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Value At Risk Analysis Using Historical Method and Monte Carlo Simulation in Banking and Mining Sector Companies

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ABSTRACT

Purpose – Investments in the capital market must be able to understand the risks that exist, because investments that will be faced in the future contain uncertainty. The growth of trading activity and the increasingly uncertain market makes market participants feel the need to develop more accurate and reliable risk measurement techniques. One of the risk measurement techniques is Value at Risk (VaR).

Methodology/approach – Value at Risk (VaR) is a method of calculating market risk to determine the maximum risk of loss that can occur in a portfolio, both single and multi-instrument, especially the level of confidence, during a certain holding period, and under normal conditions. market conditions. This study uses secondary data in the form of stocks listed on the Indonesia Stock Exchange, the samples obtained are 2 companies. Processing data in this study using Microsoft Excel program for measuring Value at Risk in portfolios using Monte Carlo simulation.

Findings – The results of the study show that a greater return will provide a greater level of risk, judging from the return and VaR values of each portfolio. Where portfolio one has a greater return than the second portfolio, and portfolio one also has a greater risk level than the second portfolio. Investment in the capital market requires a good risk calculation in buying or selling shares, so the purpose of this study is to help investors take steps or policies that are in accordance with the company's conditions..

Novelty/value – The results in this study illustrate that the purchase of BBRI shares with the banking sub-sector and ANTM's shares in the Mining Company sub-sector has its respective risks and benefits. Therefore, the VaR Monte Carlo simulation method can describe each stock.

INTRODUCTION

Investment is a commitment to the amount of funds or other resources made at this time, with the aim of obtaining a number of benefits in the future. An investor buys a number of shares at this time in the

hope of profiting from an increase in stock prices or the amount of dividends in the future, as an imbalance of time and risk associated with the investment (Tandelilin, 2007: 3). In the business world, almost all investments involve uncertainty or risk. Investors do not know with certainty the results that will be obtained from the investments that have been made. Investors will also face other things in investing, namely if investors expect high profits, they must also face high risks (Hadi et al., 2022; Iskamto, 2015; Iskamto et al., 2021; Jaenudin & Fauziana, 2022).

In investing, investors can choose their funds in various assets, both risky assets and risk-free assets or a combination of the two assets. The investor's choice of these assets will depend on the extent of the investor's preference for risk. The more reluctant an investor is to risk (risk averse), the investment choices will tend to be more risk-free assets (Tandelilin, 2007: 76). Investing in the capital market is one of the steps that can be taken by an investor. The capital market has provided many benefits for the economic development of the Indonesian nation. There are many investments made through stocks and bonds issued by companies in order to develop the business or strengthen the company's capital. An investor who will invest in the capital market, especially stocks, must be able to understand the risks that exist, because investment in general will be faced with a future that contains uncertainty, meaning that it contains risks for investors. profit is a hope for all investors. The higher the risk (risk) faced by an investor, the higher the investor's expectations for profit (expected return) (Adu & Nawangsari, 2022; Jayaprawira et al., 2022; Roni, 2022; Sampurnaningsih & Ikhsyan, 2022; Sunaryo, 2022).

Knowledge of risk is an important thing for every investor and potential investor. Rational investors before making investment decisions do not have to consider 2 things, namely the expected income (expected return) and the risk (risk) obtained from the investment alternatives purchased. In many studies that have been carried out there is a relationship between expected income and the risk posed so that how investors can choose what method or field to take, whether in one place or one stock or by doing a portfolio, but all of them will face risks in the future. \

The most important aspect in calculating VaR is determining the type of methodology and assumptions that are suitable for the distribution of returns. This is because the VaR calculation is based on the distribution of security returns, where securities are proof of money or proof of capital payments, for example stocks, bonds, notes, certificates, and deposits. The application of the right methods and assumptions will result in an accurate VaR calculation to be used as a risk measure.
There are three main methods for calculating VaR, namely the parametric method (also called the variance-covariance method), the Monte Carlo simulation method and the historical simulation method (Butler, 1999: 78). The three methods have characteristics with their respective advantages and disadvantages. The variance-covariance method assumes that returns are normally distributed and portfolio returns are linear with respect to the return on a single asset. Both of these factors lead to a lower estimate of the potential future volatility (standard deviation) of the asset or portfolio. VaR with the Monte Carlo simulation method assumes that the return is normally distributed which is simulated using the appropriate parameters and does not assume that the portfolio return is linear with respect to the return on a single asset. VaR with historical simulation is a method that overrides the assumption of returns that are normally distributed and linear between portfolio returns and single asset returns. The VaR value is used to determine the estimated maximum loss that may occur so as to reduce the risk (Butler, 1999: 119).

