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Research paper

Optimal risk computation on precious metal's assets diversification

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Abstract

Optimization is the selection of a best element with regards to certain criterion from set of available alternatives. This paper investigates the effects of assets in optimizing risk using diversification strategy and also examines gold quality of hedging and safe haven. The reduction strength of assets is estimated. Hence, it is observed that gold exhibits highest risk reduction strength. Also it is noticed that gold acts as hedge and safe haven for investors during economic recession.

Keywords: *Asset; Black Litterman; Diversification; Return; Risk.*

1. Introduction

Over the years, the choice to diversify assets has offered tremendous benefits to investors. Diversification improves debt capacity, alleviates cases of bankruptcy by enhancing new products/markets [1] and improves assets placement and productivity. A diversified firm can transfer funds from a cash surplus section to a deficit unit without taxes or transaction costs. Diversification circumvent unsystematic risk and minimize the variability of operating cash flow [2], [17]. Diversification is investing in many assets for the purpose of optimizing both risk and return. There are other studies that involves in diversification, optimization and minimizing operating cash flow [12], [13], [14], [15], [16].

According to economics, there is trade-off with diversification and it is definite that the outcomes of firm hinge on the way investors maintain the trade-off in each concrete case [3], [15] the management researchers claim that diversification elongates the life of a firm but if the strategy of diversification are not strictly followed it may not fulfil the purpose of optimization.

This study focuses on diversification strategy that optimizes risk of portfolio and to provide better platforms for investors to make optimal choice. The remaining parts of this paper is organized as follows: section two reviews literature, section three explains the methodology adopted, section four describes the data used, section five discusses the findings and section six concludes the paper.

2. Literature review

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 noted that there are many perfectly positively correlated assets in circulation. This observation gives rise to the theory of diversification [4], [5].

Black and Litterman improved on the original MV model by combining mean-variance optimization of Markowitz and CAPM [6]. The original model was first developed in 1990 and a year later they elaborated on the strategic asset allocation that is embedded with investor's views in a global sense. Therefore, it is observed that investors would make more returns by combining their views about returns with the information in the equilibrium [6].

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 and give a reasonable portfolio weight [7]. Hence, the model produces better stable result than classical mean-variance optimization.

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 [8]. 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 [9]. 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 [10].

3. 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 $\Re_i$ and expected return of asset i be $E(\Re_i)$. Then, the expected return vector is $E(\Re) = col\{E(\Re_i)\} \in R^n$, (i=1,2, ….,n). The covariance matrix is denoted by $\sum \in R^{nxn}$. The covariance of assets i and j is given as σ_{ij} [8]. The return $\Re_p$ of portfolio is estimated by

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

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

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

$$= x'E(\gamma) \quad (1)$$

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

$$\sigma_p^2 = \sigma_i^2\left(\sum_{i=1}^{n} x_i \Re_i\right)$$
$$= \sum_{i=1}^{n}\sum_{j=1}^{n} \sigma_{ij}\left(x_i \Re_i, x_j \Re_j\right)$$
$$= \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij}\left(\Re_i \Re_j\right)$$
$$= \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij}$$

$$= x'\sum x \quad (2)$$

The expected return of equilibrium portfolio as:

$$\Pi = \delta \sum x_{mkt} \quad (3)$$

where Π is the expected return of market equilibrium, δ is the risk aversion, x_{mkt} is the market weight, δ_p^2 is the variance of portfolio, Σ is the covariance matrix, δ_i^2 is the variance of assets i, R_i *and* R_j are returns of assets i and j respectively, δ_{ij} is the covariance matrix of assets i and j.

The improvement in the BL model allows the investors to combine their views directly in the model in an intuitive way.

$$P.E(\Re) = Q + \varepsilon \quad (4)$$

Where P is the vector that describes the assets concerned by the views, Q is the vector of their performances and ε is the random normal vector of error terms, $\varepsilon \sim N(0, \Omega)$ with diagonal variance matrix Ω, and $E(\Re)$ is the expected return.

