

## The Analysis of Portfolio Risk Management using VAR Approach Based on Investor Risk Preference

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### Abstract

Ackert and Deaves (2010) said that most people have tendency to being risk averse, but with appropriate amount of compensation, people may take more risk. Understanding those circumstances, this research trying to figure risk involved in a Mean-Variance Model. This model has taken consideration about investor risk preference in composed VAR model. VAR define as a measure of the risk of investments, which in this research focuses on risk preferences. This research also conducts comparison between optimum portfolio model known as Single Index Model and Mean-Variance Mode. Robustness test taken too analyze the outcomes from different data input. Research showed that risk preference has an impact on generating portfolio based on Mean-Variance Mode (MVM). Meanwhile, Single Index Model (SIM) found to given a similar result as MVM in high risk preference. This has shown that SIM may not adequate for those who have low risk preference. Research also show that risk taker investor get more gain and endure more risk than risk averse investor. But, based on robustness test, we found that the lowest risk an investor bear is on the highest risk preference. Thus, we make a conclusion that variance is not the only factor that might cause VaR increased, data dispersion has become more major factor.

**Keywords:** Value at risk, Single Index Model, Optimum Portfolio.

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## 1. INTRODUCTION

Investment has become a common thing today. In determining investment, an investor tends to face an option to create an optimum portfolio. However, in determining the optimum portfolio, the most important factor is neglected which is the level of risk preference that is owned by the investor.

Ackert and Deaves (2010) state that basically everyone is risk averse. However, with the reasonable compensation, one can face bigger risk. Damodaran (2011) explains that the risks of a Chinese character namely 危机 (Wéiji) which contains two letters namely danger and opportunity, therefore, the risk must be handled properly so that danger can be avoided and opportunities can be achieved.

The Basel Accord amendment in 1995 required each financial institution to calculate Value of Risk (VaR) on its investment risk. The amendment gave freedom for the institution to use the method they want. VaR calculates the greatest possible value drop in normal market condition over a certain period of time and certain level of confidence (Surya and Situngkir, 2016).

Several researches in portfolio optimization using VaR have been conducted by Chang et al. (2011), Sukono et al. (2008), Kim (2008), and Buchdadi (2007). Research on the characteristics of VaR has been done by Jorion (2007), Harmantzis et al. (2006), Degiannakis et al. (2012), and Surya and Situngkir (2006). Jorion (2007) states that calculation using VaR uses a percentile based with a confidence level that is adjusted to the level of investor confidence. Harmantzis et al. (2006) calculated VaR using skew method distribution by focusing on the probability point of the data skew. Surya and Situngkir (2006) measured VaR with a data distribution approach that combines Jorion (2007) and Harmantzis et al. (2006). This research uses a VaR that focuses on investor preferences on risk.

After knowing that there are generally 3 categories of investor based on risk aversion level (risk averse, risk neutral, and risk taker), therefore, the composed investment portfolio of each investor type will be different. The higher the risk that an investor dares to bear, the higher the return volatility of portfolio results that are formed. It is vice versa for investors who do not want to take a high risk. Therefore, it is necessary to calculate the amount of changes in return results that can be tolerated by an investor with a certain level of risk and a certain level of confidence. The amount of change in the value of this return result will be found using the VaR method.

This research aims to examine the effect of risk preference towards portfolio formation using Mean-Variance Model as well as to recognize the characteristics of return and risk level on the formed portfolio. Comparison to the optimal model using Single Index Model is conducted to find out the similarity characteristics of both methods. Furthermore, hypothesis testing to find out the difference of return and risk between investor of risk takers and risk averse is also done to see the significance (Panjaya, 2014). In addition, Robustness testing is also conducted to find out the suitability of results with different data. After the establishment of the portfolio, portfolio performance is conducted with the testing of Sharpe, Treynor, and Jensen Alpha.

The data that will be used are stocks incorporated in LQ45 during the research period February 1, 2010 – October 1, 2015. Robustness testing is also conducted to find out the results formed at the different time frame on February 1, 2009 – October 1, 2014.

## 2. THEORITICAL REVIEW AND HYPOTHESIS DEVELOPMENT

Based on the objectives of this research, thus, this section discusses directly about the measurement method and problem formulation that produces research hypothesis. The problem formulations in this research are as follow:

- a. Does risk preference impact the portfolio selection that consists of LQ45 stocks?
- b. Which one produces better profit levels between risk averse and risk takers investor?
- c. Is the VaR value of investor with risk averse type equal to or different from the investor of risk taker type?
- d. Does the portfolio result using Single Index Model have similarities with portfolio result using Mean-Variance Model at a certain risk level?