The advantage of VaR is that this method focuses on downside risk, does not depend on the assumed distribution of returns, and this measurement can be applied to all traded financial products. Figures obtained from measurements with this method are the result of an aggregate or comprehensive calculation of the risks of products as a whole. VaR also provides an estimate of the probability or probability of the occurrence of a loss that is greater than the predetermined loss figure. This shows

something that is not obtained from other risk measurement methods. VaR also pays attention to changes in the price of existing assets and their effect on other assets. Thus, it is possible to measure the reduced risk caused by diversification of product groups or portfolios.

VaR became widely known since 1994 when J.P. Morgan made the Risk Metrics system (based on the VaR method) available on the internet (www.jpmorgan.com) and the program can be downloaded by users free of charge. The method used by J.P. Morgan is hereinafter known as RiskMetrics or VaR calculations with the Variance-Covariance Method.
VaR has three methods for calculation, namely the historical method, the Variance-Covariance method, and the Monte Carlo simulation method. The three methods have their respective advantages and disadvantages. According to Jorion (2002), the covariance approach or also known as the delta normal method has advantages in terms of ease of computation and implementation, while its weakness is that its accuracy is weaker than the other two methods.

Although the two methods, namely the historical method, and the Monte Carlo simulation method, have the advantage of accuracy, they have computational weaknesses because they require a large number of risk factor simulations, especially the Monte Carlo simulation method. The historical method has advantages over the Monte Carlo simulation method because the computation is relatively easier and does not face the risk model problem.

LITERATURE REVIEW

Investment

The definition of investment according to Sumanto (2006) is a contract of will certain amount of funds in a certain period to get the desired acquisition expected in the future, as a substitute for the shares invested as capital. Investment is any asset in which funds can be invested in the hope of generating positive returns or increased value. (Bukit, G. & Hendratno, 2021).

Risk

The definition of risk according to Hanafi (2006) is the magnitude of the differencebetween the expected return and the actual returnobtained. Risk is a possibility of loss, whether not desirable or unexpected (Drmawi, 2016:23).

Historical Simulation Method

VaR with historical simulation is estimated by creating a time serieshypothetical of the return value obtained, through historical data and changes that are already happened (Adrianto et al, 2018).

Monte Carlo Simulation Method

According to Maruddani & Purbowati (2009), the Monte Carlo simulation methoddone by randomizing random numbers according to the data criteria examined, then used to find the value of VaR.

METHOD

According to a survey conducted by the Insurance Information Institute found that 84% of respondents said that risk is "danger" and 77% of respondents said that risk is a possible loss. The study shows that investors are more concerned with risk as a possible loss and the possibility of profit is not a risk. So that the standard deviation as a risk measure is considered no longer in accordance with investors' risk preferences because the standard deviation weights the probability of a negative return (loss) in balance with a positive return (profit). VaR as a risk measure that focuses more on downside risk, is more appropriate to describe the risk preferences of investors. Thus, the formation of an optimal portfolio using the Mean variance model approach from Markowitz (1952) which uses standard deviation as a risk proxy needs to be adjusted to a risk measure that focuses more on downside risk, namely Value at Risk (VaR).

In this study, the Monte Carlo simulation method was used to measure or analyze the VaR of the portfolio in PT. Bank Rakyat Indonesia Tbk and PT. Aneka Tambang listed on the Indonesia Stock Exchange. This method is the most widely used method to measure VaR because it can calculate various exposures (stocks) and risks.

According to Philip Best (1998) Value at Risk or VaR is a statistical risk measurement method that estimates the maximum possible loss of a portfolio at a certain level of confidence. The VaR value is always accompanied by a probability that indicates how likely the loss will be less than the VaR value. VaR is a monetary loss value that may be experienced within a predetermined period of time. The following statement is a formal definition of VaR quoted from Philip Best (1998) in Wibowo, AW (2006): "Value at Risk is the maximum amount of money that may be lost on a portfolio over a given period of time, with a given a level of confidence." The following statement is a formal definition of VaR expressed by Philippe Jorion (2001): "VaR summarizes the worst loss over a target horizon with a given level of confidence." Cormac Butler (1999) provides a VaR definition as follows: "Value at Risk measures the worst expected loss that an institution can suffer over a given time interval under normal market conditions at a given confidence level. It assesses risk by using statistical and simulation models designed to capture the volatility of assets in a bank's portfolio."

