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IS KSE-100 INDEX A MEAN-VARIANCE EFFICIENT PORTFOLIO?

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ABSTRACT

The purpose of this study was to test the efficiency of the KSE-100 Index based on the underlying principles of efficient portfolios assuming that the allocation of portfolios in the benchmark KSE-100 Index satisfy the underlying conditions of an efficient portfolio since KSE-100 Index is assumed to depict the sentiment of the entire market. In order to do so hundred portfolios were constructed taking randomly generated weights while incorporating return and variance-covariance of all the securities enlisted as KSE-100 companies by KSE. The results indicate that the KSE-100 Index is not mean-variance efficient, in view of the comparison of actual Return-Risk Ratios of randomly developed portfolios. Hence, it is high time for the management of Pakistan Stock Exchange to reconsider the security allocation criteria of KSE-100 Index based on mean-variance efficiency rather than value-based criteria that has little practical significance. It can be further highlighted that portfolio managers who base their calculations on the performance of KSE-100 Index using it as a benchmark may miss better opportunities for portfolio selection and return-risk trade-off on their investments.

Keywords: Modern Portfolio Theory, KSE, Market Efficiency, Risk, Diversification.

INTRODUCTION

Established on January 11, 2016 by merging the erstwhile Karachi Stock Exchange (KSE), Lahore Stock Exchange (LSE) and Islamabad Stock Exchange (ISE) under the auspices of the Government of Pakistan's Stock Exchanges (Corporatization, Demutualization and Integration) Act of 2012, Pakistan Stock Exchange (PSX) has been declared the best performing stock exchange of Asia in 2016 and it was made a part of MSCI Incorporated's benchmark emerging-market index from May 2017 (Bloomberg, 2016). The KSE-100 Index (Karachi Stock Exchange is the principal platform of the Pakistani stock market, Karachi being a commercial hub, and perhaps also due to popular use of KSE abbreviation or symbol world-wide) is a value-weighted index and includes hundred top performing stocks that represent the entire market.

Studying the characteristics and behavior of stock markets has been of great interest to the researchers throughout the world. Many an authoritative study have been carried out to assess efficiency or for that matter inefficiency of the stock markets (Tobin, 1952; Fama, 1965;

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Malkiel, 1973; Shleifer, 2000; Schwert, 2001) offering meaningful methodologies and inspirational research frameworks for future researchers to infer upon.

Modern Portfolio Theory (MPT) assumes that return on any stock is a linear function of the return on market index. MPTis based on mean-variance analysis, a method that has paved the way for assessing efficiency of the individual stocks, stock markets and stock indices. Making use of this theoretical framework, Engel et al. (1995) tested the Mean-Variance Efficiency of U.S. stock market. EarlierEngel and Rodrigues (1993) had studied the Mean-Variance Efficiency of international equity markets.

On similar lines, the purpose of this study is to test the efficiency of theKSE-100 Index on the same principles as proposed by Markowitz (1952) and Tobin (1958) regarding efficient portfolios assuming that the allocation of portfolios in the benchmark KSE-100 Index satisfy the underlying conditions of an efficient portfolio since KSE-100Index is assumed to depict the sentiment of the entire market. Surprisingly, there is a considerable literature on efficiency of Pakistan Stock Exchange but KSE-100 Index has not been examined from efficiency perspective before.

In line with efficient portfolio theory, risk-averse investors select securities while configuring a portfolio that has a maximum potential return for a specified level of associated risk and vice versa. A higher variance signifies higher risk and a higher mean signifies higher return, hence portfolios with lower means and higher variances are naturally discarded while constructing a desired portfolio.

In order to consider KSE-100 to be an efficient portfolio, there should not be any combination of stocks in another portfolio that has higher return compared to the combination of portfolios included in KSE-100. Therefore, the purpose of this study is to investigate if there is any other portfolio allocation rule that provides a better risk-return potential than the one envisaged under the KSE-100 allocation mechanism. KSE-100 Index should satisfy the principles of efficient portfolio selection if it is to be taken as a benchmark index.

LITERATURE REVIEW

Efficiency of the stock market signifies that it is difficult to predict the market (Malkiel, 2003). This has led to a friction between economists and the econometricians as the later strive to prove that market variables can be predictable to some degree. Investors try to make decisions on the basis of available information and past trends assuming that one can take a calculated risk.