### 2.1. Mean-Variance Model

This model was developed by Markowitz (1952) from a single index model which explains that the portfolio is accepted if the amount of return produced is greater than the risk preference value ( $\theta$ ) multiplied by the portfolio variance. The greater the value of  $\theta$ , the lower the investor risk preference. The model can be seen as follows:

$$\bar{R}_p = \sum_{i=1}^k w_i \alpha_i + \bar{R}_m \sum_{i=1}^k w_i \beta_i - \theta \sigma_p^2$$

Description:

$R_p$  = Return portfolio

$w_i$  = Weight of assets

$\alpha_i$  = Alpha portfolio

$\beta_i$  = Beta portfolio

$R_m$  = Market Return

$\theta$  = Risk preference

$\sigma_p^2$  = Portfolio Variance

The variants of the portfolio are:

$$\sigma_p^2 = \sum_{i=1}^k w_i \sigma_i^2 + \sum_{i=1}^k \sum_{j=1}^k w_i w_j Cov(R_i, R_j) ; i \neq j$$

Furthermore, since investors have different risk preferences, therefore,  $\theta$  is a risk preference received by investors, Markowitz (1952) then formed the Mean-Variance Model as follows:

$$\bar{R}_p = \sum_{i=1}^k w_i \alpha_i + \bar{R}_m \sum_{i=1}^k w_i \beta_i - \theta \sigma_p^2$$

From the model, it can be seen that the return produced by a portfolio can be judged whether it is worthy or not based on the influence of risk preference owned by an investor. The greater the risk preference, the higher the expected return with the same variance or smaller variance with the same return.

### 2.2. Single Index Model

The establishment of a portfolio using the SIM as stated in Murhadi (2014) and Markowitz (1952) is as follows:

- a. Stock Returns

Return is the level of profit received by the investors in a period which is calculated by the equation:

$$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Description:

$R_i$  = Stock Return i

$P_t$  = Stock price period t

$P_{t-1}$  = Stock price of previous period

b. Expected Return

Expected return is the level of profit that is expected to be accepted by the investors through an investment for several periods ahead with the formulation:

$$E(R_i) = \frac{\sum_{j=1}^N R_{ij}}{N}$$

Information:

$E(R_i)$  = The rate of profit expected by an investor from a stock investment

$R_{ij}$  = Return of stock i in period j

N = Number of periods

c. Stock Risk

Stock risk is a deviation that occurs due to the difference between actual returns with stock expectations which is calculated by:

$$\sigma_i^2 = \frac{\sum_{j=1}^N (R_{ij} - E(R_i))^2}{N}$$

d. Return and Market Risk

Market return is the level of market advantage that investors can get from an investment. The value of market return in Indonesia in stock investment can be seen from IHSG with the following calculation:

$$R_{m,t} = \frac{IHSG_t - IHSG_{t-1}}{IHSG_{t-1}}$$

Description:

$R_{m,t}$  = Market return on a certain period

$IHSG_t$  = Composite Stock Price Index at certain period

$IHSG_{t-1}$  = Composite Stock Price Index in the previous period

Expected market return is the level of market profit that is expected to be accepted by the investor from an investment for several periods ahead with formulation:

$$E(R_M) = \frac{\sum_{t=1}^N R_{m,t}}{N}$$

Description:

$R_{m,t}$  = Market return for a certain period

$E(R_M)$  = The level of market profit expected by the investor

N = Number of periods

Market risk occurs due to volatility beyond the control of companies such as currency exchange rates, interest rates, commodities, and political conditions. This risk can be calculated using the following formula:

$$\sigma_M^2 = \frac{\sum_{t=1}^N (R_{M,t} - E(R_M))^2}{N}$$

Description:

$\sigma_M^2$  = Market variant

$R_{M,t}$  = Market return for a certain period

$E(R_M)$  = The level of market profit expected by the investor

$N$  = Number of periods

e. Beta

Beta is a measure against the systematic risk of a stock. In addition, beta becomes a measure of the volatility of securities returns towards market returns so that through beta, investors can find out the ratio of stock returns with market returns whether they are comparable, larger, or smaller (Markowitz, 1952).

$$\beta_i = \frac{\sum_{t=1}^N (R_i - E(R_i)) * (R_M - E(R_M))}{\sum_{t=1}^N (E(R_M) - R_M)^2}$$

Description:

$R_M$  = Market Return in certain period

$E(R_M)$  = The level of market profits expected by investors from stock investments

$E(R_i)$  = The rate of return expected by an investor from a stock investment

$R_i$  = Stock Return

$\beta_i$  = Beta stock

f. Alpha

Alpha is the difference between actual and expected return at a certain beta level. Generally, alpha becomes one measure to compare the performance of a stock investment with other stocks. Alpha can be calculated from the equation:

$$E(R_i) = \alpha_i + \beta_i \cdot E(R_M)$$

Description:

$E(R_i)$  = The rate of return expected by an investor from a stock investment

$E(R_M)$  = The level of market profits expected by investors from stock investments

$\alpha_i$  = Alpha stock

$\beta_i$  = Beta stocks

g. Residue Error and Residue Error Variant

Residue errors need to be considered in order to determine the amount of the risk that is not systematic in a security. While the residual error variant see the level of error between the expected return with actual on each stock.

$$R_i = \alpha_i + \beta_i \cdot R_M + e_i$$

Description:

$R_i$  = Stock Return

$R_M$  = Market Return

$\alpha_i$  = Alpha stock

$\beta_i$  = Beta stocks

$e_i$  = Residue error

While the residual error variant can be found by the equation:

$$\sigma_i^2 = \beta_i^2 * \sigma_M^2 + \sigma_{e_i}^2$$

Description:

$\sigma_M^2$  = Market variant

- $\sigma_i^2$  = Variant of stock
- $\beta_i^2$  = Beta stocks
- $\sigma_{ei}^2$  = Variant of residual error

h. Excess Return to Beta

Excess return to beta is used to measure the relative excess return against a type of risk that cannot be diversified by beta size.

$$ERB_i = \frac{E(R_i) - R_{BR}}{\beta_i}$$

Description:

$E(R_i)$  = The rate of return expected by an investor from a stock investment

$R_{BR}$  = Risk free return

$\beta_i$  = Beta stocks

$ERB_i$  = Excess return to beta on stock i

i. Cut-off Point

Cut-off point is a maximum return limits that investors want to obtain in order to avoid the risk on the investment of stock price fluctuations. Before performing cut-off point calculation, it must first consider the calculation of Alpha and Beta on certain stocks with the following formula:

$$= \frac{(E(R_i) - R_{BR}) * \beta_i}{\sigma_{ei}^2}$$

$$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}$$

$$C_i = \frac{\sigma_M^2 \sum_{j=1}^i A_j}{1 + \sigma_M^2 \sum_{j=1}^i B_j}$$

Description:

$C_i$  = Minimum return limit determined by investor and fluctuation rate of stock price

$A_j$  = The level of excess abnormal return that can be obtained from stock investment

$B_j$  = Th size of systematic risk that is in stock investment

$\beta_i$  = Beta Stocks

$\sigma_{ei}^2$  = Variant of residual error

$E(R_i)$  = The rate of return expected by an investor from a stock investment

$R_{BR}$  = Risk free return

j. Proportion

Furthermore, the calculation of the amount of funds proportion that should be allocated into an investment instrument is conducted so that the expected goal by investors can be achieved.

$$W_i = \frac{X_i}{\sum_{j=1}^k X_j}$$

With  $X_i$  obtained through the formula:

$$X_i = \frac{\beta_i}{\sigma_{ei}^2} (ERB_i - C^*)$$

Description:

$W_i$  = Proportion of funds on the ke-i investment stocks

$K$  = Number of stocks in optimal portfolio

$X_i$  = Proportion of each selected stock

$\beta_i$  = Beta stocks

$\sigma_{ei}^2$  = Variant of individual error

$ERB_i$  = Excess return to beta on stock i

$C^*$  = The maximum return restriction set by the investor from the stock price fluctuation rate

### 2.3. Value at Risk (VaR)

VaR calculates the largest daily value decrease over a certain time span and a certain degree of confidence. Using historical data, non-parametrically, VaR can be calculated using a percentile with the desired level of confidence Linsmeier et al. (2000) and (Jorion, 2007).

