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Optimizing the Portfolio in Malaysian Stock Market with Mean-Variance Model

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Abstract

The FTSE Bursa Malaysia Kuala Lumpur Composite Index (FBMKLCI) is a capitalization-weighted stock market index which plays a prominent role to evaluate the performance of the Kuala Lumpur stock market. The investors are interested in obtaining the maximum level of the expected return with the minimum level of the risk. In view of the COVID-19 pandemic, the FBMKLCI has been affected recently. Portfolio optimization is crucial to determine the optimal combination of stocks and proportions with the aim of achieving higher profit at minimum less risk in an investment. The mean-variance portfolio optimization model is robust to minimize the portfolio risk at the expected return. In this paper, an optimal portfolio is constructed with mean-variance model to obtain the target rate of return at minimum risk. The data of this paper consists of returns of 30 stocks of FBMKLCI. The main findings of this paper indicate that the optimal portfolio is able to obtain the target rate of return at minimum risk. The contribution of this study is to construct an optimal portfolio by achieving higher return at minimum risk in portfolio investment using mean-variance model..

Key-words: Portfolio Optimization, Risk, Return, Optimal Portfolio

I. INTRODUCTION

The COVID-19 pandemic has brought numerous negative impacts on the global financial market (Chia, Liew, & Rowland, 2020; Lee, Jais, & Chan, 2020; Liu et al., 2020a; Aldulaimi, 2021). The COVID-19 pandemic has been adversely affected the country's economic and corporate earnings growth as well as the stock markets. Undoubtedly, all the stock markets around the world were affected by the pandemic. According to the past studies, the impacts of the COVID-19 pandemic on the stock markets from different countries such as the USA, Indonesia, China, Korea, and Spain have been investigated by the researchers (Albulescu, 2020; Liu et al., 2020b; Nia, 2020; Sansa, 2020; Yilmazkuday, 2020; Zeren & Hizarci, 2020).

The stock markets play a prominent role in spurring economic development and growth (Naqvi et al., 2017). The stock market is important to provide a platform to make the investment in different stocks efficiently and effectively. Portfolio selection is very important on how to choose an optimal portfolio among a number of assets that are capable to strike a balance between minimizing the risk and maximizing the return. In other words, portfolio selection is to consider the best satisfactory allocation of investments among various assets. Mean-variance (MV) model has been proposed in portfolio optimization to construct an optimal portfolio in market investment (Markowitz, 1952). The MV model has played an important role to identify an optimal portfolio that can generate the expected return at minimum risk (Tayali & Tolun, 2018; Konno & Yamazaki,

1991; Weston & Ford, 2003; Huang, 2012; Michael, 2013; Pinasthika & Surya, 2014; Spaseski, 2014; Markowitz, 1991).

According to the past studies, the researchers have conducted a study on the portfolio optimization and selection with the portfolio optimization model (Wilcox & Fabozzi, 2009; Li, Qin, & Kar, 2010; Beardsley, Field, & Xiao, 2012; Liu, Liu, & Wang, 2013; Fulga, 2016; Mei, DeMiguel, & Nogales, 2016; Xidonas et al., 2017; Zhang, Jin, & An, 2017; Huang, 2008; Huang, 2010). Jiang, Ma, & An, (2010) have investigated the investor's portfolio choice with the MV portfolio optimization model. They have also investigated the efficient portfolios' properties and the investor's hedging behavior in the presence of risk. Santos-Alamillos et al. (2017) have explored the alternative repowering actions in Spain by using MV portfolio optimization model. The aim of the study is to provide valuable insight for energy policy-making in order to repowering the renewable generation optimally in the future. Guo et al. (2018) have done a study on the banking firms' behavior with the MV model.

The COVID-19 pandemic has affected the global stock markets. Since the stock markets are very important in promoting the economic growth and development of a country, therefore it is essential to construct an optimal portfolio to analyze the performance of the stocks in Malaysia. This paper aims to construct the optimal portfolio in Malaysian stock market with mean-variance optimization model which can achieve the expected return at minimum risk.

The remainder of the manuscript is structured as follows. Section 2 presents the materials and methods. The next section demonstrates the empirical results of this study. Finally, the concluding remarks are enumerated in Section 4.

II. MATERIALS AND METHODS

In this paper, the weekly returns of 30 stocks of FBMKLCI are collected. The study's period is ranging from January 2018 to December 2020.

