranian mutual funds. We first give a brief introduction to Data Envelopment Analysis (DEA) and the related literature using DEA for evaluation of performance of mutual funds. We continue by explaining methodology, how samples are selected and analysed. Finally, we bring the results and findings and give the concluding and remarks.

5.2 Review on studies on Performance of Mutual Funds

Pandow (2017) studied Mutual Fund industry in India from its inception in 1963 till 2011 in terms of growth in number of funds, growth in number of schemes, fund mobilization, growth in asset under management, mobilization of household savings and concluded that although the mutual fund industry has witnessed sufficient growth in all the parameters. They observe that the sector yet has not been able to utilize its potential fully. On almost on all parameters, it is far behind the developed economies and even most of the emerging economies of the world. Eliasu (2014) used Treynor-Mazuy (1966) model and Henriksson- Merton (1981) model to examine market timing and selectivity performance of mutual fund managers in Ghana. Market timing refers to managers' forecasts of price movement of the general stock market as a whole and selectivity refers to managers' forecasts of price movements of selected individual stocks (Fama (1972) given in Eliasu(2014). The results showed that in general, fund managers in Ghana failed in both criteria i.e., to select stocks efficiently as well as to predict both the magnitude and direction of future market returns.

In a similar attempt, Pandow (2017) studied the persistence of performance of fund managers in India over five years (2007-2011) to test fund managers ability to consistently select efficient stocks as well as their market timing skills through Henriksson & Morton; Jensen, and Fama's models. The results showed persistency in selectivity skills but failing in consistency of timing skills of fund managers in Indian context.

According to Tripathy (2017) , despite the extensive literature on performance of mutual funds, no consensus has been reached so far. Also, there is no evidence of undertaking such research to evaluate the performance of Indian Mutual Fund post 2008 financial crisis. Therefore, the author applied absolute performance measures such as Sharpe ratio, Treynor ratio, Sortino ratio and Modigliani and Modigliani (M-square) to evaluate performance of funds and fund managers over five years (2008-2014). Jensen's alpha was also applied by the author to determine the selectivity skill of fund managers. Finally, to understand the persistency of fund managers' performance, information ratio was used. Market timing ability of the mutual fund managers was captured by using Treynor-Mazuy (TM) and Henriksson-Merton (HM) quadratic regression model. The result of this study reveals that the outperformance of mutual fund managers based on Jensen alpha, Sharpe ratio, Treynor ratio and M-square measures. The findings of market timing skills from both models also reveals outperformance of fund managers indicating superior market timing skills of fund managers in Indian mutual funds over the period of study.

Devaney et. al (2016) analysed the performance of 188 mutual funds relative to risk/return frontier considering transaction costs. For this purpose, they used directional output distance function, rather than the common data envelopment analysis, to estimate mutual fund performance. They compared the performance of each mutual fund relative to the capital market line (CML) and found out that in order to be consistent with the CML, majority of

mutual funds should reduce risk. They also could simultaneously increase return and decrease risk by 3.2 times if it were operated on the efficient frontier.

5.2.1 Reviews on application of DEA in performance evaluation of Mutual Funds

Data envelopment analysis (DEA) is a commonly used method for estimating the efficiency of decisions made. It takes into account the ratio of weighted sum of outputs to weighted sum of inputs as a typical measure of efficiency (Lamb and Tee (2010)). In the investment management context, one can consider mutual funds as decision making units (DMUs) and estimate the performance of their portfolio construction as per DEA method. If output is replaced by return and input replaced by risk we come up with generalized versions of risk-return ratios such as Sharpe ratio, Calmar ratio and Sortino ratio (Murthi et. al (1997), Gregoriou and Zhu (2005) as given in Lamb and Tee 2010) which are used by portfolio managers to evaluate absolute performance of funds. DEA is an excellent “data oriented” approach with a wide range of application to evaluate efficiency of different kinds of entities engaged in different activities (Cooper, Seiford and Zhu (2011)). It is also applicable not only for cross-sectional data, but time series as well. Hence, the changes in performance and efficiency of DMUs can be analysed over time using this method.

Dasgupta and Patel (2015) considered three sub-categories of mutual funds namely equity, equity ELSS based and hybrid funds and studied 15 mutual funds in India for which data was available for above five years. Using DEA, they tried to understand how different parameters influence the risk and return of mutual funds. Nik et al. (2015) aimed to separate efficient and inefficient funds as well as to identify the inefficiency resources of mutual funds. They applied a combined model of DEA and goal programming (GoDEA) approaches to analyze the return efficiency of Mutual Funds.

5.3 Methodology and Data Collection

5.3.1 Data Collection

In order to evaluate the performance of mutual funds, we collected data from published factsheets of mutual funds in India available in their official websites. Our purpose was that the secondary data collected for this part of the study i.e., evaluation of performance of the sample through DEA, to be in consistence with the time frame of data collected at the time of survey. Therefore, in order to make the results more comparable, we extracted required data from those factsheets which were available for the months of July 2019 to September 2019.

It is observed that mutual funds in India follow a systematic approach in presenting information about various schemes offered by them. Information such as category of the scheme, date of allotment, investment objective and style, Net Asset Value (NAV) for regular and direct plans with or without dividend, monthly average AUM (Asset Under Management), statistical measures such as Standard Deviation, Beta, Sharpe ratio, etc., Portfolio Turnover, Expense ratio, benchmark, information about fund manager, etc., are commonly provided in the factsheets of listed mutual funds in India.

Moreover, percentage of asset allocated in different asset classes and industries are given for each scheme. We narrowed our analysis to the oldest open-ended equity and equity-related schemes. We initially shortlisted 20 equity schemes based on the availability of data and the software limitations. Later, we removed one equity fund which showed outliers; Therefore, we ended up analysing the efficiency of 19 equity funds in the case of India, which we refer to them as Decision Making Units (DMUs). The details of the sample of 20 mutual funds for India are presented in Table 5.1 listed below.

Table 5.1 List of selected Equity and equity related funds in India

Name of fund	Category	Age of the fund in Days (as Of 25 Nov. 2022)	(Crores)	CAGR % Return Since Inception
HDFC Growth Opportunities	Large & Mid Cap	10,507	1,223.26	10.83
Aditya Birla Sun Life Equity Advantage	Large & Mid Cap	10,136	5026.85	15.99
Reliance Vision	Large & Mid Cap	9,910	2,845.04	17.78
UTI Mastershare Unit	Large Cap	13,190	5,817.09	15.44
DSP Equity Fund (DSPEF)	Multi Cap	9,341	2,551	19
Tata Large & Mid Cap	Large & Mid Cap	10,865	1,377.87	17.16
Edelweiss Large & Mid Cap	Large & Mid Cap	5,643	436.34	9.47
BNP Paribas Large Cap	Large Cap	6,637	737.95	15.77
IDBI India Top 100 Equity	Large Cap	3,846	361.4	12.4
Motilal Oswal Focused 25	Large Cap	3,483	1,076.71	12.68
ICICI Prudential Multicap	Multi Cap	10,282	3,939.96	14.38
SBI Large & Midcap	Large & Mid Cap	10,862	2,472.98	13.81
Franklin India Bluchip	Large Cap	10,909	6,899.54	18.66
IDFC Core Equity	Large & Mid Cap	6,287	2,806.60	11.23
Sundaram Diversified Equity	ELLS	8,404	2,434	16.9
Invesco India Tax Plan	Large & Mid Cap	5,810	1,011.19	10.99
LIC Multicap Fund	Multi Cap	10,816	278.93	5.93
Canara Robeco Equity Tax Saver (CRETSE)	ELLS	10,831	945.61	18.64
HSBC Large Cap Equity Fund	Large Cap	7,290	646.39	19.83

There are some differences between data collection between India and Iran. In India, all the information of various schemes offered by mutual funds are published and available in their factsheets. Most of those factsheets are archived in the official websites of mutual funds. However, data for each fund was collected directly from FIPIRAN official website as it stores

a complete data set of listed mutual fund in Iran. Our sample stood at 19 equity funds in case of Iran (Table 5.2).

Table 5.2 List of selected equity funds in Iran

Name of Fund	Category	Age of fund (in days) as of 25-nov-2022	Net Asset Under Management (in million IRR)	Return from Inception (%)
Eghtesad Novin Bank	Equity	5114	177084	1459.86
Shakhesi Karafarin	Equity	4303	343510	892.5
Yekom e Aban	Equity	1889	231609	445.81
Navid Ansar	Equity	3582	182730	614
Sina	Equity	4344	114527	2024.59
Day Bank	Equity	4211	503396	860.2
Ofogh e Roshan e Khavaremi-aneh	Equity	2259	551241	477.85
Amin Avid	Equity	3397	359825	541.82
Hamyan Sepehr	Equity	3070	441804	243.9
Karizma	Equity	3734	378571	1468.18
Servat Afarin e Tamadon	Equity	3730	2137847	1502.8
Ofogh e Mellat	Equity	1671	623235	289.63
Hafez	Equity	5387	395090	2415.62
Bazr e Omid Afarin ETF	Equity	1142	706945	27.19
Zarin e Parsian	Equity	2992	1531723	529.89
Saba	Equity	4666	437991	1194.81
Pishtaz	Equity	5341	3976119	7530.98
Saham e Bozorg e Kardan	Equity	2818	307131	242.95
Boursiran	Equity	4906	5513631	8643.54

As we see in the above table, the rate of return from inception is surprisingly very high in the range of 27.19 to 8643.54. This could, however, be justified by considering the economic condition and its high rate of inflation. Below the rate of inflation (in %) of Iran and India is given over the last five years (Table 5.3).