Non-parametric method is used to calculate VaR regardless of the type of distribution it has. Knowing that the initial value of investment is  $W_0$  and the final value of the portfolio at the end of the target period is  $W$ , then it will show the equation:  $W = W_0(1+R)$  and  $R$  is the return earned by the investor. The expected return and the volatility of  $R$  are expressed in terms of  $\mu$  and  $\sigma$ . Since VaR measures the greatest loss measured in a certain confidence level expressed as  $c$ , then the formula becomes  $W^* = W_0(1+R^*)$ . The measurement of VaR is measured by the average return during the investment horizon (Jorion, 2007) are:

$$VaR(mean) = E(W) - W^* = -W_0(R^* - \mu)$$

Whereas if VaR is seen on point 0 or is called VaR absolute then the formula is as follows:

$$VaR(zero) = W_0 - W^* = -W_0R^*$$

The value of these two formulas will be close to each other if the investment period is relatively short because the average return is quite small. However, in the long term, the use of VaR relative to the mean is more appropriate because it sees risk as a deviation of the target calculated by time value of money.

In general, VaR can be derived from the probability distribution of portfolio value in the future. With the value of confidence level of  $c$ , the worst value of  $W^*$  is found with formulation:

$$c = \int_{W^*}^{\infty} f(w)dw$$

If the probability of a value is less than  $W^*$ ,  $p = P(w \leq W^*)$  is  $1-c$ , then

$$1 - c = \int_{-\infty}^{W^*} f(w)dw = P(w \leq W^*) = p$$

### 2.4. Portfolio Testing

This research also examines the portfolio established with VAR and SIM Murhadi (2014) through several tests as follows:

- a. **Coefficient of Variation.** This measurement aims to find out the amount of the standard deviation of each produced return. The greater the value indicates that portfolio volatility is greater.
- b. **Sharpe Ratio.** This measurement aims to find out the level of excess return above the risk free rate towards the standard deviation value of a portfolio. The greater the

value of this ratio indicates that the given rate of return is greater for each standard deviation value covered. Here is the Sharpe ratio formula

$$\text{Sharpe Ratio} = \frac{\text{portfolio return} - \text{risk free rate}}{\text{standar deviasi portofolio}}$$

- c. Treynor Ratio.** This measurement aims to find out the level of excess return above the risk free rate towards the Beta value of a portfolio. The greater the value of this ratio indicates that the given rate of return is greater for each Beta value owned by the portfolio. Here is the formula of Treynor ratio

$$\text{Treynor Ratio} = \frac{\text{portfolio return} - \text{risk free rate}}{\text{Beta portofolio}}$$

- d. Jensen Alpha.** The Jensen measurement takes into account the excess return above the expected performance. This measurement is known as the alpha of a portfolio. This value is generally used as the basis for the testing of each investment manager in preparing their portfolio. The greater the alpha value indicating the performance of the portfolio will be better above average.

Here is the formula of Jensen Alpha

$$\text{Jensen Alpha} = \text{Return Portfolio} - \text{RFR} - (\beta * (R_M - \text{RFR}))$$

Description:

RFR = Risk free rate

R<sub>M</sub> = Return market

β = Beta portfolio

## 2.5. Research Hypothesis

This research consists of four hypotheses that test the investor preference towards risk, profit level of each risk preference, VaR value per risk preference, and portfolio difference between VaR and SIM method. More hypotheses are in table 1.

**Table 1. Research Hypothesis**

H <sub>i</sub>	Key Issue	Hypothesis Statement
H <sub>1</sub>	Against the level of risk averse investor profit and risk taker	There are different levels of profit between risk taker investors and risk averse
H <sub>2</sub>	Against the value of risk averse investors and risk takers	There are different VaR values between risk taker investors and risk averse

## 3. RESEARCH METHOD

### 4.

This research used stock samples contained in the current LQ 45 with monthly data retrieval over the last 5 years from 1 January 2010 to 1 October 2015. The research object is assumed to be an efficient portfolio that has been formed and will be screened into optimal portfolio. In addition, the daily data downloading period from October 1, 2014 to October 1, 2015 which will be used in calculating the VaR value was conducted.

### 4.1. The steps in the research

- a. Download and adapt the data from yahoo finance website.
- b. Calculates returns, standard deviations, and covariance of candidate stocks.
- c. The value obtained at point (b) was processed using Matlab with mixed integer quadratic programming algorithm to find the portfolio with Mean-Variance Model. Risk preference (θ) was used for 1 to 1,000. The purpose function used is as follows Kuhn et al. (2003):



$$\text{Max } \bar{R}_p = \sum_{i=1}^k w_i R_i - \theta \sigma_p^2$$

With constraint function:

$$\sum_{i=1}^k w_i = 1 ; 0 \leq w_i < 1$$

- d. After getting the portfolio, then calculating the value of 7 factors namely: return, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio, and Jensen Alpha.
- e. Analyzing profit and risk level of investor risk taker and risk averse. By dividing into 2 large groups that is group with value  $\theta$  between 1 - 300 (risk taker) and group with value  $\theta$  between 701 - 1,000 (risk averse). The testing was performed using a 2-sample-t test with  $\alpha = 5\%$ .
- f. Forming a portfolio with Single Index Model. Once it was formed, it will calculate the value of 7 factors namely: return, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio, and Jensen Alpha. This value will be compared with the mean-variance model.
- g. Comparing the portfolio formed from the MVM model:  
The objective function and constraint function of this model are as follows Two et al. (2002), Rockafellar and Uryasev (2000), and Sharma et al. (2015):

