Efficient Method for Assets Allocation

Dare Jayeola, Peter O. Olatunji*, Y. J. Aborisade

Department of Mathematical Sciences, Adekunle Ajasin University, PMB 001, Akungba Akoko, Ondo State, Nigeria

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ABSTRACT

Asset allocation requires allotting savings among many assets. The goal of investors is to minimize risk at a given returns or/and maximize returns at a specified risk. The aim of this paper is to compare two asset allocations, Black Litterman model (BLM) and Mean Variance Model (MVM). The data used are groundnut oil, palm oil and palm kernel oil. The data is used to estimate values of risk and returns using both asset allocations to estimate risk and return of the three assets. It is observed that BLM minimizes risk and maximizes the return of its portfolio better than MVM.

Keywords: Mean, Variance, Return, Risk, Portfolio, Diversification, Investment

INTRODUCTION

Portfolio management is the skill of decision-making using all accessible information to formulate a most likely scenario for the future while also balancing risk against performance. The early theoretical development of portfolio theory harks back to Harry Markowitz's article "Portfolio Selection" (1952) where he outlined the foundation for what is today known as the Mean-Variance theory (MVT). In this article, Markowitz postulated that investors are risk averse and that there is a tradeoff between risk and return. Markowitz's framework has since been further developed by scholars and one of the most influential contributions is the work by Robert Black and Bob Litterman (1991). The model proposed is known as the Black-Litterman model (BLM), which has in recent times come to achieve great recognition among portfolio managers worldwide.

Portfolio is used to combine many kinds of financial securities, like shares, government bonds and other financial assets. The term, investment portfolio refers to the different assets of an investor that are to be seeing as a unit. It is not merely a collection of unrelated assets but a carefully blended asset combination within a unified framework. It is necessary for investor to take all decisions as regards their wealth position in a context of portfolio. The goal of portfolio is to minimize risk and maximise profit by diversification strategy. The analysis of risk-return features the individual securities in the portfolio, which is prepared from time to time. The changes that may take place in combination with other securities are adjusted.

BLM was developed by Fischer Black and Robert Litterman of Goldman Sachs in (1990). It is constructed on the knowledge of two main theories of modern portfolio theory, the capital asset pricing model (CAPM) and Harry Markowitz mean-variance optimization theory. BLM is used in this research work to evaluate the risk and return of portfolio. It is a model that determines optimal asset allocation in a portfolio, it provides a clear way to specify investor's views with prior information, it gives a quantitative framework for specifying the investor's views, and a clear way to combine those investor's views with an intuitive prior to arrive at a new combined distribution.

In this study we examine the following assets: groundnut oil, palm oil and palm kernel oil using BLM and MVM. The study is aimed at investigating the efficient asset allocation of the two asset allocations. The paper is organized as follows: section two reviews literature of the study, section three explains the methods and materials, section four discusses the results, and section five concludes the study.

LITERATURE REVIEW

Mean-Variance optimization (MVO) was developed by [1], it has resulted to the foundation of modern finance theory (MPT). The technique considers the performance of the investor as well as the return, risk and diversification effects, which help to minimize the overall risk of the portfolio. It has become the foundation of modern finance theory. MVO model has thus become a key financial instrument for choosing asset allocation, but several difficulties arise [2]. Markowitz portfolio theory states that a portfolio is diversified if its variance could not be reduced any further at the same level of expected return. It means that a portfolio's variance may be used as a proxy for the fund's diversification level. Maximum diversification was introduced by [3] along with the concept of a Diversification Ratio (DR). [4], [5] established some foundations of modern portfolio theory, namely the efficient frontier and the capital market line.

The modern Markowitz theory on portfolio is indeed the mainstay of portfolio management. Diversification has been an enormous issue since MPT has been approved as a tool in managing asset portfolio. Many researchers have tried to model the rewards of developing diversification strategies for portfolio investments. The risk of a well-diversified portfolio of an asset class is much higher than the volatility of its components. Second is the well-diversified portfolios within an asset class which are highly correlated; however, well-diversified portfolios of different asset classes are less correlated. All investors want to maximize the expected return, given implicitly; investors are risk averse and assume the mean-variance theory for selection criterion that is, the mean and the standard deviation of the return [6].

Investors can reduce risks in their portfolio simply by holding assets that are not positively correlated, thus diversifying the investments. This allows them to obtain the same return potential by reducing their portfolio volatility. The MVO model has thus become a key financial instrument for choosing asset allocations, but several difficulties arise. According to [7], it was established that problems incurred with mean variance optimization include creation of concentrated (or non-diversified) portfolio and unstable model causing significant changes in portfolio during small variations in initial data.