Table 5.3 Rate of Inflation for India and Iran (2018-2022)

Year	Rate of Inflation (%) Iran	Rate of Inflation (%) India
2018	30.22	3.43
2019	34.62	4.76
2020	36.44	6.18
2021	40.13	5.51
2022	39.99	6.89

Published by IMF, October 2022. [imf.org](https://www.imf.org), ID 294320 and ID 271322

5.3.2 Research Design

The age of selected funds was taken as an input factor to find out to what extent the age of DMUs influences the performance of that particular fund. The age of funds is given in days calculated from the date of allotment as an inception date up to 25th of November 2022 for each selected scheme. Our sample implies that, in most cases Large and Midcap, and Large Cap funds are the oldest equity schemes offered by each mutual funds, followed by Multi Cap and ELSSs (Equity Linked Savings Schemes). Therefore, among selected 19 schemes 8 are Large and Midcap Funds, 6 are Large Cap Funds, 3 are Multi Cap Funds, and 2 are ELSS funds. Another input factor considered for evaluation of sample funds' performance is the size of asset under management in each scheme. The average asset under management (AAUM) (given in Crore Rupees) are either for the month of July 2019 or August 2019, except for two cases that the factsheets belong to the month of January 2020. However, since the time window is not very wide, and also the average AUM is considered, we believe that this difference in the time of reports does not have significant impact on the result of this study. We considered Compound Annual Growth Rate (CAGR) Returns (%) from inception as our output factor.

5.4 Efficiency Analysis

To test the efficiency of performance of selected funds we used a free version of DEA Frontier add in Excel version which allows maxim 20 DMUs entry. This suits our purpose as the number of DMUs in both India and Iran was less than 20. To run an efficiency test in DEA, it is necessary to enter data as per the given format to make sure a smooth and error free result. In the first attempt, the list of DMUs, inputs (age of fund and asset under management) and output (return from inception) were entered, and efficiency test was run. The input and output data extracted from companies' factsheets in case of India and FIPIRAN portal in case of Iran and fed into DEA. The results of DEA indicate the actual efficiency of a particular fund. Our aim is to understand how adoption or not adoption of sophisticated techniques in portfolio and risk management affected the fund performance. For this purpose, we defined a model based on definition of sophistication or non-sophistication given by Amenc et al. (2011) whci are given in Chapter 3 (Tables 3.1 and 3.2).

In the next stage, we counted the frequency of choosing a sophisticated measures and models applied by a particular firm by analysing primary data collected via the questionnaire. We then calculated the percentage of the sophistication of each mutual fund in a range of 0-1, and ranked them accordingly. For developing a sophistication model and to run the efficiency test, we defined a model considering those mutual funds for which the level of sophistication is equal or more than 0.5 as sophisticated fund and unsophisticated otherwise. Table 5.4. and Table 5.5 and table show the sophistication percentage and assigned ranks of selected funds in India and Iran respectively.

Table 5.4 Ranking of funds in India based on the level of sophistication of applied techniques

No. of DUM	Name of DUM	Sophistication of respected firm (%)	Rank
1	Franklin Tempelton	1	1
2	DSP	0.875	2
3	HSBC	0.75	3
4	Investco	0.75	3
5	Aditya Birla Sun Life	0.625	4
6	UTI	0.625	4
7	Tata	0.625	4
8	BNP Paribas	0.625	4
9	ICICI Prudential	0.625	4
10	Edelweiss	0.500	5
11	IDBI	0.500	5
12	SBI	0.500	5
13	IDFC	0.500	5
14	HDFC	0.375	6
15	Reliance Nippon Life	0.375	6
16	Sundaram	0.375	6
17	Canara Robeco	0.375	6
18	Motilal Oswal	0.250	7
19	LIC	0.250	7

Table 5.5 Ranking of funds in Iran based on the level of sophistication of applied techniques

No. of DMUs	Name of DMU	Sophistication of respected firm (%)	Rank
1	Saham e Bozorg e Kardan	0.875	1
2	Eghtesad Novin Bank	0.750	2
3	Zarin e Parsian	0.750	2
4	Yekom e Aban	0.750	2
5	Ofogh e Mellat	0.625	3
6	Charisma	0.625	3
7	Pishtaz	0.625	3
8	Boursiran	0.500	4
9	Saba	0.500	4
10	Amin Avid	0.500	4
11	Servat Afarin e Tamadon	0.500	4
12	Day Bank	0.375	5
13	Shakhesi Karafarin	0.375	5
14	Bazr e Omid Afarin ETF	0.375	5
15	Navid Ansar	0.75	6
16	Sina	0.375	7
17	Hamyan Sepehr	0.125	8
18	Ofogh e Roshan e Khavaremineh	0.125	8
19	Hafez	0.125	8

In the next step, we ran the efficiency test using DEA for the listed funds for both India and Iran by taking into account their level of sophistication. We also defined an alternative model to answer the following questions:

- What would be the efficiency of the unsophisticated funds if they adopt sophisticated techniques?
- What would be the efficiency of the sophisticated funds if they follow unsophisticated techniques?

The purpose of designing the alternative model was to find out the possibility of improvement in efficiency of funds if they switch from sophisticated to unsophisticated approach or vice versa. Therefore, we switched the sophistication index for the funds under study in case of both India and Iran and ran the efficiency test using DEA. We represented the results of DEA efficiency test without model, with model and with alternative model in the Table 5.6 and Table 5.7 below.

Table 5.6 Results of DEA Efficiency Tests in case of India

No. of DMU	Name of DMU	Efficiency		
		Actual	With Model	With Alternative Model
1	HDFC Growth Opportunities Fund	0.31544	0.315444	0.58932
2	Aditya Birla Sun Life Equity Advantage Fund	0.43333	0.806354	0.43333
3	Reliance Vision Fund	0.49867	0.541916	0.99369
4	UTI Mastershare Unit Scheme	0.32154	0.778618	0.32154
5	DSP Equity Fund (DSPEF)	0.56963	0.958144	0.56963
6	Tata Large & Mid Cap Fund	0.48039	0.865356	0.60322
7	Edelweiss Large & Mid Cap	0.63254	0.659757	0.65976
8	BNP Paribas Large Cap Fund	0.72943	0.856077	0.81997
9	IDBI India Top 100 Equity Fund	1.00000	1.000000	1.00000
10	Motilal Oswal Focused 25 Fund	1.00000	1.000000	1.00000
11	ICICI Prudential Multicap Fund	0.38416	0.725164	0.38416
12	SBI LARGE & MIDCAP FUND	0.36504	0.696420	0.38290
13	Franklin India Bluchip Fund	0.46985	0.940998	0.46985
14	IDFC Core Equity Fund	0.49065	0.635679	0.49065
15	Sundaram Diversified Equity	0.54594	0.588409	0.99152
16	Invesco India Tax Plan	0.55978	0.660572	0.56790
17	LIC Multicap Fund	0.61962	0.619621	0.89092
18	Canara Robeco Equity Tax Saver Fund (CRETSE)	0.57451	0.574514	1.00000
19	HSBC Large Cap Equity Fund	0.89412	1.000000	1.00000

Table 5.7 Results of DEA Efficiency Tests in case of Iran

No. of DMU	Name of DMU	Efficiency		
		Actual	With Model	With Alternative Model
1	Eghtesad Novin Bank	0.59855	1.00000	0.59855
2	Shakhesi Karafarin	0.38671	0.38671	0.41871
3	Yekom e Aban	0.39826	0.47896	0.39826
4	Navid Ansar	0.34388	0.34388	0.34388
5	Sina	1.00000	1.00000	1.00000
6	Day Bank	0.34708	0.34708	0.39257
7	Ofogh e Roshan e Khavaremianeh	0.28122	0.28122	0.28151
8	Amin Avid	0.27950	0.38101	0.27950
9	Hamyan Sepehr	0.12802	0.12802	0.13015
10	Charisma	0.69630	0.96837	0.69630
11	Servat Afarin e Tamadon	0.34004	0.34894	0.34004
12	Ofogh e Mellat	0.18805	0.19174	0.18805
13	Hafez	0.84956	0.90512	1.00000
14	Bazr e Omid Afarin ETF	0.01912	0.01912	0.01912
15	Zarin e Parsian	0.16036	0.16537	0.16036
16	Saba	0.46155	0.66812	0.46155
17	Pishtaz	1.00000	1.00000	1.00000
18	Saham e Bozorg e Kardan	0.15002	0.19785	0.15002
19	Boursiran	1.00000	1.00000	1.00000

In the tables above, the efficiency ranges between 0 and 1. Numbers close to zero indicate less efficiency and numbers close to 1 imply more efficiency. Number 1 indicates 100% (perfect) efficiency.

5.5 Findings

First, we calculated the difference between the actual efficiency and model efficiency i.e., the difference in efficiency of funds without using sophisticated models and efficiency of funds with using sophisticated models. Then we calculate the average of each approach to understand

what the loss is or gain of funds (on average). In case of India, the average efficiency of equity funds which are using sophisticated methods is 56.39%. We found out that such companies that already are applying sophisticated techniques, there is on average 25.02% of efficiency loss even though they are adopting sophisticated methods in their portfolio and risk management practices. Therefore, their efficiency was supposed to be 81.4% on average. For those Indian firms that do not adopt sophisticated techniques in their practices their actual efficiency is 59.23% on average. We found out that there would be 31.85% efficiency gain on average if they adopt sophisticated models in their portfolio construction and risk management as well as performance evaluation practices.

Therefore, there is a possibility of efficiency improvement for Indian companies which use less sophisticated techniques to increase their efficiency by 91.08% on average. In case of Iran, the average efficiency of equity funds which do not use sophisticated techniques is 47.93 % on average. We found out that those companies which already are applying sophisticated techniques, would improve their efficiency up to 58.18% if they applied sophisticated techniques. Therefore, there would be on average 10.235% improvement if they applied more sophisticated methods in their practices.

For those Iranian firms that do not adopt sophisticated techniques in their practices, the actual efficiency based of their current practices is 41.94%. We found out that there would not be any efficiency gain for such companies even though they adopt sophistication models provided in portfolio construction and risk management theories.

Chapter 6. Conclusion

6.1 Introduction

In this chapter the findings of the current study are presented in four parts based on the different methodologies applied in the process of data analysis as below.