Let the mean $E(\Re) = \Pi$, the covariance, assumed to be proportional to Σ, with factor of uncertainty τ, $E(\Re) \sim N(\Pi, \tau\Sigma)$. Therefore, equation (5) 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)

$$E(\Re) = \left[(\tau\Sigma)^{-1} + P'\Omega^{-1}P\right]^{-1}\left[(\tau\Sigma)^{-1}\Pi + P'\Omega^{-1}Q\right] \quad (5)$$

In a case where there is no investor views, then $P = Q = 0$ and $E(\Re) = \Pi$ the market equilibrium, Σ is the covariance matrix, τ is the weight on investor view, P is the link matrix, Q is the investor views, Ω^{-1} is the level of uncertainty for investor views predictions.

4. Data

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

5. Results and discussion

The result of BL model is used for estimation of portfolio risk and assets. The proposed diversification strategy for optimizing risk of portfolios are given as follows: first partition assets into portfolios, second estimate risk of the portfolios, third calculate risk-reduction strength assets, fourth swap redundant asset (or lowest risk-reduction asset) for any profitable asset, fifth compute risk of portfolios with new asset in order to decide on optimal portfolio. This strategy is used to develop diversified assets portfolio and estimating risk in Tables 1 and 2.

Table 1: Asset Portfolio

Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Gold	Gold	Gold	Silver
Silver	Silver	Oil	Oil
Oil	Platinum	Platinum	Platinum

Table 2: Portfolio Risk

	Benchmark Portfolio	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Portfolio risk	0.0068	0.0068	0.0078	0.0088	0.0106

Table 1 displays portfolios 1 to 4 and Table 2 divulges portfolios' actual risk. Portfolios 1 to 4 exhibit 0.0068, 0.0078, 0.0088 and 0.0106 risks respectively. It is observed that Portfolio 1 has the lowest risk with the values 0.0068 which is the same with benchmark portfolio risk and portfolio 4 contains highest risk with the values 0.0106. Hence it is observed that portfolios with gold divulged minimum risk while portfolios with platinum generated high risk. It implies that the presence of gold in the portfolios minimizes risk of portfolio while the presence of platinum made no impact in the portfolio. Furthermore, we discovered that portfolio 1 is as good as benchmark portfolio. This motivated us to investigate the strength of each asset in risk reduction. Table 3 presents the strength of each asset in percentage.

Table 3: Assets Risk-Reduction Strength

Gold	Silver	Oil	Platinum
56%	29%	15%	0%

Table 4: Correlation Matrix for Hedging

	Gold	Oil	Silver	Platinum
Gold	1	0.24156	0.10426	0.41623
Oil	0.24156	1	0.00762	0.20457
Silver	0.10426	0.00762	1	0.26193
Platinum	0.41623	0.20457	0.26193	1

The total risk of benchmark portfolio is 0.0068; this is the extent to which these four assets can reduce the risk of portfolio. Table 3, shows that gold, oil, silver and platinum exhibit risk reduction strengths of 56%, 29%, 15% and 0% respectively. This implies that gold has 56% risk reduction strength, silver is 29%, and oil has 15% while platinum has 0% risk reduction. This vividly show that gold made more impacts in risk reduction than other assets. It is worth stating that gold reduced more than half risk of the portfolios. This is the reason portfolio 1 that contained gold and no platinum has lowest risk while portfolios 4 with platinum and no gold has highest risk. According to our result platinum makes no impact in risk reduction of the portfolio and this is called redundant asset, therefore it worth no investing. The last step of our procedures is to discard the redundant asset and swap with valuable asset. Table 4 presents the correlation matrix of the assets for hedging and safe haven. The guiding rule is that, any asset that is uncorrelated (value between 0 and 0.4) and negatively correlated (negative value) is hedge or safe haven with gold otherwise not hedge/safe haven with gold. The result show that gold is uncorrelated with other assets, it implies that gold can acts as hedge/safe haven for others assets.

6. Conclusion

This paper proposed diversification strategy in optimizing risk of portfolio. In addition, we investigate the impacts of each asset we diversify, in order to examine the strength of each asset in risk reduction. 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 for rational investors.

According to this study, in order to minimize risk of portfolios, there is need for investors to follow the diversification strategy itemized above strictly in order to optimize risk or return of portfolio. Furthermore, we wish to state that gold can serve as hedge and safe haven; meaning that investor can invest more on gold to safe the investments of silver, oil and platinum during financial crisis/recession.

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