2.1 Mean-Variance (MV) Model

In this paper, the optimal portfolio is constructed with the MV portfolio optimization model (Markowitz, 1952). The formulation of the MV portfolio optimization model is shown as follows:

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

Subject to

$$\sum_{j=1}^{n} r_j x_j \geq \rho \qquad (2)$$

$$\sum_{j=1}^{n} x_j = 1 \qquad (3)$$

$$x_j \geq 0,\ j = 1,2,3,...,n \qquad (4)$$

where

n is the number of assets,

σ_{ij} is the covariance between assets i and j,

x_j is the weight invested in asset j,

x_i is the weight invested in asset i,

ρ is a parameter representing the target rate of return required by an investor,

r_j is the expected return of asset j per period.

Equation 1 shows the objective function which aims to minimize the portfolio risk. Equation 2 aims to obtain the returns at the desired level of return. Equation 3 is used to set the sum of all the assets' weights is equal to one. Equation 4 is to let the weights of all the assets are non-negative.

The portfolio mean return is shown as follows (Bodie, Kane, & Marcus, 2005):

$$r_p = \sum_{j=1}^{n} r_j x_j \qquad (5)$$

where

r_p is the portfolio mean return,

x_j is the weight invested in asset j,

r_j is the expected return of asset j per period.

The formula of portfolio performance ratio is presented as follows (Bodie, Kane, & Marcus, 2005):

$$\text{Performance ratio} = \frac{\text{Mean return}}{\text{Risk}} \qquad (6)$$

The computational work is performed using LINGO software which generates the results for the optimization models (Lam, Jaaman, & Ismail, 2015a; Lam, Liew, & Lam, 2018; Liew, Lam, & Lam, 2017; Lam, Jaaman, & Ismail, 2015b; Lam, Lam, & Liew, 2017; Lam, Liew, & Lam, 2018; Ibrahim, Aburukba, & El-Fakih, 2018; Ho, 2019).

III. RESULTS AND DISCUSSIONS

Table 1 presents the optimal portfolio composition of the MV model.

Table 1 - Optimal Portfolio Composition of the MV Model

Stocks	Percentage (%)
AXIATA	0.00
CIMB	0.00
DIALOG	2.94
DIGI	0.00
GENM	0.31
GENTING	0.00
HAPSENG	0.00
HARTA	0.00
HLBANK	0.00
HLFG	0.00
IHH	12.54
IOICORP	0.00
KLK	6.65
MAXIS	7.03
MAYBANK	12.21
MISC	12.31
NESTLE	23.01
PBBANK	0.00
PCHEM	0.00
PETDAG	3.57
PETGAS	1.41
PMETAL	0.00
PPB	13.23
RHBBANK	0.00
SIME	0.00
SIMEPLT	1.67
SUPERMX	0.00
TENAGA	0.00
TM	0.00
TOPGLOV	3.12

As tabulated in Table 1, the MV model's optimal portfolio composition has been determined. The optimal portfolio consists of DIALOG (2.94%), GENM (0.31%), IHH (12.54%), KLK (6.65%), MAXIS (7.03%), MAYBANK (12.21%), MISC (12.31%), NESTLE (23.01%), PETDAG (3.57%), PETGAS (1.41%), PPB (13.23%), SIMEPLT (1.67%), and TOPGLOV (3.12%). Based on the results, NESTLE gives the largest weight (23.01%) which indicates NESTLE is the biggest component in the optimal MV portfolio. The next stock that obtains the second largest component is PPB (13.23%), followed by IHH (12.54%), MISC (12.31%), and MAYBANK (12.21%). The stocks with less than 10.00% are indicated by MAXIS, KLK, PETDAG, TOPGLOV, DIALOG, SIMEPLT, PETGAS, and GENM. On the other hand, there are total of 17 stocks are not chosen and invested since these stocks give 0.00% based on the optimal solution of MV model. These 17 stocks are as follows: AXIATA, CIMB, DIGI, GENTING, HAPSENG, HARTA, HLBANK, HLFG, IOICORP, PBBANK, PCHEM, PMETAL, RHBBANK, SIME, SUPERMX, TENAGA, and lastly TM.

Table 2 summarizes the descriptive statistics of the stock returns.