Destination Function:  $\text{Max } \bar{R}_p = \sum_{i=1}^k w_i R_i - \theta \sigma_p^2$

Description:  $\sigma_p^2 = \sum_{i=1}^k w_i \sigma_i^2 + \sum_{i=1}^k \sum_{j=1}^k w_i w_j \text{Cov}(R_i, R_j) ; i \neq j$

Constraint function:

$$\sum_{i=1}^k w_i = 1 ; 0 \leq w_i < 1$$

Description:

$R_p$  = profit rate of portfolio

$w_i / w_j$  = The weight of each  $i / j$  securities

$R_i$  = Profit level of each securities

$\theta$  = The risk preference level (the bigger the risk averse)

$\sigma_p^2$  = Portfolio Variance

$\sigma_i^2$  = Securities variance

$\text{Cov}(R_i, R_j)$  = Securities covariance  $i$  and  $j$

The value of  $\theta$  in this research is set from 1 to 1,000 to see the impact of extremes.

Steps in constructing MVM:

- i. Researcher prepared data that has been processed and processed in the form of stock return data, per stock return deviation standard, covariance of stocks that exist as input into MATLAB.
- ii. The researcher performed the iteration process to get the value of stock proportion of each value  $\theta$ . The algorithm used is Mixed Integer Quadratic Programming.
- iii. Next, after this research got the stock proportion for each value of  $\theta$ , this research calculated seven factors for the portfolio namely, return, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio, and Jensen Alpha.
- h. SIM portfolio establishment:  
After the results were obtained from the SIM, then calculating 7 factors namely: return, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio,

and Jensen Alpha. The portfolio formed will be compared with the portfolio of the Mean-Variance model.

- i. Conducting Analysis of Profit Level between Investor Risk Taker and Risk Averse
- j. After obtaining optimal portfolio composition for each risk preference, then calculating the amount of profit of each existing portfolio. Investor data with risk preference level ( $\theta$ ) ranging from 1 to 300 will be classified into investor risk taker while investors with risk preference level ( $\theta$ ) ranging from 700 to 1,000 will be classified into risk averse investors. By using Minitab through the average test of 2-sample-t test, it will find out whether the level of profit is both the same or the rate of return of investors with higher risk preferences will be greater than the profit level of investors who have lower risk preferences.
- k. Performing VaR Value Analysis between Investor Risk Taker and Risk Averse:  
After obtaining optimum portfolio composition from the mean-variance model, this research further calculated the VaR value of each portfolio and found out if there is any difference in VaR values between risk taker and risk averse investors. This research classified risk taker investors if they have risk preferences ( $\theta$ ) from 1 to 300 and are classified as risk averse if they have a risk preference ( $\theta$ ) of 700 to 1,000. Furthermore, by using Minitab through the 2-sample-t test, it will be found whether the VaR values of these two types of investors are the same or whether investors with high risk preferences will have a more negative VaR score than investors with lower risk preferences.
- l. Performing Portfolio Analysis Formed from Single Index Model and Mean-Variance Model:  
Afterwards, using the results obtained in the compilation of the portfolio using Single Index Model and Mean-Variance Model, it will be found whether the portfolio formed from the Single Index Model has the same characteristics as the portfolio formed using the Mean-Variance Model at a certain value ( $\theta$ ).

#### 4.2. Hypothesis Testing and Robustness

To find out whether the results obtained in accordance with the initial hypothesis or not, it is necessary to test the hypothesis as follows:

- a) Testing on the impact of risk preference towards the portfolio profit level between risk taker (RT) and risk averse (RA) investors used the mean difference test t-test  
H0:  $\mu_{RT} = \mu_{RA}$ : There is no difference in profit level between investor risk taker and risk averse  
H1:  $\mu_{RT} > \mu_{RA}$ : The profit rate between investor risk takers is greater than risk averse.
- b) Testing on the impact of risk preference towards portfolio VaR value between investor risk taker and risk averse using t-test average test.  
H0:  $VaR_{RT} = VaR_{RA}$ : There is no VaR difference between investor risk taker and risk averse  
H1:  $VaR_{RT} < VaR_{RA}$ : VaR value between investor risk taker smaller risk averse (the less risky).

