

## Effects of diversification of assets in optimizing risk of portfolio

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### Abstract

Diversification is a strategic option that investors use to optimize their portfolio. Diversification is investing in many assets for the purpose of minimizing risk or maximizing return of portfolio. It is an opportunity by which investors improve from his micro-firm into macro-firm. The investors' aim is to make an optimal choice that leads to minimization of risk and maximization of return, but the platform that achieves these objectives is not at the finger tips. The purpose of this study is to propose procedures for constructing optimal portfolio for rational investors. Also, the study demonstrates the benefits of diversification of each asset in portfolio. The assets allocations divulge by Black Litterman model are used to estimate risk of both portfolios and assets. We explore DataStream (Yahoo finance) of Gold, Oil, Silver and Platinum. It is observed that diversifying in Gold minimizes higher risk and achieve more benefits than other assets in the portfolio, which made portfolio1 of the constructed portfolios to be optimal. In view of these facts, it means diversifying in gold acts as hedge/safe haven for investors during economic recession.

**Keywords:** Diversification, portfolio, assets, black litterman, investment

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## INTRODUCTION

Diversification is an approach by which firm expand from its main business into other product market (Hsu, Chen, & Cheng, 2013). Research reveals that corporate management strongly engaged diversification activities and many researchers established this fact. Diversification advances debt capacity, alleviate the chances of bankruptcy by introducing new products/markets (Higgins & Schall, 2016) and improves asset placement and productivity. A diversified firm can move funds from a cash surplus unit to a deficit unit without taxes or transaction costs. Diversified firms pool unsystematic risk and reduce the variability of operating cash flow enjoy comparative benefit in hiring because key employees may have a higher sense of job security (Nyaingiri & Ogollah, 2015).

Diversification is investing in many assets in order to minimize risk or maximize return in the portfolio. It is an opportunity by which investors grow from his small firm into other market products (Badertscher, Shroff, & White, 2013). Study on diversification has captured the attention of many management scholars and is one of the significant areas of study in business. Among others, researchers have studied the antecedents of diversification and the financial performance (Elango, Ma, & Pope, 2008). Investors indeed would explore the benefit of diversification by investing on 10 to 15 securities as suggested by scholars of financial management. The benefit of investing in a large number of securities was clearly established in a more recent study (Fragkiskos et al., 2014).

Black Litterman model (BLM) is an asset allocation model that provides flexibility to combine the market equilibrium with additional

market views of the investor. In the BLM the user gives any number of views or statements about the expected returns of arbitrary portfolios, then the model combines the views with equilibrium, producing both the set of expected return of assets as well as the optimal portfolio weight (Walters, 2011).

Capital asset pricing model (CAPM) describes the relationship between risk and expected return and it serves as a model for pricing risky assets. CAPM states that the expected return of an asset or a portfolio equal the rate on a risk free asset plus a risk premium. If this expected return does not meet or beat the required return, then the investment should be avoided (Barberis, Greenwood, Jin, & Shleifer, 2015).

This study focuses on proposing procedures for partitioning of assets into optimal portfolios with the aid of Black Litterman allocations and investigating the effects of assets in minimizing risk of portfolio. We shall use  $\tau = 1.0$  which is considered to produce the best allocation (Satchell, 2000; Walters, 2013), with this allocations we shall estimate the risk of portfolios and assets, hence decide on optimal portfolio. Furthermore, we shall identify redundant asset and swap with riskless asset (Treasury Bill).

The remaining parts of this paper is organized as follow: section two reviews literatures, section three discusses the data used, section four explains the methodology adopted, section five discusses the findings and section six concludes the paper.

**LITERATURE REVIEWS**

Modern Portfolio theory is a finance theory that attempts to minimize risk of the portfolio and maximize portfolio expected return. Harry Markowitz (1952) was the first to discover the theory of modern portfolio. His discovery was filled with insights and ideas that anticipated many of the subsequent growth in the field. He originated a portfolio problem as a choice of the mean variance portfolio of assets. He observed that risk encountering by investors was portfolio risk which would lead to a basic and important point that the risk of a stock should not only be estimated just by the variance of the stock but also by the covariance. Moreover, he also mentioned that the best (optimal) portfolio should consist of assets that are perfectly negatively correlated. He noted that there are many perfectly positively correlated assets in circulation. This observation gives rise to the theory of diversification (Markowitz, 1952, 1959).