It was observed that the volatility facing by an investor was portfolio risk which leads to a basic and essential point that the volatility of a stock should be estimated not only by variance but also by covariance. Notably, correlations are useful for constructing portfolio allocation strategies, but do not offer a total and accurate measure of overall market combination. Furthermore, one cannot fully account for the structure of risk since simple correlations simplify the factor structure. One would need to include the full covariance matrix. Investors use MVO choice models because they are well understood; most investors use them because of their simplicity and transparency.

[8], suggested BLM as a substitute to Markowitz optimization. Black and Litterman introduced an intuitive optimization method to resolve the MVO difficulties. This method makes it possible to combine allocations resulting from market equilibrium according to CAPM with portfolio managers' views. The most essential aspect of Markowitz model was his explanation of the effect on portfolio diversification by the number of securities (risky and riskless) within a portfolio and their covariance relationships. [9] recognized that MPT provides a rigorous understanding of what diversification is and how it works to improve investment opportunities. MVT has been used to formulate an ex-post framework of international portfolio diversification but a defect in this approach is that investment is in intuition which makes investor's decision to be uncertain and vulnerable to huge risk. They observed a few parameters of uncertainty, owing to the lack of historical data and low data frequency.

[10] provided an extension to the BLM for a further factor which is uncorrelated with the market. They showed the intuitiveness impact of the expected returns computed from the model. [11] provided a detailed transformation involving the two specifications of the BLM for the estimated asset returns. BLM is relatively flexible when it comes to the method used to choose the portfolio as declared by [12] and [13]. [14] declared that, under the economic theory of choice, an investor chooses among the opportunities by specifying the unresponsiveness curves or utility function. These curves are constructed so that the investor is equally content along the same curve which leads to an analysis of the assumed investor's profile.

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The extreme sensitivity of portfolio weights to expected returns which investors focus on is itself not responsive to how investors make their choice; there is a trade-off involving portfolio risk and portfolio return, the more risk an investor is keen to accept, the higher the expected return of the investment. Therefore, for a given amount of risk, there is an "optimal" portfolio that constructs the highest possible return, if it reflects a reasonably smooth trade-off between risk and expected return. Black and Litterman put down quite a lot of freedom to the investor in terms of their portfolio choice model. [15] believed that BLM combines views of the investor and the market equilibrium on the expected return of the assets in one model. This model should be a better estimate of the expected returns. These expected returns, or more precisely the estimator of the expected return, could then be used in a mean-variance optimization.

METHODS AND MATERIALS

A portfolio of n assets is denoted by a vector $x \in R^n$ with $\sum_{i=1}^{n} x_i = 1$. Let the returns of an asset be represented by $\Re_i$ and expected return of asset i be denoted by $E(\Re_i)$. Then the expected return vector is $E(\Re) = col\{E(\Re_i)\} \in R^n$, *(i=1, 2,...,n)*. The covariance matrix is represented by $\sum \in R^{nxn}$. The covariance of assets i and j is given as σ_{ij}. The return $\Re_p$ of portfolio is estimated by:

$$\Re_p = \sum_{i=1}^{n} x_i \Re_i \qquad (1)$$

$$E(\Re_p) = E\left(\sum_{i=1}^{n} x_i \Re_i\right) \qquad (2)$$

$$\sum_{i=1}^{n} E(x_i \Re_i) = \sum_{i=1}^{n} x_i E(\Re_i) \qquad (3)$$

$$= x' E(\gamma) \qquad (4)$$

The variance of return of the portfolio can be estimated as:

$$\sigma_p^2 = \sigma_i^2 (\sum_{i=1}^{n} x_i \Re_i) \qquad (5)$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_{ij} (x_i \Re_i, x_j \Re_j) \qquad (6)$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \sigma_{ij} (\Re_i \Re_j) \qquad (7)$$

$$= \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \sigma_{ij} \qquad (8)$$

$$= x' \Sigma x \qquad (9)$$

The expected return of the equilibrium portfolio is estimated as:

$$\Pi = \delta \sum x_{mkt} \qquad (10)$$

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where, Π is the expected return of market equilibrium, δ is the risk aversion,

The equation below is known as the Black Litterman equation and represents the expected return vectors that is produced from a Bayesian mixing of the implied equilibrium excess return vector Π and the vector of investor views Q

$$E(\Re) = [(\tau\Sigma)^{-1} + P'\Omega^{-1}P]^{-1}[(\tau\Sigma)^{-1}\Pi + P'\Omega^{-1}Q] \tag{11}$$

where P is the vector that depicts the assets concerned by the views, Q is the vector of their feats and ε is the random normal vector of error terms, $\varepsilon \sim N(0,\Omega)$ with diagonal variance matrix Ω. However, where there are no views from the investor $P = Q = 0$ then $E(\Re) = \Pi$ the market equilibrium τ is weight on investor view

