The Calculation of Value at Risk Using Variance Covariance in LQ-45 Companies

Yoseva Maria Pujirahayu Sumaji
Ciputra University, Surabaya, Indonesia
e-mail: yoseva.maria@ciputra.ac.id

Abstract: The Government of Indonesia is trying to find some solutions to Indonesia's economic problems. One of the problems of Indonesia's economic growth is the lack of capital and correct calculation of capital risks, especially in stock investments can reduce the occurrence of various capital problems in accordance with the criteria required and obtained by 9 companies analyzed. The analytical method used in calculating market risk in stock investments in this study is variance covariance value at risk. This method is a risk measurement through the highest estimated losses over a period of time and assumed confidence levels. To prove the level of trust of the variance covariance value at risk method, analysis was conducted using back testing method. The results of this study show that the method of calculating variance covariance value at risk is the right and accurate method to calculate market risk from the company's stock.

Keywords: VaR, variance-covariance, back testing

PRELIMINARY

Capital flows as a part of economic growth from the capital market, namely the Indonesia Stock Exchange. The capital market sells shares that have an economic function because the capital market provides facilities or a vehicle for meeting interests, namely those who have excess funds and those who need funds. Stocks that are known to have high risk-high return characteristics, meaning that they provide opportunities for high profits but also have the potential to have a high risk of loss. Stock price fluctuations cause investors to gain or lose. Not only investors who have the risk of their investment, but the company will also have risks that are in the company after the investor makes an investment. This risk is called speculative risk. Speculative risk, arguably includes a larger class of risk. Speculative risk is the uncertainty of events that can give rise to gain or loss. According to Aparna Gupta (2013), speculative risk can be categorized as market risk, credit risk, strategy, business and reputation risk. Companies must manage risks, especially market risks, so as not to have an impact on company earnings and also the profits provided to investors.

This risk can occur in all sectors including the manufacturing industry sector. Company industrial sector manufacturing in Indonesia has a great influence on economic growth. The manufacturing industry is the sector most attractive for investors to invest. The industry ministry has been optimistic about the growth of the manufacturing industry, despite various obstacles including limited availability of infrastructure and others. According to Markowitz (1952), going public companies also have an impact on a large number of domestic and foreign investors. In investing, there are three bases that need to be calculated, namely the expected return, the level of risk, and the relationship between return and risk. Investors can reduce risk by diversifying their investments. Diversified investment will provide optimal re-

turns in return for investment in a portfolio. Markowitz (1952) has proven that investment risk will be reduced when combining several assets in a portfolio.

Yoseva (2017) states that there are several methods of measuring risk, namely the traditional method and the value at risk method. According to the traditional method of risk measurement, quantification of risk is carried out by measuring sensitivity by observing changes in one of the risk factors and their effect on the gain or loss of a portfolio. Traditional measurement results are the amount of loss experienced, but these measurements do not provide an idea of the probability of the potential amount or loss that may be experienced. In addition, the measurement is traditionally used on individual assets, so that each asset has a different risk measurement method (Sartono, 2006). According Sartono (2006), when each of these assets are combined into one portfolio, risk measurement becomes difficult because many methods used for each calculation of the asset.

In 1994, JP Morgan developed the Value at Risk (VaR) method which is then used very widely to measure various types of risk. According to Best (1999), Value at Risk (VaR) is a statistical risk measurement method that estimates the maximum loss that may occur at a certain level of confidence in a portfolio. There are several models in measuring VaR, namely the Variance-Covariance model, the Historical Simulation model, and the Monte Carlo model. Previous research (Yoseva, 2017) found that calculating VaR using the Variance-Covariance model resulted in a greater undiversified VaR compared to the historical calculation model.