The most important aspect of Markowitz model was his description of the impact on portfolio diversification by the number of securities within a portfolio and their covariance relationships (Mangram, 2013). They used data on sectoral level of employment and value added to generate new and robust evidence that economic growth through stages of diversification and that sectoral concentration follows a U-shaped pattern in relation to per capital income (Imbs & Wacziarg, 2003). It is observed that mean-variance (MV) optimization is still the best theory of portfolio optimization but it is difficult to implement in practice. The asset weights are extremely sensitive to inputs and the inputs are difficult to achieve. Furthermore through MV it is not possible for investors to express their opinions on relative asset performance and their confidence in their selected expected asset returns

Black and Litterman improved on the original MV model by combining mean-variance optimization of Markowitz and capital asset pricing model (CAPM) (Black & Litterman, 1991). The original model was first developed in 1990 and a year later they elaborate on the strategic asset allocation that is embedded with investor’s views in a global sense. The model does not consider the assumption that expected returns are always at equilibrium with CAPM. Rather as expected returns deviate from the mean, imbalances in the markets will attempt to drive them back. Therefore, it is observed that investors would make more returns by combining their views about returns with the information in the equilibrium (Black & Litterman, 1991)

Moreover, additional vital feature of the BL structure is that investors should be willing to take risk according to their views and this should be done when they have strong evidence to support their views (Bevan & Winkelmann, 1998). BL model uses Bayesian approach to syndicate the views from the investor with respect to the expected returns of one or more assets with the market equilibrium vector of expected returns to provide a new, mixed estimate of expected returns. The new vector of returns results to intuitive portfolio gives a reasonable portfolio weight (Idzorek, 2005). Hence, the model produces better stable result than classical mean-variance optimization.

**METHODOLOGY**

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  $i$  be denoted by  $\mathfrak{R}_i$  and expected return of asset  $i$  be  $E(\mathfrak{R}_i)$ . Then the expected return vector is  $E(\mathfrak{R}) = col\{E(\mathfrak{R}_i)\} \in R^n$ , ( $i=1,2, \dots,n$ ). The covariance matrix is denoted by  $\Sigma \in R^{n \times n}$ . The covariance of assets  $i$  and  $j$  is given as  $\sigma_{ij}$  (Horasanlı & Fidan, 2007). The return  $\mathfrak{R}_p$  of portfolio is estimated by

$$\begin{aligned} \mathfrak{R}_p &= \sum_{i=1}^n x_i \mathfrak{R}_i \\ E(\mathfrak{R}_p) &= E\left(\sum_{i=1}^n x_i \mathfrak{R}_i\right) \\ \sum_{i=1}^n E(x_i \mathfrak{R}_i) &= \sum_{i=1}^n x_i E(\mathfrak{R}_i) \\ &= x'E(\gamma) \end{aligned} \tag{1}$$

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

$$\begin{aligned} \sigma_p^2 &= \sigma_i^2 \left(\sum_{i=1}^n x_i \mathfrak{R}_i\right) \\ &= \sum_{i=1}^n \sum_{j=1}^n \sigma_{ij} (x_i \mathfrak{R}_i, x_j \mathfrak{R}_j) \\ &= \sum_{i=1}^n \sum_{j=1}^n x_i x_j \sigma_{ij} (\mathfrak{R}_i \mathfrak{R}_j) \\ &= \sum_{i=1}^n \sum_{j=1}^n x_i x_j \sigma_{ij} \\ &= x'\Sigma x \end{aligned} \tag{2}$$

The expected return of equilibrium portfolio as:

$$\Pi = \lambda \sum x_{mkt} \tag{3}$$

where  $\Pi$  is the expected return of market equilibrium,  $\lambda$  is the risk aversion,  $x_{mkt}$  is the market weight.

The improvement in the BL model allows the investors to combine their views directly in the model in an intuitive way. The views can be relative. The views have to be in the same format with constraints. The investors should be able to fix a level of confidence in his views. This requirement may be as follows:

$$P.E(\mathfrak{R}) = Q + \varepsilon \tag{4}$$

where  $P$  is the vector that describes the assets concerned by the views,  $Q$  is the vector of their performances and  $\varepsilon$  is the random normal vector of error terms,  $\varepsilon \sim N(0, \Omega)$  with diagonal variance matrix

$\Omega$ . It is assumed that the market is rotating around an equilibrium point and the same with investors’ portfolio in respect to CAPM hypothesis (Hidalgo & Desportes, n.d.)