6.2 Findings of the study

6.2.1 Descriptive Analysis

Based on the survey approach used by Amenc et al. (2011) for analysing the portfolio managers in Europe. We have used their approach to analyse the nature of sophistication of techniques in emerging economies by focusing on fund managers of mutual funds in India and Iran. The consolidated data points to awareness among fund managers both in India and Iran about the existence of advanced portfolio techniques and measures. But it is observed on average the fund managers use less complicated models both in India and Iran. In terms of metrics for performance evaluation, the fund managers are using the popular measures. The widely used measures in Indian and Iranian firms are Sharpe ratio, Treynor ratio, and Jensen's alpha. Further, the portfolio optimisation techniques of Indian firms include sophisticated and non-sophisticated ones. While in case of Iranian fund managers, they use of sophisticated measures for ex-post performance evaluation is higher than their Indian counterparts.

6.2.2 Logistic Multivariate Regression Analysis

Using logistic multivariate regression analysis, it is observed that none of firms' characteristics (Type, Type of service, Size of Asset Under Management, and Country of Origin) has any impact on firms' approach in not considering absolute risk measures or adoption of non-sophisticated absolute risk measures (variance/volatility).

Similarly, none of firms' characteristics has significant impact on not considering any relative risk measures. However, those firms offering no active service adopt tracking error relative to a benchmark as a non-sophisticated relative risk measures in portfolio optimization. This may imply that those firms which do not offer active services (i.e., those only follow passive strategies by replicating market index) tend to be less sophisticated and consider non-sophisticated relative risk measures than sophisticated measures.

Relatively smaller firms with lesser assets under their management, and firms that do not offer active investment services seem to adopt non-sophisticated approach in calculation of Value at Risk. They either do not account for extreme risk or calculate value at Risk (VaR) based on models which assume that asset returns are normally distributed. The regression analysis results for estimation error reveals that Iranian firms have higher odds to deal with estimation risk using non-sophisticated weight constraints technique than the Indian firms.

In performance part, we found out that firms from India have higher odd ratio in favour of considering Sharpe or average excess returns to measure absolute performance than the firms from Iran.

Results of studying the impact of firm's characteristics on the unsophisticated methods they apply to measure the relative performance of portfolio shows that all the coefficients are insignificant in all three panels (Average excess return to a benchmark, information ratio, average excess return to a benchmark, information ratio) indicating that the impact of country of origin, type of service and other factors is insignificant in selecting the method to measure the relative performance. Further, the regression analysis results indicate that firms from India are more likely than firms from Iran to analyse managers performance in a sophisticated approach which is analysing managers' alpha in a peer group.

6.2.3 Comparative Analysis based on Pearson's Chi square Test

A comparative study between India, Iran, Brazil (as examples of emerging economies) and Europe (as example of developed economy) has been conducted to examine to what extent sophisticated and non-sophisticated methods are applied by them and how they differ in their practices in portfolio construction, risk management and performance evaluation. For this purpose, a Chi-square tests is carried out on the primary and secondary data which were earlier extracted from surveys in each case.

India-Iran

The difference in adoption of absolute risk in the portfolio construction is statistically significant between India and Iran, and a relatively higher share of Iranian firms seem to adopt sophisticated measures of absolute risk. Higher percentage of Iranian firms consider tail risk relative to a benchmark as a measure of relative risk than Indian firms at a statistically significant level (1%). Indian firms significantly use more sophisticated techniques as well as more unsophisticated techniques for estimation of covariance matrix than their Iranian counterparts. Higher percentage of Indian firms calculate VaR based on normal distribution assumption, hence use non-sophisticated method than Iranian firms. On the other hand, CvaR is adopted by higher share of Indian firms. Overall, the results of Chi-square test indicate that Indian firms apply more sophisticated techniques and less non-sophisticated ones than Iranian firms in addressing estimation error in their portfolio construction practices.

Further, the results of Chi-square test indicates that there is a statistically significant difference between Indian and Iranian firms in performance measures and higher percentage of Iranian firms tend to use sophisticated performance ratios than Indian firms. Relatively higher share of Indian firms analyse fund managers' alpha in a peer group than Iranian firms. Single factor Model (CAPM) and multi-factor models are also more popular methods of measuring

managers' alpha in Indian firms than Iranian firms. However, higher percentage of Iranian firms apply style analysis to measure alpha.

India-Europe

European firms adopt sophisticated risk measures (tail risk and downside risk measures) at a significant level than Indian firms. Indian firms seem to adopt less non-sophisticated measures of relative risk than European firms. Downside risk relative to a benchmark is applied by Indian firms three times more than European firms at 1% significant level. The results of comparison of covariance matrix estimation methods between India and Europe implies that Indian firms adopt less unsophisticated and more sophisticated techniques (Except implicit factors models) for estimation of covariance matrix. There is no statistically significant difference between India and Europe in using non-sophisticated method of calculating VaR. However, Higher percentage of European firms take into account CvaR as a measure of extreme risk than Indian firms. Higher percentage of Indian firms use sophisticated techniques than European firms in addressing estimation error. Also, lower percentage of Indian firms apply non-sophisticated models for estimation error than European firms. European firms tend to consider more non-sophisticated performance measures than Indian firms in evaluation of portfolio performance. European firms seem to apply sophisticated performance measures than Indian firms for measuring manager's alpha.

India-Brazil

There is no statistically significant difference between Indian and Brazilian firms in adoption of sophisticated absolute risk measures. Less than 5% of respondents from both countries adopt less tail/downside risk measures in portfolio construction process.

However, lesser percentage of Brazilian firms seem to adopt dispersion risk measures such as variance or volatility which represent non-sophisticated measure of absolute risk. Indian firms

seem to adopt less non-sophisticated measures of relative risk than Brazilian firms. Downside risk relative to a benchmark is applied by Indian firms three times more than Brazilian firms at 1% significant level. The results of Chi-square test indicates that Indian firms tend to adopt more sophisticated approach in estimation of covariance matrix compare to Brazilian firms. Brazilian firms adopt non-sophisticated techniques in calculating extreme risk more than Indian firms. Higher percentage of Brazilian firms account for CVaR, while higher share of Indian firms consider the higher moments of return distribution to calculate VaR.

The results of Chi-square test for methods of estimation error in case of India and Brazil are same as the results between India and Europe. Indian firms seem to be more sophisticated to tackle the problem of estimation error than Brazilian firms. Both Indian and Brazilian firms apply different sophisticated techniques for measuring managers alpha at a significant level along with peer group analysis.

Iran-Europe

Higher percentage of European firms tend to set sophisticated absolute risk measures i.e., tail risk and downside risk measures in portfolio construction stage than Iranian firms. Higher percentage of European firms either do not account for relative risk or consider non-sophisticated relative risk measure (tracking error relative to a benchmark) than Iranian firms. The results show that, except Implicit Factors Models, Iranian firms tend to adopt less unsophisticated technique as well as more sophisticated technique at a statistically significant level than European countries for estimation of covariance matrix. The adoption of optimal shrinkage technique is very less (less than 5% of firms) and it is insignificant in case of both Iran and Europe. European firms tend to adopt non-sophisticated techniques for calculation of VaR more than Iranian firms. European firms are more advanced than Iranian firms in tackling the problem of estimation error while constructing their concerned portfolios. European firms

tend to use non-sophisticated performance ratios at a higher rate than Irania firms. On the other hand, higher percentage of Iranian firms tend to use sophisticated performance measures than European firms. Higher percentage of European firms adopt non-sophisticated peer group analysis than Iranian firms. Other sophisticated methods in measuring managers' alpha are also applied by participants in both Iran and Europe.

Iran-Brazil

Relatively higher percentage of respondents from Iran consider tail risk and downside risk than Brazilian firms, and the difference in adoption of VaR/CvaR between Iranian and Brazilian firms is statistically significant at 1% level. The result of comparison between Iran and Brazil is similar to the case of Iran and Europe. Iranian firms seem to use less non-sophisticated relative risk measure than Brazilian firms. Brazilian firms tend to use more non-sophisticated models and less sophisticated models for estimation of covariance matrix compared to Iranian firms. Higher percentage of Brazilian firms use non-sophisticated techniques for calculation of extreme risk than Iranian firms. Sophisticated techniques based on higher moments is popular among Irania firms, while majority of Brazilian firms prefer to calculate CvaR as a measure of extreme risk. There is no statistically significant difference between Iran and Brazil in dealing with estimation error except in case of Black/Litterman or other Bayesian approach which is significant at 5% level. Iranian firms tend to use less non-sophisticated measures in performance evaluation and more sophisticated ones than Brazilian firms. Higher percentage of Brazilian firms apply non-sophisticated methods in measuring managers' alpha. Sophisticated measures are also applied along with non-sophisticated measures in both Iran and Brazil for measuring managers' alpha.

Summary:

In overall, Iranian firms tend to use less unsophisticated methods in portfolio construction and performance evaluation than Indian firms. Comparing India and Europe shows that Indian firms tend to adopt less unsophisticated and more sophisticated methods in portfolio optimization decisions they make than European firms. However, Brazilian firms seem to apply more sophisticated techniques than Indian firms. In case of Iran, the results show that Iranian firms tend to adopt less unsophisticated and more sophisticated techniques in portfolio construction and performance evaluation than both European and Brazilian firms.

6.2.4 Efficiency Analysis based on Data Envelopment Analysis (DEA)

In case of India, the average efficiency of equity funds which are using sophisticated methods is 56.39%. We found out that such companies that are applying sophisticated techniques, there is on average 25.02% of efficiency loss even though they are adopting sophisticated methods in their portfolio and risk management practices. Therefore, their efficiency was supposed to be 81.4% on average. For those Indian firms that do not adopt sophisticated techniques in their practices, their actual efficiency is 59.23% on average. We found out that there would be 31.85% efficiency gain on average if they adopt sophisticated models in their portfolio construction and risk management as well as performance evaluation practices. Therefore, there is a possibility of efficiency improvement for Indian companies which use less sophisticated techniques to increase their efficiency by 91.08% on average.

In case of Iran, the average efficiency of equity funds which do not use sophisticated techniques is 47.93 % on average. We found out that those companies which already are applying sophisticated techniques, would improve their efficiency up to 58.18% if they applied sophisticated techniques. Therefore, there would be on average 10.235% improvement if they applied more sophisticated methods in their practices. For those Iranian firms that do not adopt

sophisticated techniques in their practices, the actual efficiency based of their current practices is 41.94%. We found out that there would not be any efficiency gain for such companies even though they adopt sophisticated models provided in portfolio construction and risk management theories.