The theory of efficient markets introduced by Fama (1970) focuses on the ability of the stock market to absorb available information and reflect it in the stock prices. At the time efficient market hypothesis was introduced, it was widely believed that markets are efficient as they quickly reflect the available information in stock prices. It was assumed that stock markets can be categorized in terms of level of efficiency, as practically, it is possible to earn abnormal profits with the help of information that has not been absorbed by the market, yet at the same time it is possible for a novice to earn abnormal returns without having any information or a general idea of the dynamics of the stock market (Malkiel, 1973).

It is a challenging task to introduce a theory and then find empirical evidence and finally substantiate the results in the field of Finance. For instance, the Efficient Portfolio Theory introduced by Markowitz (1952) suggested ways in which an investor can make smart choices in selecting a portfolio comprising of different securities while satisfying the need for

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a considerable level of diversification in order to maximize returns. But, it is difficult to substantiate that the normative approach suggested by Markowitz is the only best course as it is based on certain assumptions and there are other factors that need to be examined.

Return and associated risk are the two main factors that naturally affect the decision of any investor while making an investment decision the investor weighs the expected returns with associated risks to arrive at a decision. The task becomes difficult when the investor has to choose between different securities for investment. There is a level of risk that an investor is willing to take for an expected return. Interestingly, the efficient portfolio theory has all the ingredients in the sense that it focuses on risks and returns while employing statistical techniques that have strong conceptual frameworks.

The initial portfolio selection models were one-period models, but later many researchers worked on continuous-time models (Phelps, 1962; Tobin, 1965; Samuelson, 1969; Merton, 1969).

Another aspect that has been addressed is that once a portfolio is selected it is upgraded from time to time adding new securities and divesting from some securities. The changes in configuration of portfolio over time pose another challenge to test the potential of new configuration from the perspective of optimality of diversification of portfolio. Kan and Zhou (2012) have suggested ways to address the issue of mean-variance spanning.

After the introduction of Capital Asset Pricing Model (CAPM), the development of which is attributed to many researchers (Markowitz, 1959; Treynor, 1961; Sharpe, 1964; Lintner, 1965;Mossin, 1966), there has been a considerable literature on testing mean-variance in terms of theoretical and empirical basis as it is said that CAPM is primarily a mean-variance model.Levy and Roll (2010) first introduced the method of testing efficiency of market portfolio using mean-variance analysis on empirical data. Afterwards many researchers have used the concept of reverse engineering to test stock portfolio efficiency (Ni, Malevergne, Sornette&Woehrmann, 2011) and these researchers have concluded empirically the efficacy of CAPM on the basis of quantitative analysis. A two-factor model has been introduced by Malvergne, Santa-Clara and Sornette (2009) which uses an alternate approach taking along Zipf Factor, named after Professor George Kingsley Zipf, with the market factor to perform regression analysis.

Fama& French (1993) introduced a three-factor asset pricing model based on company size, company price to book ratio and market risk. Keeping in view that the classical CAPM explains the return of a stock or portfolio as a function ofsystematic risk, it was a remarkable sequential progress, but substantiating how only three factors should be taken in the equation to explain a phenomenon where many other factors are present, is obviously a tricky business, hence the originators of the three-factor model could not make an exception by explaining how only three-factors explain a complex relationship. A new five-factor asset pricing model has been introduced (Fama& French, 2014) which incorporates size, value, profitability, and investment patterns in average stock, is claimed by the originators to perform better than their own three-factor asset pricing model introduced earlier.

The Arbitrage Pricing Theory (APT), as an alternate to CAPM, highlights the significance of using macro-economic factors for pricing of capital assets (Ross, 1976). According to APT, expected return of a financial security can be derived as a linear function of certain key macro-economic indicators.

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In the context of Pakistan, many studies have been carried out to test the efficiency of Pakistani capital markets with varying results in terms of empirical evidence. For instance, Haque, Liu and Fakhar-Un-Nisa (2011) tested the weak form efficiency of the Pakistani stock exchange taking data from year 2000 to 2010 and did not find evidence ofPakistani stock markets being weak form efficient. Earlier, Hameed and Ashraf (2006) also concluded that Pakistani stock market cannot be categorized under the weak form efficiency hypothesis.