According to Butler (1999), estimating potential losses that could arise from adverse changes in market conditions is a key element of risk management. For financial institutions and treasuries companies around the world, Value at Risk (VaR) is fast emerging as the dominant methodology for estimating exactly how much money is at risk on a daily basis in financial markets. Crouhy (2001) states that; VaR is the worst possible loss that you can expect from holding a security or portfolio over a period of time, given the specified level of probability (known as the 'confidence level'). This research was conducted to determine the validity of risk calculations using the variance covariance method, followed by a backtesting test to see that the calculation method used is valid and accurate, or vice versa. This study uses the objects of the manufacturing industry in Indonesia which are members of the LQ-45 where the company is the most active for the last 3 years and has the highest market capitalization for the last 12 months, because it can represent the values of daily market trading, and to find out whether this method is used, and can be used as a reference for calculating risk, especially for companies that have a major contribution to economic growth in Indonesia.

LITERATURE REVIEW

Previous Research

This study is a continuation of previous studies, where several researchers tested the measurement of potential losses (VaR) using the Variance-Covariance model and the Historical Simulation model. In 2005, Oom Komariyah conducted research on the risk analysis of stock market investment against Sharia in the 10 Jakarta's Islamic Index (JII). In the study sample, 10 stock issuers representing 30 Sharia, whose shares were consistently traded in the first period from November 2002 to December 2004,

were taken on the Jakarta Stock Exchange. The research methodology used is the methodological value of the Risk Variance-Covariance model and the Historical Simulation model. The results of the study conclude that the second model is applicable to measure a maximum of 10 losses of Sharia stocks that are included in the Jakarta Islamic Index. To test the validity of the model is to look at the failure rate (failure rate) with the Kupiec test.

In 2007, a research entitled Value at Risk Method: An Application For Swedish National Pension Fund (AP1, AP2, AP3) was conducted by students of Blanka Grubjesic University of Skovde Sweden Using a Parametric Model. The study was conducted in the calculation of the Daily Earning at Risk with a parametric or Variance-Covariance model on three pension fund asset portfolios consisting of 20 types of stocks traded on the Swedish Exchange, 20 foreign stocks and 10 bonds. The period examined was from January 3, 2005, to December 30, 2005, with a 95% confidence level. The resulting conclusion emphasizes that the application of a simple parametric model approach can easily be applied to the investment of the Swedish national pension fund (AP pension fund).

Understanding Investment and Risk

According to Bodie (2009) ordinary shares have two important characteristics as an investment tool that claims the remainder (residual claim) and limited liability. Investment is a variety of activities that are capable of investing a number of funds in these assets. Investment is the attachment of a number of funds or other resources to do this time, with the goal of obtaining a profit in the future (Tandelilin, 2010). This objective affects investment because of a need or need where the investment occurs spontaneously in accordance with the development of life needs, as well as investment because of an expectation of profit and profit. Apart from motivation, there are also aspects that can arise in the investment, namely the aspect of sacrifice. In this case, an investor must be answered resources, the aspect of hope to the investment which he did for the public welfare, the aspect of risk that each person can conduct business investment to earn a profit, but the reality is not everyone can make a profitable business, will there is a turnover or even a loss, the time aspect in which to invest requires patience in waiting for the expected return and the type aspects where each investment likes to take different forms and risks. According to Hanafi (2006) is a risk, the imbalance between the actual rate of return with the expected rate of return (ER). Risk is the prospect of an unwelcome result (operating as the standard deviation). With this, it can be concluded that the definition of risk is a condition that arises due to uncertainty with completely unfavorable and possible impacts. According to Fabozzi (2007) portfolio risk is not only determined by the risk-weighted average shares that make up the portfolio, but is also influenced by the correlation coefficient factor between the level of stock earnings. Meanwhile, a variance portfolio consisting of two or more assets depends not only on the variance of each asset but also on how close the relationship is between the two asset.

Investments and Stock Returns

One of the goals of investors in investing is to make a profit. If investing does not generate a profit, of course investors will not invest. So, broadly speaking, the main objective of all in-

vestments is to make a profit. According to Tandelilin (2010), the expected profit from a portfolio is the weighted average of the expected rate of return of each individual asset that makes up the portfolio. The presentation of the value of the portfolio that has been invested in each individual asset in the portfolio is known as portfolio weighting. If all portfolio weights are added and have a total of 100% or 1.0, then all funds have been invested with the expected portfolio return (Tandelilin, 2010).