Generally, VAR is calculated for a period of 24 hours. For example, if we say that the VaR of a portfolio is US$5,000 with a confidence level of 95 percent, this means that there is a 95 percent chance that the portfolio will lose under US$5,000 in the next 24 hours. It can also be said that there is a 5 percent chance that the portfolio will lose at least US$5,000 for the next 24 hours.

VaR Historical Simulation Method.

Some VaR methods, such as variance-covariance VaR, assume that the risk factors are normally distributed and are therefore called the arametric VaR approaches. As we know the distribution of real market data does not always approach the normal distribution. In fact, some real market data actually have a non-normal distribution (Campbell, Huisman and Koedijk, 2000). One of the VaR approaches that is able to solve the problems mentioned above is historical simulation VaR (which is a nonparametric VaR approach). Historical simulation VaR uses historical time series data as a representation of market movements. According to Philip Best (1998), historical simulation can be divided into four stages, namely: compiling historical changes from risk factors, calculating changes in portfolio value for each historical change, sorting from changes in portfolio value and finally calculating the VaR value.

Penza and Bansal (2001) state that in the historical simulation method, changes in market conditions from today to tomorrow are considered the same as changes that occurred some time ago, so that basically this method uses the historical distribution of returns on assets in a portfolio as an indicator. simulation to obtain the VaR value.

RESULT AND DISCUSSION

The results of the research and discussion on the measurement of Value at Risk in the portfolio using Monte Carlo simulations and the application of the Value at Risk measurement on the portfolio using the Monte Carlo simulation of the portfolio formed from the shares of PT Aneka Tambang Tbk and PT Bank Rakyat Indonesia Tbk.

Data Description

The description of the secondary data used and the results of data processing in this study are as follows:

1. The stock sample is ANTM and BBRI for 1 period from January 2021 to December 2021.
2. The observation sample or observation days is the number of return days during the period January 2021 to December 2021 or as many as 260 observation days.

Data analysis

Based on the sample criteria and market capitalization on ANTM and BBRI shares.

Table 1.1 VaR with Historical Method and Monte Carlo Simulation

Stock ANTM	Stock BBRI

	P/L	Return	Log Return	P/L	Return	Log Return
Mean	26,54	0,001569	0,001219	-1,02	-0,000455	-0,000807
Standar Deviasi	527,55	0,0266	0,026	32,39	0,026	0,026
Confidence Level (0.05)	0,05	0,05	0,05	0,05	0,05	0,05
Kurtosis	2,57	4,14	3,48	2,90	4,41	3,863
Skewnes	0,028	0,60	0,38	0,51	0,76	0,54
Quantile	-1,64	-1,645	-1,645	-1,645	-1,645	-1,645
Zcf	-1,58	-1,38	-1,46	-1,43	-1,32658	-1,40652
VaR	809,63	0,035	0,037	47,53	0,035	0,03

Based on the table above, the VaR P/L value for the next period at a 95% confidence level is 47.53846602. This value is relative to ANTM's share price. So the potential loss that will be experienced by investors is 47.53 for the next period, while in the table above, the VaR Return value for the next period at a 95% confidence level is 0.035905932. This value is relative to ANTM's share price, so the potential loss that will be experienced by investors is 0.035905932 for the next period.

Based on the table above, the VaR P/L value for the next period at a 95% confidence level is 122.5535156. This value is relative to BBRI's share price. So the potential loss that will be experienced by investors is 122.5535156 for the next period, while in the table above, the VaR Return value for the next period at a 95% confidence level is 0.044072481. This value is relative to BBRI's share price. So the potential loss that will be experienced by investors is 0.044072481 for the next period.

From the two approaches above, it shows that a greater return will provide a greater level of risk, this can be seen from the return and VaR values of each portfolio. So that the risk of buying ANTM shares has a greater risk than buying BBRI shares in the same period. In accordance with the statement in investment "the higher the profit, the higher the risk faced".

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