Robustness testing was performed to see if the results obtained will remain consistent / appropriate for different data / conditions with the same treatment. This test was conducted using data from 1st January 2009 - 1st October 2014 and this data still has slices with previously used data that is period January 1, 2010 - October 1, 2015. Next, portfolio formation using the same risk preference value from Worth 1 to 1,000 will be conducted. The results of this portfolio formation will then be compared with the results that have been obtained previously.

## 5. RESEARCH RESULT AND DISCUSSION

There were 19 Stocks that are included in the LQ45 index consecutively period 1 February 2009 to 1 October 2015 ie: AALI, ADRO, ASII, BBKA, BBNI, BBRI, BMRI, INDF, INTG, ITMG, JSMR, KLBF, LPKR, LSIP, PGAS, PTBA, TLKM, UNTR, and UNVR. The average value of BI-rate during the research period was 6.70% / year or 0.56% / month. The general result shows that risk preference give impact on the selection of portfolio consisting of LQ45 stock, that each risk preference has different portfolio return value (Table 2) and proved to be significant that return of investor risk taker group is higher than risk averse group, as well as the risks. The overall portfolio formed reflects the efficient portfolio because with 19 stock options, the securities market line of each stock is on the efficient line, as well as the capital market line portfolio.

### 5.1. Mean-Variance Model

After obtaining the portfolio according to the specified risk preference, then the calculation of the 7 factors value mentioned previously mentioned was conducted. Next, the researcher did the grouping of data into 10 large groups in which each group contains 100 data in sequence which using 2-sample-t-statistical test.

From the result summary in Table 2, it can be seen that overall, the return value tends to decrease as the investor risk preference decreasing. VaR values also decreased. However, the value of Coefficient of Variation increased from risk taker investors to risk averse investors. The three commonly used ratios such as Sharpe, Treynor, and Jensen Alpha show the best performance generally resides in portfolios with high risk preferences.

Table 2 shows that VAR which is formed with risk preferences will produce portfolios that match the investor's preferences, and each group of investors has different returns and risks, in accordance with the risk return trade off. Portfolio return value tends to decrease along with changing of investor risk preference as well as VaR value.

**Table 2.** Summary of Portfolio Results Period February 1, 2010 - October 1, 2015

<b>Indicator</b>	<b>Results</b>
<i>Return</i>	Risk taker investors have higher value than risk averse investors. There are some groups that have same value when compared with groups with lower risk preference.
<i>Value at Risk</i>	The risk taker investor has a higher risk of impairment risk than risk averse, but there are some risks rising or equal for lower risk preferences ( $\theta$ higher)
<i>Variance</i>	Investors risk taker has a higher value than risk averse, but there are some groups that have the same value when compared with groups with lower risk preference.
<i>Coefficient of Variation</i>	The risk taker investor has a smaller value than the risk averse investor, but there are groups that have the same value when compared to the lower-risk preference group.
<i>Sharpe Ratio</i>	Risk taker investor has a higher value than risk averse investor, but there are groups that have the same value when compared with groups with lower risk preference.
<i>Treynor Ratio</i>	Risk taker investor has a higher value than risk averse investor, but there are groups that have the same value when compared with groups with lower risk preference.
<i>Jensen Alpha</i>	Risk taker investor has a higher value than risk averse investor, but there are groups that have the same value when compared with groups with lower risk preference.

**Table 3.** The summary of Portfolio Results Period February 1, 2009 - October 1, 2014

<b>Indicator</b>	<b>Results</b>
<i>Return</i>	Risk taker investor has higher value than risk averse investor, but there are some groups that have the same value when compared with groups with lower risk preference.
<i>Value at Risk</i>	Group I has the smallest VaR value and then gradually rises from group II to group X, but there are some groups that have the same value even greater when compared with the lower-risk preference group.
<i>Variance</i>	The risk taker investor tends to have higher value than the risk averse investor, but there are some groups that have the same value even lower when compared with the lower-risk preference group.
<i>Coefficient of Variation</i>	The risk taker investor tends to have smaller value than the risk averse investor, but there are some groups that have the same value when compared to other groups with lower risk preferences.
<i>Sharpe Ratio</i>	The risk taker investor tends to have higher value than the risk averse investor, but there are some groups that have the same value even lower when compared with the lower-risk preference group.
<i>Treynor Ratio</i>	The risk taker investor tends to have higher value than the risk averse investor, but there are some groups that have the same value even lower when compared with the lower-risk preference group.
<i>Jensen Alpha</i>	The risk taker investor tends to have higher value than the risk averse investor, but there are some groups that have the same value even lower when compared with the lower-risk preference group.