6.3 Research Limitations

Due to the highly competitive nature of financial industry, some of respondents considered their internal information as confidential and therefore were unwilling to reveal methods applied by their respective company in constructing portfolios and managing the risks associated with it. In case of India, most of AMC's headquarters are located in Delhi and Mumbai, while data was collected by approaching AMCs branches in Hyderabad which are sales and marketing bodies in nature. As a result, most of respondents are sales Managers. Therefore, one might ponder that respondent's technical knowledge might not be as accurate as portfolio and fund managers or analysts, and therefore, the obtained results would be more accurate and reflected the real scenario more clearly if data was gathered from respondents in headquarters. This may be justified as most of sales managers are MBA finance graduates or have academic backgrounds in core finance, having a proper knowledge of investment management practices.

Another probable limitation of this study could be attributed to the sample size, which is relatively small, especially in case of Iran. The sample size corresponds to 56.8% of the population in India and 31.4% of the population in Iran. Part of this limitation is due to the occurrence of COVID-19 Pandemic when a lockdown was announced by governments, forcing companies to restrict physical access to their offices and personnel. Hence, reaching to respondents became nearly impossible. Although several attempts have been made to reach out

to the uncovered companies via online mediums such as emails and LinkedIn, only a few responses were collected post-pandemic.

6.4 Recommendation for future research

- This study can be extended to study more countries from emerging economies
- The approach of this study in conducting a field survey could be extended to examine other fields of finance and economics

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Appendix 1. Questionnaire in English given to Indian respondents

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Practitioner Portfolio Construction and Performance Measurement Evidence from India

The purpose of this survey is to identify portfolio construction and performance measurement practices in India. The questionnaire is designed to collect data that will be used purely for academic (Doctoral Research) purposes.

You may choose multiple options. Please identify any other options if the answer is 'other'.
Thanks for your time.

Section1: Respondent Details

Last Name

First Name

Company

E-Mail

- Please indicate the principal area of activity of your company
 - Institutional Investor, Pension fund
 - Asset Management or Fund Management Company
 - Private Bank or Family Office
 - Investment Bank

- Please indicate the asset under management that your firm oversees
 - Less than Cr. 1,000
 - Cr. 1,000 to less than Cr. 5,000
 - Cr. 5,000 to less than Cr. 10,000
 - Cr. 10,000 to less than Cr. 50,000
 - Cr. 50,000 to less than Cr. 100,000
 - More than Cr. 100,000

- Please indicate which best describes your position within your company

- Managing Director or CEO
 - Other Director (Director of Advisory Board, Finance Director, CFO, etc.)
 - Chief Investment Officer
 - Head of Asset Allocation, Head of Risk Management, Head of Research, Head of Quantitative Analysis)
 - Analyst, Quantitative Analyst, Research Analyst, etc.
 - Marketing Position
 - Other: Please fill in the details in the below given box
- Which investment services are offered by your company?
 - Passive investments
 - Actively managed investments
 - Enhanced indexing strategies
 - Multi-management products

Section 2: Risk and Asset Allocation

- When implementing portfolio optimization, do you set *absolute* risk objectives?
 - No
 - Yes, average risk, such as variance or volatility
 - Yes, tail risk, such as VaR or CVaR
 - Yes, Downside risk, such as semi-deviation or lower partial moments
 - Yes, other:
- When implementing portfolio optimization, do you set relative risk objectives with respect to a benchmark?
 - No
 - Yes, Tracking error with respect to a benchmark
 - Yes, tail with respect to a benchmark, such as value-at-tracking error risk
 - Yes, downside risk with respect to a benchmark, such as semi-deviation
 - Yes, other:
- When implementing portfolio optimization, how do you estimate the covariance matrix?
 - Use of sample covariance matrix

- Specify a model with explicit factors, such as single-factor model, constant correlation approach, or multifactor forecast
 - Implicit factor models (e.g., use of PCA [Principal Component Analysis])
 - Use of optimal shrinkage techniques
 - Other:
- When Implementing portfolio optimization, how do you calculate extreme risk measures?
 - Do not account for this
 - Value-at-risk based on normal distribution
 - Value-at-risk that accounts for higher moments through approximations (eg., Cornish-Fisher VaR)
 - Value-at-risk based on extreme value theory
 - Conditional value-at-risk
 - Other
- How do you deal with estimation error (i.e., uncertainty about the estimated parameters that are used as inputs in portfolio optimization)?
 - By imposing constraints on the portfolio weights
 - By calculating global minimum risk portfolio (such as a global minimum variance portfolio) that avoid using the estimation mean returns
 - By using the Black-Litterman approach or similar Bayesian techniques
 - By using portfolio resampling
 - Other:

Section 3: Performance Measurement

- To measure *absolute* performance, do you use?
 - The Sharpe ratio
 - The Treynor ratio
 - The Sortino ratio
 - Measures based on VaR
 - Average return in excess of the risk-free rate
 - Other:

- To measure *relative* performance, do you use?
 - The M-squared measure of Modigliani and Modigliani
 - The Graham-Harvey measures (GH1 and GH2)
 - Jensen's alpha
 - The information ratio
 - Adapted information ratio that defines tracking error risk as downside tracking error or tail risk of tracking error
 - Average return difference with a broad market index
 - Other:

- Do you analyze managers' alpha through -
 - Alpha from multifactor models
 - Alpha from market models (CAPM and Jensen's alpha)
 - Alpha from return-based style analysis
 - Absolute performance in a peer group
 - Other:

Appendix 2. Questionnaire in Farsi given to Iranian respondents

نحوه ایجاد سبد سرمایه گذاری و سنجش عملکرد آن توسط صندوق های سرمایه گذاری در ایران

*هدف این تحقیق ارزیابی عملکرد سبدهای سرمایه گذاری در ایران میباشد. این پرسشنامه جهت جمع آوری داده طراحی شده و صرفاً برای اهداف دانشگاهی (تحقیق دکترا) مورد استفاده قرار میگیرد.

بخش اول: اطلاعات پاسخ دهندگان:

نام: نام خانوادگی: نام شرکت:

آدرس ایمیل:

1) لطفاً زمینه فعالیت شرکت را مشخص نمایید:

الف) سرمایه گذار خصوصی، صندوق باز نشستگی

ب) شرکت مدیریت سرمایه گذاری یا مدیریت دارایی

ج) بانک خصوصی یا شرکت خانوادگی

د) بانک سرمایه گذاری

2) لطفاً سرمایه تحت مدیریت شرکت را مشخص نمایید:

الف) کمتر از 100 میلیارد ریال

ب) بین 100 میلیارد ریال و 1,000 میلیارد ریال

ج) بین 1,000 میلیارد ریال و 10,000 میلیارد ریال

د) بین 10,000 میلیارد ریال و 100,000 میلیارد ریال

ه) بیش از 100,000 میلیارد ریال

3) لطفاً سمت خود را در شرکت مشخص نمایید:

الف) مدیر عامل

ب) سایر مدیران (مانند مدیر گروه مشاوران، مدیر مالی و غیره)

ج) مدیر سرمایه گذاری

د) سرپرست تخصیص دارایی، سرپرست مدیریت ریسک، سرپرست تحقیقات، سرپرست تحلیل کمی

ه) تحلیلگر، تحلیلگر کمی، تحلیلگر تحقیق و غیره

و) سمت بازاریابی

ی) سایر (لطفاً عنوان شغلی خود را ذکر نمایید.)

4) شرکت شما کدامیک از خدمات ذیل را ارائه مینماید؟

الف) سرمایه گذاری های غیر فعال (منفعل)

ب) سرمایه گذاری هایی که بصورت فعال مدیریت میشوند.

ج) استراتژی های ارتقاء شاخص

د) محصولاتی که بصورت چندگانه مدیریت میشوند.

بخش دوم: اختصاص سرمایه و مدیریت ریسک

1) در هنگام اجرای بهینه سازی سبد سرمایه، آیا اهداف ریسک مطلق را در نظر میگیرید؟

الف) خیر

ب) بله، ریسک متوسط (میانه) از قبیل واریانس یا volatility

ج) بله، ریسک حاشیه ای، مثل ارزش در معرض خطر یا ارزش در معرض خطر شرطی

د) بله، ریسک بد مانند نیمه-واریانس یا گشتاورهای جزئی مرتبه پائین

ه) سایر (لطفاً ذکر نمائید).

2) در هنگام اجرای بهینه سازی سبد سرمایه، آیا اهداف ریسک نسبی را در رابطه با الگو یا شاخص بازار

در نظر میگیرید؟

الف) خیر

ب) بله، خطای موجود در استراتژی فعال نسبت به شاخص بازار

ج) بله، خطای ریسک حاشیه ای مانند ریسک ارزش در معرض خطر نسبت به شاخص بازار

د) بله، خطای ریسک بد مانند نیمه-واریانس نسبت به شاخص بازار

ه) سایر (لطفاً ذکر نمائید).

3) در هنگام اجرای بهینه سازی سبد سرمایه، چگونه ماتریس کوواریانس را تخمین میزنید؟

الف) استفاده از ماتریس کوواریانس نمونه

ب) تعریف یک مدل با فاکتورهای صریح مانند مدل تک عاملی، رویکرد کوریلیشن ثابت و یا پیش بینی با

فاکتورهای چند عاملی

ج) مدل های فاکتورهای ضمنی (غیر صریح) (بعنوان مثال: استفاده از تحلیل اجزاء بنیادی PCA)

د) استفاده از تکنیک های جمع شدگی بهینه

ه) سایر (لطفاً ذکر نمائید).

4) در هنگام اجرای بهینه سازی سبد سرمایه، چگونه معیارهای ریسک مفرط (Extreme risk measures)

را محاسبه مینمایید؟

الف) این معیارها را به حساب نمی آوریم.

ب) ارزش در معرض خطر بر روی تابع توزیع نرمال

ج) ارزش در معرض خطر که گشتاورهای بالاتر را از طریق روشهای تخمینی در نظر میگیرد

(مانند Cornish-Fisher VaR).

د) ارزش در معرض خطر بر اساس تئوری ارزش مفرط (Extreme value Theory)

ه) ارزش در معرض خطر شرطی (CVaR)

ی) سایر (لطفاً ذکر ننمائید).

