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# REVIEW ARTICLE ON MODERN PORTFOLIO THEORY: MARKOWITZ MODEL

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**ABSTRACT**

*Noted economist, Harry Markowitz ("Markowitz) received a Nobel Prize for his pioneering theoretical contributions to financial economics and corporate finance. His innovative work established the underpinnings for Modern Portfolio Theory—an investment framework for the selection and construction of investment portfolios based on the maximization of expected portfolio returns and simultaneous minimization of investment risk. This paper reviews portfolio selection model by Markowitz and provides perspective on some open issues. It starts with a review of the classic Markowitz mean-variance framework. It then presents the portfolio choice approach developed by various authors. Martingale methods and resulting portfolio formulas are also reviewed. Their usefulness for economic insights and numerical implementations is illustrated. Areas of future research are outlined based on the Review article. For the long period of time Portfolio theory has been an area of interest of many economists.*

**KEYWORDS**

financial economics, modern portfolio theory, portfolio construction, minimization of investment risk, risk return analysis, optimum portfolio, market indexes.

## INTRODUCTION-Modern portfolio theory – Markowitz

Markowitz (1952) has developed this theory that is popularly known as the theory of investment or portfolio theory. The concept of diversification was mathematically developed by him. He used mathematical programming and statistical analysis in order to arrange for the optimum allocation of assets within portfolio. He developed the optimal rule for allocating the available amount in different securities.

In his theory Markowitz assists in the selection of the most efficient portfolio by analyzing various possible portfolios of the given securities. This model shows investors how to reduce their risk. This model is based on expected returns (mean) and the standard deviation (variance) of the various portfolios. The optimal portfolios were used in 1952 by Harry Markowitz, and it shows us that it is possible for different portfolios to have varying levels of risk and return. Portfolio theory deals with the value and risk of portfolios rather than individual securities. It was proved by Markowitz that investor invest in different securities it is possible to reduce risk The classical mean-variance approach for which Harry Markowitz received the 1990 Nobel Prize in Economics offered the first systematic treatment of a dilemma that each investor faces.

The conflicting objectives of high profit versus low risk. In dealing with this fundamental issue Markowitz came up with a parametric optimization model that was both sufficiently general for a significant range of practical situations and simple enough for theoretical analysis and numerical solution. As the Swedish Academy of Sciences put it [154], "his primary contribution consisted of developing a rigorously formulated, operational theory for portfolio selection under uncertainty."

## PORTFOLIO SELECTION

*Markowitz, H. (1952). Journal of Finance, 7(1), 77–90.*

Harry Markowitz is generally acknowledged as the father of modern portfolio theory after publishing his seminal paper in 1952, for which he (jointly) received a Nobel Prize in 1990. Markowitz (1952) and Tobin (1958) showed that it was possible to identify the composition of an optimal portfolio of risky securities, given forecasts of future returns and an appropriate covariance matrix of share returns. Markowitz introduced the idea of risk aversion of average investors and stated that they wanted to maximize the expected return with a minimum amount of risk. This model provides a theoretical framework for analyzing risk and return. In relation to this William F. Sharpe's has described the advantages of using an Asset Class Factor Model for practical applications of the Markowitz portfolio analysis technique.

**Markowitz Revisited: Mean-Variance Models in Financial Portfolio Analysis**

*Marc C. Steinbach SIAM REVIEW c_ 2001 Society for Industrial and Applied Mathematics Vol. 43, No. 1, pp. 31–85*

Mean-variance portfolio analysis provided the first quantitative treatment of the tradeoff between profit and risk. The Author describes in detail the interplay between objective and constraints in a number of single-period variants, including semi variance models. Particular emphasis is laid on in this article is to avoiding the penalization of over performance. The results are then used as building blocks in the development and theoretical analysis of multi period models based on scenario trees. A key property which Author shows is the possibility of removing surplus money in future decisions, yielding approximate downside risk minimization.

**Lifetime Portfolio Selection Under Uncertainty: The Continuous-Time Case**

*Robert C. Merton, the Review of Economics and Statistics, Vol. 51, No. 3 (Aug., 1969), pp. 247-257*

Introduction OST models of portfolio selection have been one-period models. Author examines the combined problem of optimal portfolio selection and consumption rules for an individual in A continuous-time model where his income is generated by returns on assets and these returns or instantaneous "growth rates" are stochastic. P. A. Samuelson has developed a similar model In discrete-time for more general probability distributions in a companion paper. Author derives the optimality equations for a multi- asset problem when the rate of returns is generated by a Wiener Brownian-motion process. A particular case examined in detail is the two-asset model with constant relative risk- aversion or is elastic marginal utility. An explicit solution is also found for the case of constant absolute risk-aversion. The general technique employed can be used to examine a wide class of inter temporal economic problems under uncertainty. In addition to the Samuelson paper there is the multi-period analysis of Tobin Phelps has a model used to determine the optimal consumption rule for a multi-period example where income is partly generated by an asset with an uncertain return. Mirr less has developed a continuous-time optimal consumption model of the neoclassical type with technical progress a random variable.