Mean Variance Model

$$R_p = \sum_{i=1}^{3} w_i R_i \tag{12}$$

$$\sigma^2_{gnutoil} = \sum_{i=1}^{3} w_i^2\sigma_i^2 + 2w_1w_2\gamma_{1,2}\sigma^2_{1,2} + 2w_1w_3\gamma_{1,3}\sigma^2_{1,3} + 2w_2w_3\gamma_{2,3}\sigma^2_{2,3} \tag{13}$$

$$\sigma^2_{palm\ oil} = \sum_{i=1}^{3} w_i^2\sigma_i^2 + 2w_1w_2\gamma_{1,2}\sigma^2_{1,2} + 2w_1w_3\gamma_{1,3}\sigma^2_{1,3} + 2w_2w_3\gamma_{2,3}\sigma^2_{2,3} \tag{14}$$

$$\sigma^2_{palm\ kernel\ oil} = \sum_{i=1}^{3} w_i^2\sigma_i^2 + 2w_1w_2\gamma_{1,2}\sigma^2_{1,2} + 2w_1w_3\gamma_{1,3}\sigma^2_{1,3} + 2w_2w_3\gamma_{2,3}\sigma^2_{2,3} \tag{15}$$

where R_p represents return of portfolio, w_i is weight of assets, σ_i^2 is risk of assets and $\gamma_{i,j}$ is correlation of two assets.

DISCUSSION OF RESULTS

The results of our investigations are presented in Table 4.1 and 4.2:

Table 4.2: Showing Return of the two Assets

Asset	MVM Risk	BLM Risk
Palm oil	0.0025	0.0017
Groundnut oil	0.0021	0.0016
Palm kernel oil	0.0021	0.0018

Table 4.2: Showing Return of the two Assets

Asset	MVM Return	BLM Return
Palm oil	0.005	0.038
Groundnut oil	0.005	0.035
Palm kernel oil	0.005	0.040

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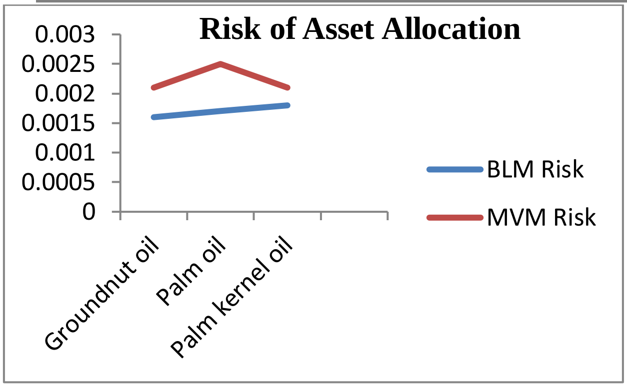

Figure 4.1: Showing Risk of Asset Allocations

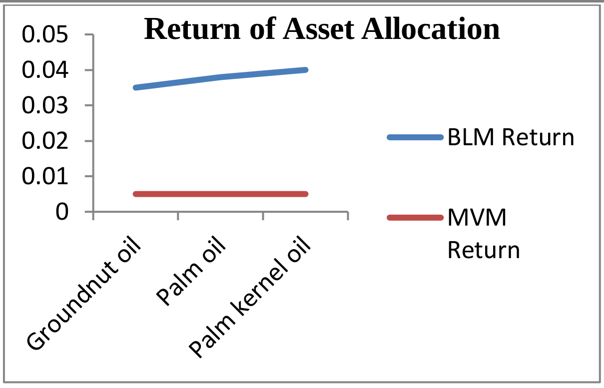

Figure 4.2: Showing Return of Asset Allocations

Tables 4.1 and 4.2 show results of assets risk and returns respectively. Table 4.1 gives risk generated by asset allocations; BLM and MVM for the three assets, groundnut oil, palm oil and palm kernel oil. BLM gives the risk of groundnut oil as 0.16% palm oil, 0.17% and palm kernel, 0.18% while MVM also estimates risk of groundnut oil as 0.21%, palm oil, 0.25% and palm kernel, 0.21%.

Examine Table 4.2, it divulges results of returns. BLM estimates return groundnut oil as 3.5%, palm oil, 3.8% and palm kernel, 4.0% while MVM gives returns of the three assets as 0.5%. Analysing the risk of the two portfolios, BLM minimizes the risk of its portfolio by 0.16% than MVM. Moreover, BLM maximizes its portfolio by 9.8% than MVM. Therefore, looking at the two portfolios, it is vividly seen that BLM minimizes the risk and maximizes the return of its portfolio than MVM.

CONCLUSION

This research is carried out to examine optimal asset allocation. BLM and MVM are used to estimate for risk and return of groundnut oil, palm oil and palm kernel. It is observed that BLM reduced the risk of its portfolio by 0.16% and maximized the return of the same portfolio by 9.8% more than MVM. As is shown in the results, Tables 4.1 and 4.2, BLM is better both to minimize risk and maximize return than MVM. Therefore, it is recommended that investors should invest using BLM instead of MVM.

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