## 5.2. Hypothesis testing

From the portfolio obtained using MVM, then the hypothesis was tested to see if there is any difference in terms of return and risk between investor risk taker and risk averse. The test was conducted using 2-sample-t statistic test by dividing the data into 2 groups ie risk taker group with risk preference value ( $\theta$ ) between 1 - 300 and risk averse group with risk preference value ( $\theta$ ) between 701 - 1,000. The hypothesis used is risk taker return investor is greater than risk averse and risk taker investor risk is greater than risk averse investors are indicated by the value of VaR the more negative. Both test results provide the same p-value that is equal to 0 so it can be concluded that the risk taker investor return is greater than risk averse investors as well as the risks they bear.

## 5.3. Single Index Model

Using Single Index Model, it produced result in the following portfolio composition: UNVR (38.39%), KLBF (31.71%), TLKM (17.04%), JSRM (7.09%), and ASII (5.77%). The value of Expected Return on monthly period February 1, 2010 - October 1, 2015 is equal to 2,43%, VaR equal to -2,22%, variance 0,26%, coefficient of variation equal to 2,09, Sharpe ratio 36,86%, Treynor of 2.76%, and Jensen Alpha of 1.70%.

## 5.4. Robustness Testing

The summary of test results can be seen in Table 3. In this test, the results obtained shows that the highest return exactly has the most positive VaR values and the greatest risk preferences. This is in contrast to the establishment of previous data with the period February 1, 2010 - October 1, 2015.

The test period February 1, 2010 - October 1, 2015 is a Single Index Model robustness test for the portfolio formation, with results that showed that the highest return is at the most positive VaR value and the greatest risk preference. This shows that VAR model of risk preference with portfolio of MVM formation reflect more trade off risk and return than portfolio with SIM. Although the results of the portfolio are almost the same between the two models, but the SIM tends to form a more risk taker portfolio. The next will be explained in the discussion.

## **6. DISCUSSION**

### **6.1. Mean Variance-Model**

Portfolio composition is determined by the value of risk preference. The lower the risk preference level, the value of  $\theta$  will increase. Therefore, in accordance with the Markowitz equation, the value of variance for investors at low risk preference levels will always be lower because investors do not want high volatility. However, the results show that the lower risk preference level will not always provide lower returns and the higher risk preference level will not always present the risk of more negative VaR values.

### **6.2. SIM vs MVM**

From the results obtained for the optimal portfolio using the SIM has the same results with the formation of a portfolio using MVM except in terms of assets are arranged. SIM return value is 2.43%. This return value resembles the result of formation by using MVM for risk preference value ( $\theta$ ) of 4. This indicates that the result of the SIM form is in the range of risk taker if seen in terms of return. Value at risk (VaR) SIM is at -2.22%. If it is seen at the results of formation using MVM, then this value is at the level of investor risk preference ( $\theta$ ) between 3 and 4 ie -2.42% and -2.10%. By looking at this value, it can be said that the SIM model is at the risk taker level. The amount of the variance indicating the volatility of the portfolio value of the SIM formation results is 0.26%. This value is equivalent to the value of variance produced using MVM with investor risk preferences level ( $\theta$ ) between 3 and 4 ie 0.27% and 0.24%. By looking at this value, the resulting portfolio of SIM forms is classified into investment for risk taker investors. The amount of risk in the form of standard deviation covered by each return generated by the portfolio of SIM form is 2.09. When compared to the value produced by MVM, then this value is at the investor risk level ( $\theta$ ) between 2 and 3 ie 2.14 and 2.06. Therefore the SIM-formed portfolio is classified into investment for risk taker investors. Sharpe ratio value for SIM form result is equal to 36,86%. This value is equivalent to the result of portfolio formation using MVM with investor risk preferences level ( $\theta$ ) between 1 and 2 ie 33.70% and 36.89%. Therefore, the result of SIM formation portfolio can be classified into investment for risk taker investor. Treynor ratio value for SIM model is 2.76%. This ratio is equivalent to the result of portfolio formation using MVM with investor risk preferences level ( $\theta$ ) between 1 and 2 that is equal to 2.72% and 2.86%. Therefore, this investment can be classified into investment for risk taker investors. The value of alpha portfolio of SIM form is 1.70%. This value is equivalent to the result of portfolio formation using MVM with investor risk preferences level ( $\theta$ ) between 3 and 4 that is equal to 1.79% and 1.69%. Therefore, this investment belongs to investment for investor which is risk taker.