**Markowitz's Portfolio Selection: A Fifty-Year Retrospective**

MARK RUBINSTEIN, THE JOURNAL OF FINANCE · VOL. LVII, NO. 3 · JUNE 2002

In his Paper MARK RUBINSTAIN Stated that Markowitz had the brilliant insight that, while diversification would reduce risk, it would not generally eliminate it. Markowitz's paper is the first mathematical formalization of the idea of diversification of investments: the financial version of the whole is greater than the sum of its parts. Through diversification, risk can be reduced but not generally eliminated. without changing expected portfolio return. Markowitz postulates that an investor should maximize expected portfolio return while minimizing portfolio variance of return

Probably the most important aspect of Markowitz's work was to show that it is not a security's own risk that is important to an investor, but rather the contribution the security makes to the variance of his entire portfolio that this was primarily a question of its covariance with all the other securities in his portfolio.

**A note on applying the Markowitz portfolio selection model as a passive investment strategy on the JSE**

*AJ du Plessis and M Ward, Investment Analysts Journal – No. 69 2009, page 39-46*

In his Work AJ du Plessis and M Ward Writes that Harry Markowitz is generally acknowledged as the father of modern portfolio theory after publishing his seminal paper in 1952, for which he (jointly) received a Nobel Prize in 1990. Markowitz (1952) and Tobin (1958) showed that it was possible to identify the composition of an optimal portfolio of risky securities, given forecasts of future returns and an appropriate covariance matrix of share returns. Authors in their research endeavors to apply the theory of Markowitz to the Johannesburg Securities Exchange (JSE) to establish whether an optimal portfolio can be identified and used as an effective trading rule. Weekly data over 11 years on the top 40 JSE listed companies was analyzed to construct Markowitz mean-variance optimized portfolios using ex-ante data. The optimal portfolio was then selected and re-balanced periodically, and the returns compared against the FTSE/JSE ALSI40 index. The study found that the trading strategy significantly outperformed the market in the period under review.

**A SIMPLIFIED PERSPECTIVE OF THE MARKOWITZPORTFOLIO THEORY**

*Myles E. Mangram, SMC University, Switzerland GLOBAL JOURNAL OF BUSINESS RESEARCH - VOLUME 7 - NUMBER 1 - 2013*

This paper presents a simplified perspective of Markowitz' contributions to Modern Portfolio Theory, foregoing in-depth presentation of the complex mathematical/statistical models typically associated with discussions of this theory, and suggesting efficient computer-based' short-cuts' to these performing these intricate calculations. this analysis focuses on Markowitz' contributions to MPT in context of the theoretical and technological advances that have occurred since his theory first came to light in 1952.Since then, the field of financial investing has undergone major evolutions that include significant advances in the financial concepts and tools available to investors and investment professionals. While substantial part of MPT is devoted to statistics-based mathematical modeling and formulas which support its theoretical assumptions, this analysis expands upon this body of literature by focusing on a simplified perspective of its key theoretical assumptions. At the same time, examples are strategically included to demonstrate how modern computing technology (specifically Microsoft Excel) can be used as highly efficient 'short-cuts' to make the often complex calculations needed to support MPT, thus allowing for more attention to be placed on MPT's theoretical underpinnings.

**OPTIMAL PORTFOLIO CONSTRUCTION WITH MARKOWITZ MODEL AMONG LARGE CAP'S IN INDIA**

*NITHYA.J Research journal's Journal of Finance Vol. 2 | No. 2 February | 2014 ISSN 2348-0963*

The aim of this paper was to construct effective portfolio for the large cap companies. This study enables to know the performance of some Nifty Fifty companies having larger market capitalization. The study was conducted with the financial data for four Years and the study was limited to 15 large cap companies from nifty fifty They were a combination of stocks from various sectors namely Banking, Information Technology, Energy, FMCG, Infra, Parma, etc. The analysis was carried out in this project was on the basis of risk & return and on Sharpe index model. This project suggested best investment decision in selected large cap industries.

**CONSTRUCTION OF OPTIMAL EQUITY PORTFOLIO USING THE SHARPE INDEX MODEL**

*Dr.K.V.Ramanathan, K.N. Jahnavi, IJBARR Review, Vol.2, Issue.3, Jan-March, 2014*

The main focus of this research is to construct an optimal equity portfolio with the help of Sharpe index model. In this research, media and entertainment sector has been taken into consideration for constructing the optimum portfolio. Twenty companies like PVR, Sun Network, INOX, Raj television have been selected. Than excess to beta ratio has been calculated and ranks has been given to the companies based on this ratio. The cut-off point was calculated based on the highest value and then cut-off point has been used to calculate the proportion of money to be invested in each stocks. This research is helpful to take investment decision.