5) چگونه خطای تخمین (عدم قطعیت پارامترهای تخمینی که بعنوان داده ورودی در بهینه سازی سبد

سرمایه گذاری مورد استفاده قرار میگیرند) را بررسی مینمایید؟

الف) با در نظر گرفتن محدودیت هایی بر وزن دارایی ها در سبد سرمایه گذاری

ب) با محاسبه پرتفولیوی حداقل ریسک موضعی (نسبی) که استفاده از میانگین تخمینی را مجاز نمی شمارد.

ج) با استفاده از رویکرد بلک-لیترمن یا تکنیک های بیسیان (Bayesian) مشابه

د) با تکرار نمونه گیری پرتفولیو

ه) سایر (لطفاً ذکر ننمائید).

بخش سوم: ارزیابی عملکرد

1) برای اندازه گیری عملکرد مطلق از کدامیک از معیارهای ذیل استفاده مینمایید؟

الف) نسبت شارپ $Sharpe Ratio = \frac{R_p - R_f}{\sigma_p}$ (این نسبت بازده اصلاح شده با ریسک را اندازه گیری می کند).

ب) نسبت ترینور $Treynor Ratio = \frac{R_p - R_f}{\beta_p}$

ج) نسبت سورتینو $Sortino Ratio = \frac{R_p - R_f}{\sigma_d}$

د) معیارهایی که براساس ارزش در معرض خطر میباشند.

ه) بازگشت متوسط بیش از نرخ سرمایه گذاری بدون ریسک

و) سایر (لطفاً ذکر ننمایید)

2) برای اندازه گیری عملکرد نسبی از کدامیک از معیارهای ذیل استفاده مینمایید؟

الف) اندازه گیری عملکرد براساس نسبت مودیلیانی و مودیلیانی $M2 = R_p - R_m$

ب) معیارهای گراهام- هاروی

ج) از آلفای مدل جنسن (Jensen's alpha)

$$Jensen's \alpha = R_p - R_f - \beta_p(R_m - R_f)$$

د) ضریب اطلاعات

ه) ضریب اطلاعات انطباقی که ریسک موجود (مانند ریسک بد یا ریسک در معرض خطر) را نسبت به

شاخص بازار تعریف می کنند.

و) اختلاف بازگشت سرمایه متوسط با یک شاخص بازار

ی) سایر (لطفاً ذکر ننمایید)

3) عملکرد آلفای مدیران را از کدام طریق ذیل تحلیل مینمایید؟

الف) آلفا حاصل از مدل های چندعامله (مانند فاما-فرنچ...)

ب) آلفا حاصل از مدل های بازار (CAPM و آلفای جنسن)

ج) آلفا حاصل از شیوه تحلیل بازگشت سرمایه

د) عملکرد مطلق در گروه همگن

ه) سایر (لطفاً ذکر نمایید)

Appendix 3. Asset Management Companies Listed in AMFI as of July 2019

No.	Company Name
1	Aditya Birla Sun Life AMC Limited
2	Axis Asset Management Company Ltd.
3	Baroda Asset Management India Limited
4	BNP Paribas Asset Management India Private Limited
5	BOI AXA Investment Managers Private Limited
6	Canara Robeco Asset Management Company Limited
7	DHFL Pramerica Asset Managers Private Limited
8	DSP Investment Managers Private Limited
9	Edelweiss Asset Management Limited
10	Essel Finance AMC Limited
11	Franklin Templeton Asset Management (India) Private Limited
12	HDFC Asset Management Company Limited *
13	HSBC Asset Management (India) Private Ltd.
14	ICICI Prudential Asset Management Company Limited
15	IDBI Asset Management Ltd.
16	IDFC Asset Management Company Limited
17	IIFCL Asset Management Co. Ltd.
18	IIFL Asset Management Ltd. (Formerly known as India Infoline Asset Management Co. Ltd.)
19	IL&FS Infra Asset Management Limited
20	Indiabulls Asset Management Company Ltd.
21	Invesco Asset Management (India) Private Limited
22	ITI Asset Management Limited
23	JM Financial Asset Management Limited
24	Kotak Mahindra Asset Management Company Limited (KMAMCL)
25	L&T Investment Management Limited
26	LIC Mutual Fund Asset Management Limited
27	Mahindra Asset Management Company Pvt. Ltd.
28	Mirae Asset Global Investments (India) Pvt. Ltd.
29	Motilal Oswal Asset Management Company Limited-96+8\

30	PPFAS Asset Management Pvt. Ltd.
31	Principal Asset Management Pvt. Ltd.
32	Quant Money Managers Limited
33	Quantum Asset Management Company Private Limited
34	Reliance Nippon Life Asset Management Limited
35	Sahara Asset Management Company Private Limited
36	SBI Funds Management Private Limited
37	Shriram Asset Management Co. Ltd.
38	SREI Mutual Fund Asset Management Pvt. Ltd.
39	Sundaram Asset Management Company Limited
40	Tata Asset Management Limited
41	Taurus Asset Management Company Limited
42	Union Asset Management Company Private Limited
43	UTI Asset Management Company Ltd
44	YES Asset Management (India) Ltd.

Appendix 4. Asset Management Companies listed in FIPIRAN as of July 2019

No.	Name of Company
1	Aban Brokerage
2	Aban Portfolio Management Co.
3	Agah Portfolio Management Co.
4	Algirithm Capital Co.
5	Almas Portfolio Management Co.
6	Amin Investment Bank
7	Amin Nikan Afagh Investment Counsulting Co.
8	Ansar Brokerage
9	Arian Valuer Invesment Consulting CO. (AIKO)
10	Arman Ati Investment Consultant
11	Asal Portfolio Management
12	Ashena Share Portfolio Management Co
13	Asman Portfolio Management Co.
14	Ayandeh Bank Brokerage
15	Bahman Brokerage
16	Bank of industry and Mine Brokerage
17	Parsian Bank Brokerage
18	Behgozin Brokerage
19	Boursiran Securities
20	Capital Reward Portfolio Management Co
21	Charisma Asset Mngt.
22	Day Bank Brokerage
23	Entekhab Mofid Portfolio Management
24	Export Development Bank Brokerage
25	Farabi Brokerage
26	Faraz Ide No-Afarin Investment counsalting Co. (FINETECH)
27	Firouzeh AsiaBrokerage
28	Goharan Omid Deelopment Investment Co.
29	Hadaf Portfolio Management Co.

30	Hadaf Hafez Brokerage
31	Homa Investment Counsulting Co.
32	Iran Cultural Heritage and Tourism Investment Group
33	Isatis Portfolio Management Co.
34	Karafarin Bank Brokerage
35	Kardan Investment Bank
36	Keshavarzi Bank Brokerage
37	Khobregan Brokerage
38	Lotus Investment Bank
39	Maskan Fund
40	Maskan Investment Bank
41	Meadle East Bank Brokerage
42	Mehr Eghtesad Iranian Investment Co.
43	Meli Bank Brokerage
44	Mellat Investment Bank
45	Meyad Investment Advisory Co.
46	Mobin Sarmayeh Brokerage
47	Modaberan Eghtesad Investment Co.
48	National Development Investment Group
49	National Pension FundInvestment services
50	Niki Gostar Investment counsalting Co.
51	Noandishan Brokerage
52	Novi Negar Asia Portfolio Management Co
53	Novin Investment Bank
54	Novira Portfolio Management Co
55	Omid Investment Bank
56	Omid Nahayat Negar Portfolio Management Co.
57	Parto Aftab Kian Investment Consultant
58	Refah Bank Brokerage
59	Saba Jahad Brokerage
60	Saba Tamin Brokerage
61	Saderat Bank Brokerage

62	Saman Bank Broker
63	Saramad Bazar Portfolio Management Co
64	Sarmayeh and Danesh Brokerage CO.
65	Sepehr Investment Bank
66	Tadbirgaran Farda Broker Co.
67	Tamadon Investment Bank
68	Tasmim Negar Portfolio Management Co.
69	Tehran University Ivestment Development Co.
70	Tejarat Bank Brokerage

Portfolio Construction and Risk Management in Practice: Evidence from Emerging Economies

by Fatemeh Kiassi

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Portfolio construction and performance evaluation: Evidence from India and Iran

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Abstract. *This paper comparatively examines asset management practices among practitioners in India and Iran as examples of emerging economies, in order to understand to what extent they apply sophisticated models presented in financial literature in constructing portfolios under their management, as well as in portfolio evaluation process. The sophistication of a particular technique is those given by Amenc et al. (2011). The results show that companies in India and Iran use less sophisticated models in portfolio selection stage. Regarding the performance evaluation, respondents in both countries seem to be well-aware of market models and risk-adjusted ratios are widely used by practitioners.*

Keywords: portfolio management, performance evaluation, portfolio construction, risk, portfolio practitioners.

JEL Classification: C52, G11.

1. Introduction

Markowitz (1952) Portfolio Selection Theory is a normative theory for a rational investor to identify the “Efficient frontier”. A positive theory on the other hand, describes and predict the investment behaviour of individuals under certainty. Therefore, understanding the actual behaviour of financial practitioners in constructing portfolios under their management and managing the relevant risk is of outmost importance.

Although numerous studies devoted to introduce and enhance techniques for asset allocation and risk management, the question remains is that to what extent such advanced academic theories are applied in real scenarios by practitioners.

According to Schröder (2013, pp. 25-26), although wealth advisors are aware of the limitations of traditional investment concepts, such as the statistic mean-variance analysis, they do not use new dynamics asset allocation models. He attributes this to the inherent complexity of dynamic models. Engle (2004) argues that financial practitioners fail to use dynamic models introduced in financial literature.

There are several studies compared modern portfolio theory with its application in practice and found a significant gap between theory and practice. Fabozzi et al. (2007, pp. 16-17) states that despite the high influence of mean-variance analysis in investment management, it is mostly utilized only by quantitative firms, where process for automated forecast generation and risk control are already in place. Therefore, portfolio management remains a purely judgmental process at many firms based on qualitative, not quantitative assessments. Michaud (1989, pp. 33-36) explains the reasons for not using MV optimizers by portfolio managers and terms this fact as “Markowitz Optimization Enigma”.