On the contrary, Mudassar, Ali, Nawaz and Shah (2013) have found KSE-100 Index to depict weak form efficiency implying that the investors were able to realize excessive returns on their investments. Rehman and Qamar (2014) recently found that the performance of KSE is inefficient. Hamid, Suleman, Shah and Akash (2010) investigated the efficiency of stock markets of countries in Asia-Pacific region and found out that generally the markets in this region are inefficient.

METHODOLOGY

Daily actual closing stock prices of 100 companies (as per the official list of KSE-100 companies) for the year 2018were downloaded from the website of Pakistan Stock Exchange for the study. After calculating daily returns from the stock prices, average annual returns and variances for each security were subsequently calculated. A 100x100 matrix of random weights was generated using the Excel Random function and also a variance-covariance matrix of security returns was derived using the Covariance function in Excel. Using the Solver add-in it was ensured that the sum of weights in individual portfolios is equal to 1. Each column of weights was taken as a portfolio in order to arrive at 100portfolio expected returns and standard deviations amending the following formulas to 100x1 Matrix of Returns, 1x100 Matrix of Random Weights and 100x100 Variance-Covariance Matrix:

$$E(R_p) = \begin{bmatrix} R_1 \\ R_2 \\ . \\ . \\ . \\ . \\ R_{100} \end{bmatrix} X \begin{bmatrix} W_1, & W_2 & \dots\dots\dots & W_{100} \end{bmatrix} \quad (1)$$

Where $E(R_p)$ is the Expected Return of the Portfolio; R for Return & W for weight.

$$\sigma_p^2 = \begin{bmatrix} W_1 \\ W_2 \\ . \\ . \\ . \\ W_{100} \end{bmatrix} X \begin{bmatrix} \sigma_{1,1} & \cdots & \sigma_{1,100} \\ \vdots & \ddots & \vdots \\ \sigma_{100,1} & \cdots & \sigma_{100,100} \end{bmatrix} \quad (2)$$

Where σ^2_p denotes Portfolio Variance, W is Weight and $\sigma_{n,n}$ is Variance-Covariance.

The 100 portfolio returns were analyzed in terms of Sharpe ratio in order to sort out Top 5 and Bottom 5 portfolios in terms of associated returns and risks. The Top 5 and Bottom 5 portfolio returns and variances were finally compared with the average annual return and standard deviation of the KSE-100 Index to examine efficiency of the benchmark Index as a portfolio.

RESULTS

As evident from the results collated in Table-A, KSE-100 is way too lower in terms of Return-Risk Ratio when compared to the Top 5 Portfolios of which Return-Risk Ratio ranges from 2.387418 to 1.977588. Striking revelation is the extreme volatility of KSE-100 Index as the standard deviation is 1.835770% which is way too high for the return of 0.372263% return.

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Table A.Comparison of Top 5 Portfolios With KSE-100 Index

Portfolio	Standard Deviation	Return	Return-Risk Ratio
P53	0.150536%	0.416891%	2.387418
P24	0.128663%	0.357801%	2.334002
P66	0.161210%	0.417499%	2.233105
P87	0.148462%	0.357365%	2.019807
P10	0.142201%	0.338714%	1.977588
KSE-100	1.835770%	0.372263%	0.171461

Looking at Table-B, even the bottom-most P45 portfolio has a better Return-Risk Ratio than KSE-100 benchmark. Risk-Return Ratio of the bottom-5 portfolios ranges from 0.635787 to 1.122599.

Table B.Comparison of Bottom 5 Portfolios With KSE-100 Index

Portfolio	Standard Deviation	Return	Return-Risk Ratio
P45	0.138363%	0.145469%	0.635787
P17	0.121587%	0.136802%	0.652224
P93	0.129311%	0.183197%	0.972056
P76	0.122205%	0.183954%	1.034771
P58	0.142868%	0.325668%	1.122599
KSE-100	1.835770%	0.372263%	0.171461

CONCLUSION

Results indicate that the KSE-100 Index does not satisfy the criteria of mean-variance efficiency, in view of the comparison of actual Return-Risk Ratios of randomly developed portfolios. Hence, it is high time for the management of Pakistan Stock Exchange to reconsider the security allocation criteria of KSE-100 Index based on mean-variance efficiency rather than value-based criteria that has little practical significance. It can be further highlighted that portfolio managers who base their calculations on the performance of KSE-100 Index using it as a benchmark may miss better opportunities for portfolio selection and return-risk trade-off on their investments.

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