7 factors that have been calculated beforehand, indicating that the value obtained is the same for high risk preferences. Thus, it can be said that SIM method is suitable for capital market investor especially LQ 45 with high risk preference. However, for investors who have lower risk preferences, the use of SIM will be not suitable. The return value for a portfolio formed with a high level of risk preference is greater than that portfolio formed from a lower risk preference level. In addition, the value at risk generated by investors with high preference rates is also lower than the portfolio formed from low risk preference

levels. This shows that large returns also have a high risk. However, as it has been discussed earlier, there are several return points for  $\theta$  that is larger is equal to the return rate for  $\theta$  that is smaller. It applies for VaR value as well.

### 6.3. Robustness Testing

From this test, the result obtained shows that the most important factor in determining the value of VaR is not the variance but the distribution of the data. Although the data has high variance due to wide data distribution, but if the data group has a large set at a certain percentile point, then the value of VaR can be at that point because the calculation method used in this research is the historical method using the percentile.

## 7. CONCLUSION

- a. Risk preference has an impact on the composition of portfolio selection in which in this research using LQ45 stock. The impact of portfolio selection can be observed from changes in return value, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio, and Jensen Alpha.
- b. The result of the research by doing hypothesis test using 2-sample-t test in order to compare the return which is produced between investor risk taker with the risk preference level between 1 - 300 with risk averse investor with the risk preference level between 701 - 1,000, found that the profit level of risk taker investors proved to be greater than risk averse investors. The testing is done using  $\alpha = 5\%$  and obtained the result of p-value equal to 0.
- c. The result of the research by doing hypothesis test using 2-sample-t test in order to compare value at risk (VaR) which is produced between risk taker investors with risk preference level between 1 - 300 with risk averse investors with risk preference level between 701 - 1,000, found that the risk level of risk taker investors proved to be greater than risk averse investors. Testing is done using  $\alpha = 5\%$  and obtained the result of p-value equal to 0.
- d. The optimum portfolio results using Single Index Model tend to refer to portfolio with high risk preference level. This can be seen on the value of the seven factors namely, return, value at risk, variance, coefficient of variation, Sharpe ratio, Treynor ratio, and Jensen Alpha. All these factors show the similarity of results with the portfolio formed from the mean-variance model for the value of high-risk preference level ( $\theta$  small). This is certainly not suitable for investors who want investment in the capital market with more risk averse.
- e. In the robustness test, it was found that there is a difference results between the data period 1 January 2009 - October 1, 2014 (Period A) with the data period January 1, 2010 - October 1, 2015 (Period B). With the greatest difference lies in the VaR value of Period A indicating that the greatest VaR value (the smallest risk) lies in the investor with the highest level of risk preference. While Period B data shows that the smallest VaR value (biggest risk) is in the established portfolio with the highest level of risk preference. This indicates that the portfolio with the greatest volatility is not necessarily the highest risk by looking at historical data at a certain percentile level. The amount of data distribution on the desired percentile is more influential in determining the VaR value in this research.

In robustness testing, it is found that in the calculation of risk using Value at Risk, variance / volatility of the data is not the main determinant. The main determinant of risk in VaR is how the pattern of data distribution is at a certain percentile. Therefore, even if the data has high volatility, if the data distribution in the expected percentile has more positive value than the data with low volatility, then the value of VaR data will be better.

Portfolio establishment is based on stocks incorporated into LQ45 for easy data processing. The data are also filtered with requirements to be incorporated into LQ 45 for 5 consecutive years. Since the Indonesia Stock Exchange has hundreds of stocks, this research or subsequent investors can have more varied portfolio options and match the desired level of risk preferences when using stock options that are still available.

The use of historical methods in VaR calculations in this research has limitations in predicting future events as it assumes that historical data will be repeated in the future. Therefore, in overcoming this weakness, this research takes long period that is more than 5 years for the formation of a portfolio and more than 1 year for VaR calculations. Further research can be done using a simulation model so that it can illustrate / predict VaR values in the future using existing data.

Considering that this research found out different results for different research periods, this subsequent research or investor is advised to perform calculations with different data periods but keep overlapping.

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