A close look at the available literature on Asset Allocation theories and practices reveals that: (i) Most of the previous studies conducted to survey and examine the impact of academic research on financial industry are in areas such as product innovation, corporate finance, capital budgeting, etc. (Amenc et al., 2011, pp. 40-41), and not much studies were carried out in Portfolio Construction and Performance Measurements (ii) Although there are evidences of such surveys in developed countries, there has not been much empirical work to test asset allocation practices in emerging economies. Hence, it is felt this study is considered essential by taking into account these observations and the present study intends to fill that gap.

This paper is divided into five sections, including the introduction. In Section 2, we give an overview of relevant literature in portfolio construction and risk management. Section 3 explains the methodology applied to get the results. Section 4 presents the results. Section provides the final remark and conclusion.

2. Literature review

Risk measures

Mean-Variance was pioneered by Markowitz in the 1950s. Variance is defined as dispersion around the mean which considers both positive and negative deviations from the mean as undesirable outcome and weighs both in the same manner while, in reality only left side of

return distribution is undesirable. Rom and Ferguson (1994, p. 351) argued that while in Mean-Variance framework the volatility is a symmetric measure of risk that treat all uncertainty the same, in the real world is just the opposite; only in bear market should volatility avoided, and in a bull market we should seek as much as volatility as possible. Roman and Mitra (2009, pp. 25-27) reviewed alternative risk measures in detail and concluded that although they provide good theoretical and practical properties, the mean-variance model is still the most used by practitioners.

Roy (1952) first introduced the concept of “safety first” to the investment literature in order to develop a practical framework which assumes that the first and foremost objective of an investor would be the safety of their principal by setting a minimum acceptable return that preserve the principal. Therefore, an investor prefers a portfolio with lower probability of going below the minimum accepted return called “disaster level” or “target return”.

Mean-Absolute Deviation (MAD) introduced by Konno in 1988. In this approach, the risk of a portfolio is measured by the absolute deviation of the return from the mean instead of the variance. Konno and Yamazaki (1991) used MAD portfolio optimization model to Tokyo Stock Market to show its advantages on solving portfolio optimization problem in a real time compared to Markowitz mean-variance model. Since MAD framework is that it converts the portfolio optimization problem from quadratic programming problem into a scalar parametric linear programming problem, making the implementation procedures more efficient and simpler compared to Mean-Variance model.

Markowitz (1959) introduced “semi-variance” concept which considers only the downside of return distribution as a measure of risk. Bawa (1975) and Fishburn (1977) introduced Lower Partial Moments as a generalization of semi-variance. Lower partial moment (LPM) is the risk associated with losses and considers the moments of asset returns that fall below a certain minimum acceptable level of return τ which is referred to as ‘benchmark market level’ or ‘disaster level’.

Value at Risk (VaR) is a regulatory measure of risk that entered the financial lexicon in the early 1990s (see GA Holton (2002)). First, the US security and Exchange Commission (SEC), based on the market historical data, calculated a 0.95 quintile of the amount of money a firm might lose over a one-month period which later referred to as VaR. This new risk metric imposed by regulations, such as the UK Securities and Futures Authority 1992 “portfolio” value-at-risk measure, Europe’s 1993 Capital Adequacy Directive (CAD) “building-block” value-at-risk measure and the Basel Committee’s 1996 value-at-risk measure based largely upon the CAD building-block measure, to banks and financial institutions in order to track and report the market risk exposure of their portfolios.

There is voluminous literature analyzed the mean-VaR model for portfolio selection in comparison to classical Mean-Variance model and derived some advantages and drawbacks. For instance, Alexander and Baptista (2002) examined the economic implications of using mean-VaR in compared to mean-Variance and found out that the higher variance portfolio might have less VaR. Thus, an efficient portfolio that globally minimizes VaR may not exist. They showed that it is possible for some risk-averse agents to end up choosing portfolios with greater standard deviations if they switch from using

variance to VaR as a measure of risk and concluded that regulators should be aware that VaR is not a unique improvement over variance as a measure of risk. In a subsequent study (Alexander and Baptista (2004), imposed Value-at-Risk (VAR) and Conditional Value-at-Risk (CVaR) constraints to the mean-Variance portfolio selection and compared them for both highly risk-averse and slightly risk-averse agents and obtained similar results.

Kaplanski and Kroll (2002) analyzed the validity of VaR in comparison to the traditional measures of risk and found out that the VaR family is at least as good as other measures of risk for decision making purposes. However, they showed some drawbacks of imposing VaR constraint. For instance, the congruence of Mean-VaR criterion with the expected utility theory is only observed in the presence of normality (or log-normality) assumption, which makes it applicable only in the case of irrational utility functions. For all non-normal distributions, Mean-VaR criterion may screen out alternatives which consider superior by risk-averse individuals. Furthermore, they suggested that Accumulative-Value-at-Risk (A VaR) is superior to both regular VaR and the traditional risk measures.

Roman and Mitra (2009) discussed alternative models for portfolio selection by incorporating those risk metrics that penalize only the downside (adverse) part and not the upside (potential) of the return distribution, such as Lower Partial Moments (LPMs), Value-at-Risk (VaR) and Conditional Value-at-Risk (CVaR).

Covariance matrix estimation

In the portfolio optimization practices, expected returns and covariance matrix need to be estimated using quantitative methods. Calculating the sample analogues from historical data is the most common used approach for estimation of security expected returns and covariances. It implies that past provides good estimate of future. However, the returns are time variant (nonstationary) in most cases. Therefore, historical returns are not an indication of future returns. Moreover, economic and political environments, monetary and fiscal policies, customer perspectives and business cycles are all subject to change over the time, making historical data a poor estimator (Fabozzi et al., 2007, pp. 146-152). Therefore, alternative methods such as models with explicit factors (single factor and multi-factor models), models with implicit factors (statistical/hypothetical models) and Optimal Shrinkage techniques are suggested by academia to estimate covariance matrix.

Factor models are based on Sharpe's (1964) Capital Asset Pricing Model (CAPM), Ross's (1976) Arbitrage Pricing Theory (APT) and Fama and French works (Lee and Junior, 2018, p. 348). They are called factor models because they try to each exposure to risk as a separate factor. In these models' risk is also referred to as risk factor. Single factor model know as market model is a regressive model considering the market performance.

Engle et al. (1990), showed the advantages of applying FACTOR-ARCH model to examine the dynamic relationship between the return risk premia and volatilities in a multivariate system and concluded that it works better than other models due to its property of being stable over time.

Implicit factor models aim to explain returns with factors that are linear return combinations. Although the number of factors is relatively lesser than other factor models,

they are less attractive to be used due to the fact that they are based on hypothetical model and difficult to interpret (Fabbozi et al., 2007, p. 168). Robust statistical techniques such as Shrinkage and Bayesian estimators are other advance models which improve the estimation process.

Estimation error

A crucial part of the problem of the Markowitz model of portfolio optimisation lies on the estimation error of the necessary inputs. Typically, expected returns, risks and correlations are measured from historical data and fed into an optimizer as if they were known perfectly, where these data sometimes are measured with substantial errors (Jorion, 1992).

The unintuitive character of many optimized portfolios can be traced to the fact that MV optimizers are, in a fundamental sense, “estimation-error maximizers” (Michaud, 1989, pp. 33-34). According to Phillip Jorion (1992), part of this problem is due to measurement of necessary inputs.

There are several techniques introduced in financial literature to address this issue, such as putting constraints on portfolio weights, constructing Global Minimum Risk Portfolio, Black-Litterman and Bayesian techniques, and portfolio resampling.

Shrinkage and Bayesian methods allow incorporation of uncertainty of expected return and risk in the portfolio optimization process, therefore provide more realistic models. For example, Black and Litterman (1990) combined investor views with market equilibrium. In this model, if the confidence in the view considered to be zero, they end up holding market portfolio as given by CAPM model. However, by putting the investor view into account, the resulting expected returns will deviate from the market equilibrium and imply the investor views.

Jorion (1991) compared the historical sample mean, Bayesian estimator and a CAPM-based estimator, found that historical sample covariance leads to the worst forecast and out-of-sample performance and is outperformed by shrinkage estimators. Also, an active portfolio based on the CAPM produces the best results among others. Grauer and Hakansson (1995) also confirmed earlier studies showed estimators outperformed the historical sample estimator. Another study by Nathaphan and Chunchachinda (2010), where they employed six different estimating strategies to examine the ex-post portfolio performance, showed that shrinkage estimators incorporating the single index model outperform other traditional methods of portfolio selection.

3. Methodology

This study is a survey about portfolio construction and performance evaluation techniques adopted by practitioners in investment management institutes in India and Iran. A questionnaire based on Amenc et al. (2011) survey was disseminated among participants in both countries and generated responses from institutions based in India and Iran representing 47% and 53% of the respondents respectively. Later, descriptive statistics was extracted and analysed.

The population of the survey is companies listed in Association of Mutual fund India (AMFI) and Financial Information Processing Center of Iran (FIPIRAN) in case of India and Iran respectively. At the time of survey, 44 companies were listed in AMFI and 70 companies were listed in FIPIRAN offering asset management services. Since data in FIPIRAN is sorted based on mutual funds schemes instead of list of institutions, initially the list of funds was extracted and clustered as per companies managed them. It reached 196 mutual fund schemes managed by 70 companies at the time of data collection.

The respondents are asked about their practices in risk management and performance evaluation and are given different options which almost cover most of the available methods in the portfolio management field from the least sophisticated ones to the most sophisticated ones. Tables 1 and 2 gives unsophisticated options available to choose for each question. Therefore, it is assumed that participants adopt non-sophisticated techniques for a particular category if they select any of the given options in Tables 1 and 2. Later, based on their responses, we conclude that to what extent they apply sophisticated/non-sophisticated techniques in their practices.