**CONSTRUCTION OF EQUITY PORTFOLIO OF LARGE CAPS COMPANIES OF SELECTED SECTORS IN INDIA WITH REFERENCE TO THE SHARPE INDEX MODEL**

*P.Varadharajan, Ganesh IJPSS Vol.2 Issue 8, Aug. 2008.*

In this research 18 stocks from three different large caps sectors has been analyzed and The risk and return of all the stocks has been studied individually. For constructing the portfolio in this project Author have selected companies from three sectors namely Power Sector, Shipping Sector and Textile Sector. From each sector six companies were selected, then based on the study Author selected top five stocks to form an optimum portfolio. The final step in the process is to determine the number of shares of each stock to be purchased.

**A NOTE ON APPLYING THE MARKOWITZ PORTFOLIO SELECTION MODEL AS A PASSIVE INVESTMENT STRATEGY ON THE JSE**

*AJ du Plessis and M Ward* Investment Analysts Journal – No. 69 2009*

This research endeavors to apply the theory of Markowitz to the Johannesburg Securities Exchange (JSE) to establish whether an optimal portfolio can be identified and used as an effective trading rule. Weekly data over 11 years on the top 40 JSE listed companies was analyzed to construct Markowitz mean-variance optimized portfolios. The optimal portfolio was then selected and re-balanced periodically, and the returns compared against the various other portfolio index. The study found that the trading strategy significantly outperformed the market in the period under review.

**PORTFOLIO SIZE AND DIVERSIFICATION EFFECT IN LITHUANIAN STOCK EXCHANGE MARKET**

*Vilija, Egle, Ras, a Engineering Economics, 23(4), 2012.*

In this Paper researchers have focused on measuring the effect of diversification rather than portfolio efficiency. The research is done in Lithuanian Exchange Market based on daily stock prices during 2009–2010 Portfolios in different size are formed in order to get the non-systemic risk elimination effect. Authors of the article compare the diversification effect of naive and differently-weighted stocks portfolios. The diversification effect is evaluated by percentage of diversifiable risk elimination and depending on the number of stocks in portfolio. The research results showed that the major difference between diversification effects of naive and differently weighted portfolios is when they consist of smaller number of stocks.

**THE IMPACT OF DIVIDEND POLICY ON SHARE PRICE VOLATILITY IN THE MALAYSIAN STOCK MARKET**

*Mohammad, Aref, Nejat Journal of Business Studies Quarterly 2012, Vol. 4, No. 1, ISSN 2152-1034*

The purpose of this study was to examine the relationship between dividend policy and share price volatility with a focus companies listed in Malaysian stock market. For this purpose, a sample of 84 companies from 142 companies listed in main market of Malaysia was studied for a period of six years from 2005 to 2010. The relationship between share price volatility with dividend yield and dividend payout, were examined by applying multiple regression. Based on findings of this study, it has been proved that dividend yield and payout has a great impact on share price volatility amongst other variables.

**EFFECT OF FUNDAMENTAL AND STOCK MARKET VARIABLES ON EQUITY RETURN IN PAKISTAN**

*Abdul Haque1, Suleman Sarwar Sci.Int.(Lahore),25(4),981-987,2013 ISSN 1013-5316*

This study has identified the significant determinants of equity returns in Pakistan for this study Author has used data of 394 non-financial firms, listed in Karachi Stock Exchange over the period 1998- 2009. The results provide support to the standard Capital Asset Pricing model (CAPM) and suggest that equity returns respond to market premium. Moreover, author studied the impact of various fundamental market variables like Book to market value, earning to price, cash flow to price, and volatility on equity returns. Author has used descriptive analysis to find the impact and importance of each variable on equity Return at Karachi Stock Exchange.

**MARKOWITZ' MODEL WITH FUNDAMENTAL AND TECHNICAL ANALYSIS –COMPLEMENTARY METHODS OR NOT**

*Branka, Tea Poklepović, Zdravka Croatian Operational Research Review, Vol. 2, 2011*

This paper has empirically explored important methods i.e. fundamental and technical analysis for stock selection in an optimal portfolio. The aim was to investigate if they are complementary, and to determine the way to combine them into the process of portfolio selection. The research was conducted on a 15 most traded stocks on the Croatian capital market. The research revealed that these methods are complementary each other. In the portfolio selection process it is

necessary to include each of the methods to perceive all the relevant which leads to the best results. For the purpose of selecting stocks in a portfolio it is important to start with fundamental analysis.