Table 2 - Descriptive Statistics of Stocks Returns

Stocks	Mean	Variance	Skewness	Kurtosis
AXIATA	-0.0014	0.0021	-0.2916	1.9587
CIMB	-0.0023	0.0012	0.3685	2.5975
DIALOG	0.0024	0.0009	0.7826	1.4179
DIGI	-0.0009	0.0008	0.3713	0.3816
GENM	-0.0036	0.0024	-0.9311	5.7209
GENTING	-0.0037	0.0019	0.6466	6.8176
HAPSENG	-0.0003	0.0010	0.6283	19.5769
HARTA	0.0074	0.0040	1.4136	7.2183
HLBANK	0.0010	0.0009	0.3450	6.7065

HLFG	0.0005	0.0012	0.0442	2.9993
IHH	0.0001	0.0006	0.8171	3.6857
IOICORP	0.0002	0.0006	-0.2785	4.8415
KLK	0.0001	0.0005	-0.7782	11.9354
MAXIS	-0.0009	0.0005	0.4294	0.4777
MAYBANK	-0.0007	0.0005	1.0321	5.2703
MISC	-0.0004	0.0008	0.0689	4.2756
NESTLE	0.0022	0.0005	2.7794	21.9349
PBBANK	0.0006	0.0013	2.0283	10.4552
PCHEM	0.0007	0.0017	-1.0157	8.0513
PETDAG	-0.0003	0.0011	0.4144	5.2676
PETGAS	0.0003	0.0008	1.0530	4.4780
PMETAL	0.0037	0.0024	0.5014	6.1046
PPB	0.0020	0.0004	-0.5992	5.3270
RHBBANK	0.0011	0.0009	0.6007	4.6924
SIME	0.0010	0.0019	0.8700	8.7829
SIMEPLT	-0.0004	0.0012	0.7174	13.1471
SUPERMX	0.0221	0.0111	1.5303	4.1542
TENAGA	-0.0018	0.0009	1.0403	3.9933
TM	0.0003	0.0029	1.2119	10.4495
TOPGLOV	0.0122	0.0044	2.0123	10.6377

According to Table 2, the descriptive statistics of the stock returns are presented. The mean, variance, skewness, and kurtosis are calculated and shown in the table above. Based on the Table 2, the stock returns with the smallest variance is PPB (0.0004). On the other hand, SUPERMX has the largest variance which is 0.0111. For the kurtosis, NESTLE can be observed to have the highest value which is 21.9349. Among the other stocks, the kurtosis for DIGI is the smallest with 0.3816.. The stocks with the positive mean return are DIALOG, HARTA, HLBANK, HLFG, IHH, IOICORP, KLK, NESTLE, PBBANK, PCHEM, PETGAS, PMETAL, PPB, RHBBANK, SIME, SUPERMX, TM, and TOPGLOV. There are total of 18 stocks with a positive mean. Then, the rest of the stocks such as AXIATA, CIMB, DIGI, GENM, GENTING, HAPSENG, MAXIS, MAYBANK, MISC, PETDAG, SIMEPLT, and TENAGA are with the negative return. Based on the skewness, the stocks with the negative skewness are AXIATA, GENM, IOICORP, KLK, PCHEM, and PPB. There are about 80% of the stocks are having a positive skewness. The stocks with the positive skewness consist of CIMB, DIALOG, DIGI, GENTING, HAPSENG, HARTA, HLBANK, HLFG, IHH, MAXIS, MAYBANK, MISC, NESTLE, PBBANK, PETDAG, PETGAS, PMETAL, RHBBANK, SIME, SIMEPLT, SUPERMX, TENAGA, TM, and TOPGLOV.

Table 3 displays the optimal MV portfolio's summary statistics.

Table 3 - Summary Statistics of the Optimal MV Portfolio

Mean-variance Model	**Value**
Portfolio mean return	0.0010
Portfolio standard deviation	0.0128
Portfolio performance ratio	0.0779

As depicted in Table 3, the MV model shows a 0.0010 portfolio mean return. The portfolio standard deviation obtained in this study is 0.0128. After that, the portfolio performance ratio can be obtained by taking the portfolio mean return divided by portfolio standard deviation. In this study, the portfolio performance ratio is 0.0779. The optimal portfolio identified in this paper can assist the investors to achieve the minimum level of risk.

In this study, an optimal portfolio is constructed to achieve the expected return at the minimum

risk with MV model. The contribution of this study to investigate the FBMKLCI components by generating an optimal portfolio that acts as a benchmark to the investors in portfolio investment.

IV. CONCLUSION

In this paper, the optimal portfolio is constructed with mean-variance model to generate the expected return at minimum risk. The findings of this paper indicate that there is a difference of weights for the optimal portfolio composition. Based on the results, the biggest component of optimal portfolio is NESTLE, followed by PPB, IHH, MISC, MAYBANK, MAXIS, KLK, PETDAG, TOPGLOV, DIALOG, SIMEPLT, PETGAS, and finally GENM. The results also show that the investors are able to achieve the expected return at the minimum risk. This study is significant as it is able to construct an optimal portfolio that acts as a guideline for the investors to make a better investment decision.

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