Table 1. *Non-sophisticated risk measures/techniques in the process of portfolio construction*

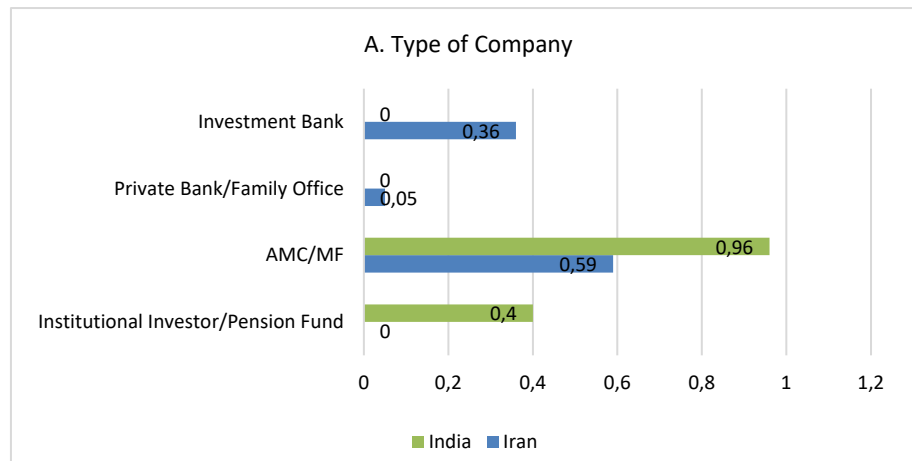
Portfolio Construction	
Measures and techniques	Non-sophisticated answers
Absolute risk measures	No No/Average risk
Relative risk measures	No No/Tracking error
Covariance matrix estimation	Sample Covariance
Extreme risk calculation	Not account for it Not account for it/Normal distribution VaR
Estimation risk	Weight constraints

Table 2. *Non-sophisticated measures/techniques in the process of portfolio performance evaluation*

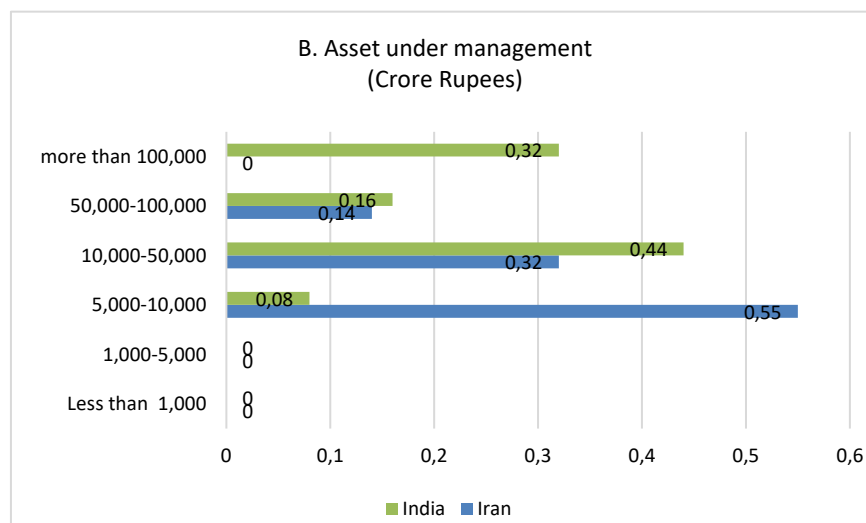
Performance Evaluation	
Measures and techniques	Non-sophisticated answers
Absolute performance evaluation	Sharpe ratio Average excess return Sharpe ratio/Average excess return
Relative performance evaluation	Average excess return Information ratio Average excess return/information ratio
Manager's alpha	Peer group

4. Analysis and discussion of results

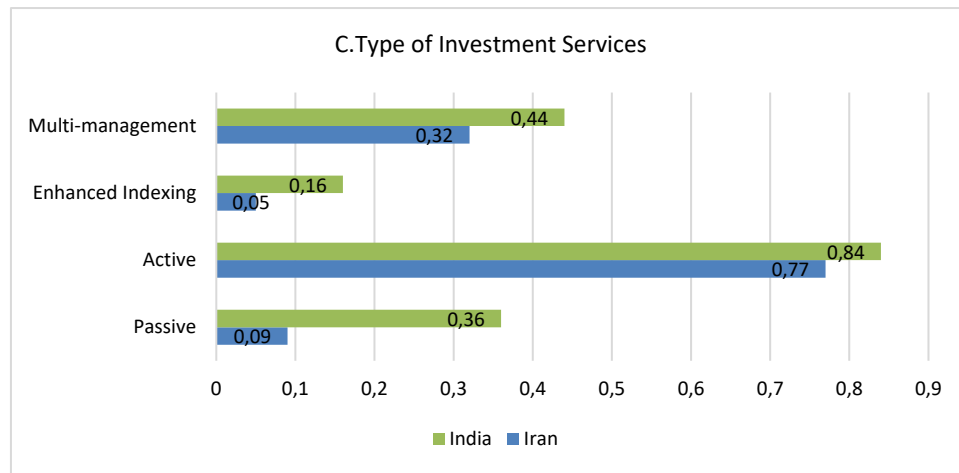
As shown in the Chart A, majority of respondents are Asset Management Companies (AMCs) in both India and Iran with a share of 96% and 59% respectively. Investment Banks constitute 36% of the participants in Iran.



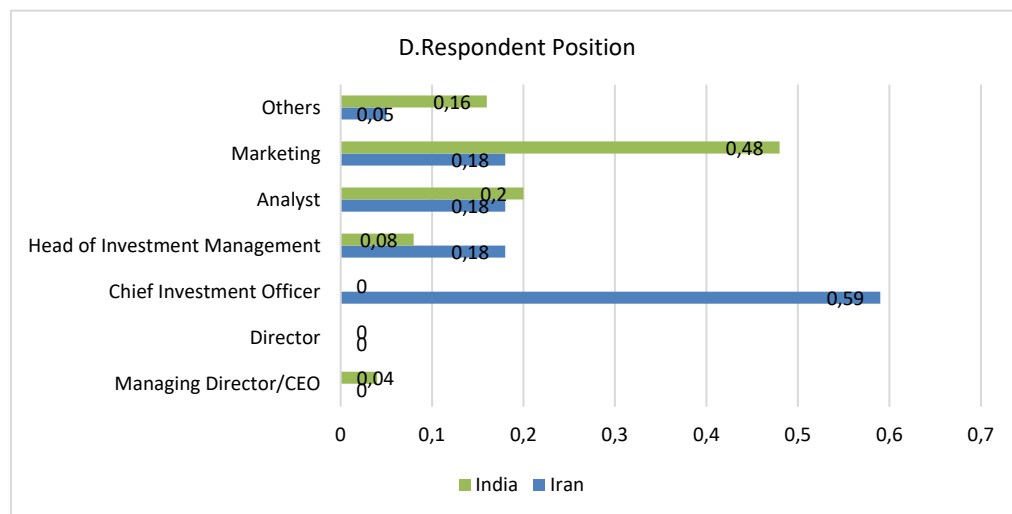
As it is indicative in Chart B, the size of asset under management in India is significantly higher compared to Iran. 55% of companies in Iran manage assets between Rs. Cr. 5,000 to 10,000 and no respondents in Iran has asset more than Rs. Cr. 100,000 under their management. In India, on the other hand, only 8% of respondents' portfolios are between Rs. Cr. 5,000-10,000 and about one-third of respondents have portfolios more than Rs. Cr. 100,000 under their management.



We also asked our respondents about the type of services their companies offer. The options cover the whole range of investment strategies including passive strategies, actively-managed strategies, multi-management (active and passive management), and enhanced indexing strategies. Evidently, majority of respondents (more than third-fourth) in both countries offer actively managed investment services as shown in Chart C. On the other hand, enhanced indexing strategies seem not to be popular among practitioners in both countries.



The role of respondents in their respective companies are questioned and presented in the Chart D. As it shows, most of the senior executive such as Managing Director/CEO, Chief Investment Officer, Head of investment management provided most of responses we received from Iranian companies. In India, on the other hand, Marketing positions account for nearly half of the responses. The responses from analysts account for less than one-fifth of responses received from Iran and one-tenth in case of India.



Portfolio construction and risk management

Modern portfolio theory emphasizes on considering both risk and return while constructing a portfolio. Although several risk measures have been introduced from the inception of the portfolio theory, the question is that to what extent the concept of risk is incorporated in the process of portfolio construction by investment management practitioners. Therefore, the respondents are questioned whether they set absolute risk measures when implementing portfolio optimization and which measures of risk they use.

As Table 3 shows, 14% and 4% of respondents from Iran and India do not count for risk measures in the process of portfolio construction. While variance/volatility is the most common used measure among both respondents from Iran and India, other risk measures such as tail risks and downside measure of risk seem to be less-common measures in both countries. Semi-deviation/LPMs are the second most popular risk measure among Indian mutual funds accounting for 40% of responses. In contrast, tail risk measures such as VaR/CVaR get lesser consideration of only 4% among Indian respondents.

Table 3. *Do you set absolute risk objectives in portfolio construction?*

Absolute Risk Measures	Iran	India
No	0.14	0.04
Variance/Volatility	0.64	0.52
VaR/CVaR	0.18	0.04
Semi-deviation/LPMs	0.09	0.4
Others	0.05	0

Regarding the relative risk measure to a benchmark as it is shown in the Table 4, the statistics are corresponding to those of absolute risk objective. 50% of respondents from Iran and 44% in India consider tracking error volatility in their portfolio construction process. Indian companies consider downside risk relative to a benchmark as twice as respondents from Iran. Tail risk relative to a benchmark is less common comparatively by respondents from both countries.

It may imply that practitioners are judged relative to some benchmark so that they have to consider the risk measures compared to some broad market index.