Let the mean  $E(\mathfrak{R}) = \Pi$ , the covariance, assumed to be proportional to  $\Sigma$ , with factor of uncertainty  $\tau$ ,  $E(\mathfrak{R}) \sim N(\Pi, \tau\Sigma)$ .

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 ( $\Pi$ ) and the vector of investor views ( $Q$ )

$$E(\mathfrak{R}) = [(\tau\Sigma)^{-1} + P'\Omega^{-1}P]^{-1}[(\tau\Sigma)^{-1}\Pi + P'\Omega^{-1}Q] \tag{5}$$

where there is no views from the investor  $P = Q = 0$  and  $E(\mathcal{R}) = \Pi$  the market equilibrium,  $\tau$  is weight on investor view.

**DATA**

The sample data consists of monthly closing spot prices for Gold, Silver, Platinum, and Oil. The data spans from 3<sup>rd</sup> January, 2000 to 1st September, 2016 with a total of 200 observations. The data are obtained from DataStream (Yahoo finance).

**RESULTS AND DISCUSSION**

The assets allocations results divulge from Black Litterman model is used for estimation of portfolios risk and assets. The proposed procedures for construction of portfolios are given as follow: first partitioning of assets into portfolios, second estimation of risk of the portfolios, third calculation of risk of each asset, fourth swapping of redundant asset (lowest risk-reduction asset) for riskless asset ;Treasury Bill (T-Bill), fifth computation of risk for portfolios with riskless asset, in order to decide on optimal portfolio. These procedures are used to construct portfolios and estimate risks in Table 3.1 below.

**Table 3:** Portfolios, Risk and Assets Allocations

Portfolio	Risk	Asset Allocation		
		Gold	Oil	Silver
Portfolio1	20%	55%	17%	28%
		Gold	Oil	Platinum
Portfolio2	26%	68%	21%	11%
		Oil	Silver	Platinum
Portfolio3	31%	40%	46%	14%
		Gold	Silver	Platinum
Portfolio4	23%	71%	29%	0%

Table 3 displayed portfolios1 to 4 and the risk percentages in them. From the table, Portfolios1 to 4 exhibit 20%, 26%, 31% and 23% risks respectively. It is observed that Porfolio1 has the lowest risk and portfolio3 contains highest risk. Hence it is noted that portfolios with gold divulged minimum risk while portfolio with platinum generated high risk. It implies that the presence of gold in the portfolios minimizes the risk of the portfolio while the presence of platinum made no impact in the portfolio. Thus, this brings motivation to further estimate the risk exhibits by each asset. Table 3.2 shows percentage of risk reduction strength of the assets.

**Table 3:** Asset Risk Reduction Strength

	Gold	Oil	Silver	Platinum
Risk.Reduction Strength	56%	15%	29%	0%

Table 3 showed the strength of each asset in risk reduction of the portfolios. It can be vividly seen in the table that gold made more impacts in risk reduction than other assets. Gold has 56% strength of risk reduction, oil is 15%, and silver has 29% while platinum has 0% in risk reduction. It is worth stating that gold reduced more than half risk of the portfolios. This is the reason portfolio1 that contained gold and no platinum has lowest risk while portfolios3 with platinum and no gold has highest risk. In view of this fact, it is expedient for rational investors to know the strength of risk reduction of every asset they wish to diversify.

**CONCLUSION**

This paper investigates effects of diversification of assets in optimizing risk of portfolio and also proposed procedures for investing in optimal portfolio. Diversification is a strategic approach for minimizing risk of portfolio but if not done according to standard procedures, it may not fulfil the purpose. In this study Black Litterman (BL) model was used for assets allocations being the best

assets allocation model in finance at present(Idzorek, 2005), the results of BL model were used to estimate both risk exhibits by portfolios and assets. Hence, it is observed that portfolio1 is the optimal portfolio to invest for rational investors.

Moreover, it is noticed that portfolio1 has the lowest risk as a result of the presence of gold and absence of platinum in the portfolio. According to this study, in order to minimize risk of portfolios, there is need for investors to; first estimate the strength of risk reduction of all the assets he wishes to diversify, second partition the assets into portfolios, third check the risk of each portfolio to decide on the optimal portfolio. Moreover, investors should endeavour to add high risk reduction assets like gold to portfolios and remove redundant asset like platinum in order to minimize portfolio risk.

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