**ON THE OPTIMAL SELECTION OF PORTFOLIOS UNDER LIMITED DIVERSIFICATION**

*Jay Sankaran, Dept. of management and Information System, Uni. Of Auckland, New Zealand*

Authors has addressed the problem of selecting portfolios that are optimal among all those portfolios that comprise at most a pre-specified number, k, of securities. They considered two criteria: maximizing the ratio of the average return to the standard deviation; and maximizing the correlation with a specified market-index. Author has considered two related problems for optimal portfolio selection. The first is to find portfolios that are mean-variance efficient and that comprise a pre-specified number of securities. The second problem is to find portfolios that optimally track a specified market-index and whose average returns equal the average return on the index.

**DIVERSIFICATION AND THE REDUCTION OF DISPERSION: AN EMPIRICAL ANALYSIS**

*Evans, J. L., & Archer, S. H., — Journal of Finance, Volume 23, Issue 5, (1968) 761-767.*

Author has studied the empirical relationship between portfolio size and its risk /return sizes based on all the stocks listed on the New York Stock Exchange. This paper examines the reduction in return of randomly selected portfolio as per the number of securities included in that portfolio. Author demonstrates that there is stable and predictable relationship exists between number of securities in portfolio and the return of this portfolio. This paper Also throws considerable light on decision of optimal number of securities to be included in portfolio.

**HOW MANY SECURITIES MAKE A DIVERSIFIED PORTFOLIO IN KLSE STOCKS?**

*G.S. GUPTA, CH'NG HUCK KHOON*

This paper examines the relationship between the portfolio risk and number of stocks in portfolio of the Malaysian stocks to determine the optimum size for the portfolio. A sample of 213 stocks traded on the KLSE is considered to form sets of portfolios using random diversification approach based on statman techniques. On an average, a well-diversified portfolio of the Malaysian stock is found to contain at least 27 randomly chosen securities.

**OPTIMAL PORTFOLIO SELECTION FOR THE SMALL INVESTOR CONSIDERING RISK AND TRANSACTION COSTS**

*Rainer Baule, Spectrum (2010) 32:61–76 DOI 10.1007/s00291-008-0152-5*

The Author found the direct application of classical portfolio selection theory is problematic for the small investor because of transaction costs in the form of bank and broker fees. In particular, fees force the investor to choose a comparatively rather small selection of assets.The existence of transaction costs leads to an optimization problem that juxtaposes those costs against the risk costs that arise with portfolios consisting of only a few assets. An empirical study shows that, for smaller investment volumes, transaction costs dominate risk costs so that optimal portfolios contain only a very small number of assets. Based upon these results, the cost-effectiveness of direct investments is compared.

**CAPITAL ASSET PRICING MODEL: SHOULD WE STOP USING IT?**

*Valeed A Ansari, Viklpa Vol. 25, No. 1, January-March 2000*

The Capital Asset Pricing Model (CAPM) predicts that expected returns on securities and market ß are adequate to describe the cross-section of expected returns. There is a controversy regarding the empirical validity of CAPM. This article reviews the content and scope of the model, examines the issues in the controversy, and provides an empirical assessment of the model in India. It notes that the evidence is not sufficient to drop the use of CAPM but one must, however, recognize and understand its limitations.

## CONCLUDING REMARKS

The methodology for data assimilation of this analysis included an extensive literature review on the topic of MPT and related concepts. This review included comparative analysis of earlier MPT works to those of more current economic theorists. In particular, derived data was generated from the current literary works of Benniga (2006). His evolved suggestions of the application of Microsoft Excel to various statistical computations of MPT were modified, tested, and verified against respective proven mathematical models. In spite of its shortcomings, including overly complicated mathematical musings and a reliance on oft disproven theoretical assumptions, MPT has established itself as the gospel of modern financial theory and practice. The gist of MPT is that the market is difficult to beat and those who are successful in doing so are those who effectively diversify their portfolios and take above-average investment risks. In any event, Markowitz' portfolio selection contributions to the MPT model can be simplified (as attempted here) and can be solved more efficiently using modern financial tools such as Microsoft Excel. In that regard, Wharton's Dr. Benniga (2006) makes an excellent argument that "Excel is a great statistical toolbox—someday all business-school statistics courses will use it" (p. 338).

The important thing to remember is that the model is just a tool although perhaps the biggest hammer in one's financial toolkit. It has been nearly sixty years since Markowitz first expounded on MPT and it is unlikely that its popularity will wane anytime in the near future. His theoretical conclusions have become the springboard for the development of other theoretical analysis in the field of portfolio theory. Even so, Markowitz' portfolio theory is subject to, and dependent upon, continued 'probabilistic' growth and expansion.

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