Table 4. *Do you set relative risk objectives in portfolio construction?*

Relative Risk Measures	Iran	India
No	0.14	0.04
Tracking Error relative to a benchmark	0.5	0.44
Tail risk relative to a benchmark	0.18	0.12
downside risk relative to a benchmark	0.18	0.36
Others	0.05	0.04

Regarding the estimation of covariance matrix, the respondents are given a variety of options including the use of sample covariance matrix, specifying a model with explicit factors such as single-factor model, constant correlation approach, or multi-factor forecast, specifying implicit factor models such as use of Principal Component Analysis (PCA), and use of optimal shrinkage techniques. Also, they are given option “other” in case they use other methods for the estimation of covariance matrix other than the given options. The responses indicate that using models with explicit factors seems to be the dominated method amongst others. The second most common option is using the traditional sample covariance matrix in both countries. Therefore, majority of respondents in India and Iran apply either sample covariance matrix or models with explicit factors jointly or individually. On the other hand, implicit factor models and optimal shrinkage techniques seem to be less familiar to the respondents, especially in case of Iran. Also, somehow surprisingly, 27% of respondents in Iran declared that they do not account for covariance matrix estimation in the process of portfolio construction which may imply that corresponded respondents adopt naive approach towards construction of portfolio under their management.

Table 5. *When implementing portfolio optimization, how do you estimate covariance matrix?*

Estimation of Covariance Matrix	Iran	India
Sample Covariance Matrix	0.27	0.36
Explicit factors models	0.45	0.52
Implicit factors Models	0.05	0.12
Optimal Shrinkage techniques	0.05	0.16
No/Others	0.27	0.04

There are at least four standard methods for calculation of VaR which are the most commonly used for calculation of VaR. Each method has its own strengths and weaknesses. Parametric approach assumes normal distribution for returns whereas non-parametric approach doesn't assume any particular return distribution.

The respondents are asked how they calculate extreme risks. As shown in Table 6, majority of respondents use simple VaR based on normal distribution technique to calculate extreme risks of their portfolios. Taking all together, more than half of the respondents in both countries either do not account for extreme risk measures or use VaR based on normal distribution method for calculation of extreme risks. One might imply that respondents' approach towards extreme risk is non-sophisticated. However, the results show that almost a quarter of respondents calculate VaR based on models that take higher moments of return distribution into account, sophisticated methods such as Cornish-Fischer semi-parametric approach, thus estimate more negative outcomes by considering the fat tails of return distributions.

Other less commonly used methods are VaR based on extreme value theory and CVaR respectively. The extreme value theory (EVT) is an advanced technique and refers to those events with an extremely rare probability of occurrence and a catastrophic impact, such as financial market turmoil. The results show that over 10% of respondents in both countries are aware of EVT and calculate VaR base on it. Conditional Value at Risk (CVaR), also referred to as expected shortfall, calculates the probability of portfolio losses beyond the VaR is applied by less respondents in both countries and participants from Iran seem to be either less aware of such measures or not adopting CVaR (tail VaR) in their practices.

Table 6. *When implementing portfolio optimization, how do you calculate extreme risk measures?*

Extreme Risk Calculation	Iran	India
No	0.09	0.08
VaR based on Normal Distribution	0.5	0.44
VaR based on Higher Moments	0.23	0.24
VaR based on Extreme Value Theory	0.14	0.12
CVaR	0.05	0.12

Next, the respondents are asked how they deal with the estimation error i.e., uncertainty about the estimated parameters that are used as inputs in portfolio optimization. As Table 7 indicates, imposing constraints on the portfolio weights is the most common used method. It counts for nearly 70% of respondents from Iran and above 30% of respondents from India. Other techniques such as Global Minimum Risk Portfolio or Black-Litterman/Bayesian Techniques seem not to be known or applied by respondents in Iran and only 5% of respondents use portfolio resampling to deal with estimation error. In India, on the other hand, about one-fourth of respondents use Global Minimum Risk Portfolio and the same proportion use portfolio resampling to deal with estimation error. The results show

that not only Indian institutions take error estimation into account more than Iranian companies, but they also use more sophisticated techniques than simply impose constraints on portfolio weights.

Table 7. *How do you deal with the estimation error?*

Estimation Error	Iran	India
Constraints on portfolio weights	0.68	0.32
Global Minimum Risk Portfolio	0.05	0.28
Black-Litterman/Bayesian Techniques	0	0.08
Portfolio Resampling	0.05	0.25
Other	0.23	0.08

Performance evaluation

The risk-adjusted performance measures, which evaluate the average excess return obtained in the managed portfolio considering the risk taken by the portfolio manager, are used to evaluate the ex-post performance of the portfolio.

Initially respondents are asked which absolute risk-adjusted ratios they use. As indicated in Table 8, Sharpe ratio and Treynor ratio are the most widely common measure in both countries. This result is corresponding to the fact that volatility and factor models are widely used in the process of portfolio construction. The other commonly used performance measure is average return in excess of risk-free rate which does not count for the risk taken.

As it is indicated in Table 8, applying Sharpe ratio and/or average return in excess of risk-free rate confirms that respondents use non-sophisticated methods. It is used by 56% of respondents in India and 23% of respondents in Iran. Surprisingly, Sortino ratio which considers semi-variance as risk adjustment is used by 27% of respondents from Iran which indicates the awareness of the respondents of the post-modern financial theories. This ratio is used by only 4% of respondents in case of India. Measures based on VaR are used by 9% of respondents in Iran and 28% of respondents in India, which implies the emphasize on tail risks by Indian institutions.

Table 8. *What do you use to measure the absolute performance?*

Absolute Performance	Iran	India
Sharpe Ratio	0.59	0.64
Treynor Ratio	0.59	0.28
Sortino Ratio	0.27	0.04
Measures based on VaR	0.09	0.28
Average return in excess of risk-free rate	0.23	0.56
Other	0.14	0.04

Assuming that the performance of a fund manager would be evaluated against a benchmark, the respondents are asked about the relative performance measures. Jensen's alpha extracted from CAPM is among the most widely used methods in both countries follows by using the naïve average return difference with a broad market index, which does not consider about the risk taken. Next most widely measure is the information ratio which considers the standard deviation of tracking error as the risk measure. It is used by 36% of respondents in India and 18% of respondents from Iran.

Table 9. *What do you use to measure the relative performance?*

Relative Performance	Iran	India
M-squared (Modigliani&Modigliani)	0.14	0.04
Graham-Harvey Measures	0.05	0
Jenson's alpha	0.59	0.52
The Information Ratio	0.18	0.36
Adapted information Ratio/VaR-based measure	0.05	0
Tail risk of tracking error	0.05	0
Average Return difference with a broad market index	0.5	0.44

Finally, the respondents are asked how they analyse manager's alpha which is the return in excess of a "normal" return on a reference portfolio. Alpha is, in other words, the "abnormal" return. As Table 10 shows, 72% of respondents in India consider absolute performance in a peer group to analyse the manager's alpha. This might not be the best approach as peer groups sometimes are not good proxies because risk exposures can vary greatly from one managed portfolio to another (Amenc et al., 2011). Comparatively peer group analysis is less commonly used by respondents from Iran (only 23%). Single-factor model which is based on CAPM are widely used by the institutions in both countries. However, alpha from multifactor models is not a common approach among respondents of both countries. According to Amenc et al. (2011) this indicate that practitioners are reluctant to use other multifactor models, probably because the ongoing debate in the asset-pricing literature about the right risk factors. In contrast, return-based style analysis which is a specific case of multi-factor models and facilitate the decomposition of the excess return into various risk factors, is among the widely used methods in calculating the manager's alpha with 32% and 24% of respondents from Iran and India respectively.

Table 10. *How do you analyze manager's alpha?*

Manager's alpha	Iran	India
multifactor models	0.05	0.12
single-factor models, such as CAPM	0.36	0.64
return-based style analysis	0.32	0.24
Absolute performance in a peer group	0.23	0.72
Other	0.09	0.04

In the table below, we summarized the outcomes of the survey and commented whether practices in India and Iran are sophisticated or non-sophisticated accordingly:

Table 11. *Summary of findings*

Methods	Comments	Sophistication/non-sophistication
Absolute risk	Variance/volatility dominates in both countries, participants from India are well aware of downside risk measures in the process of portfolio optimization	Mostly adoption of non-sophisticated measures. India seems to be more sophisticated than Iran setting downside measures in the process of portfolio optimization.
Relative risk	Tracking error dominates in both countries, however respondents from India are relatively more aware of downside risk measures relative to a benchmark than participants from Iran	Mostly adoption of non-sophisticated measures. India seems to be more sophisticated than Iran.
Covariance matrix	Explicit factors models seem to be the dominated method in both countries. Participants from India seem to adopt Implicit factor models and Shrinkage techniques more than participants from Iran.	Mostly adoption of sophisticated measures. India seems to be more sophisticated than Iran
Extreme risk	Either do not account for extreme risk measures or use VaR based on normal distribution	Non-sophisticated techniques are adopted by majority of respondent in both countries. However, some respondents in both countries adopt sophisticated techniques.

Methods	Comments	Sophistication/non-sophistication
Estimation error	Imposing constraints on the portfolio weights is the most common used method (nearly 70% of respondents from Iran and above 30% of respondents from India).	Overall, non-sophisticated techniques dominated. India adopts more sophisticated techniques than Iran.
Absolute performance	Sharpe ratio and Treynor ratio are the most widely common measure	Non-sophisticated methods dominated in both countries.
Relative performance	Jenson's alpha the most widely used methods in both countries follows by using the naïve average return difference with a broad market index	Relatively sophisticated Well aware of market model.
Managers' alpha	Single factor model, return based analysis and absolute performance in a peer group dominate in both countries.	Non-sophisticated methods are mostly applied by participants in both Iran and India. India seems to be less sophisticated.

5. Conclusion

The sophistication of adoption of a particular technique in both portfolio construction and performance Relative performance evaluation are those given by Amenc et al. (2011). This paper used the same criteria to find out the extent of sophistication of techniques adopted by asset management practitioners in India and Iran as examples of emerging economies. As resulted data in boldface in the above tables show, companies in both India and Iran use less sophisticated techniques and models in construction of their portfolios. However, it seems that practitioners in both countries are well aware of factor models. Regarding the performance evaluation, it seems ratios based on factor models such as Sharpe ratio, Treynor ratio, and Jenson's alpha are popular and widely used by practitioners in both countries. However, results show a slightly different approach between the two countries; Indian respondents seem to adopt various sophisticated measures in addition to the non-sophisticated ones in the process of portfolio optimization. On the other hand, it seems that respondents from Iran use more sophisticated measures to evaluate the ex-post performance than respondents from India.

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