RESEARCH METHODOLOGY

Type of Research and Sampling

This type of research is quantitative research. According to Gujarati (2001), quantitative research focuses on research using measured data. The type of data also uses quantitative data to calculate returns and VaR. Sources of data in this study are secondary data sources. The calculation used in this research is the manufacturing industry in Indonesia which is registered in LQ-45, which is 45 companies registered. The sampling technique in this study was nonprobability sampling with purposive sampling type. The criteria used are based on certain reasons or rations. For the research, the criteria used are with certain considerations, namely:

1. Indonesian manufacturing companies are listed on the Indonesia Stock Exchange with active stocks and meet the criteria for the 45 most active stocks in the last 3 years.
2. Manufacturing companies have a market capitalization of more than Rp 1 trillion, because they can represent the values of daily market trading, and are even able to become an index mover in the formation of the JCI on the Indonesia Stock Exchange.

Table 1 Sample Classification

No.	Criteria	Number of Samples
1	Indonesian manufacturing companies are listed on the Indonesia Stock Exchange with active stocks and meet the criteria for the 45 most active stocks in the last 3 years.	30 Companies
2	Manufacturing companies have a market capitalization of more than Rp. 1 trillion, because they can represent the values of daily market trading, and are even able to become an index mover in the formation of the JCI on the Indonesia Stock Exchange.	9 Companies

Source: Processed data, 2021

The number of stock data as an investment portfolio after the determination of these criteria is 9 shares. The daily data collected for each share is as much as 780 daily share price data.

Calculation Phase

In general, the calculation stages in measuring the risk of stock market investment policies in manufacturing companies use the Value at Risk model, including:

1. Determine the type and number of shares to be used according to the sampling criteria
2. Calculate expected returns using geometry return.
3. Calculating portfolio return using a formula.
4. Calculating VaR using Matrix V, C, VC, VCV.
5. Determine the Variance of each stock and the Variance Covariance portfolio model.

Testing of Validity

The calculation of VaR in this study uses data return stock, to measure the validity of testing needs to be carried out VaR data, which includes the distribution pattern of the classical

assumptions. To determine whether this model is valid or not, then do testing Back through Test Kupiec by using the data submarines a year. In Test Kupiec is carried Test in which the level of trust Kupiec that is used is 95% and is done with a test 252 transaction data for a period of 1 year. Here's how calculation to Kupiec Test:

1. If the failure rate (N) numbering is between $6 < N < 21$, then the VaR model is considered valid for measuring potential losses.
2. If $N < 6$ then the model is considered too conservative to measure potential losses.
3. If $N > 21$ then the model is considered too moderate to measure potential losses.

RESEARCH RESULTS AND DISCUSSION

Stock Exposure Calculation

The selection of shares by the management of Indonesian manufacturing companies is based on the consideration of investment diversification in various kinds of stocks. If the case decrease in the return of an asset class, it is expected that the return on other asset classes increase, so the return on the overall portfolio relatively fluctuated. The following is a stock portfolio arrangement used in this study:

Based on the exposure of stock investments made by companies manufacturing Indonesia looks issuers that have dominated by sub automotive sector (39,49%) namely ASII (Astra), things can be understood considering the very high development of automotive companies in Indonesia due to popular demand the market will be motorized vehicles.

The type of data in this research is a continuous data and time series, so as to calculate the result of the return day of her using the method of calculation of geometric returns are included in a logarithmic function of the ratio of the price. The use of geometric returns to avoid biased results with respect to the magnitude of the effect is divided as a common element in calculations using arithmetic returns. Based approach to geometry return, the next is to calculate the daily for the nine selected stocks. After knowing the daily return of each stock in a predetermined period, the daily portfolio return of each stock is calculated. Then, the return t is then assessed the proportion (weighted) of each share portfolio. 100% weighting occurs when the overall portfolio weight is aggregate.

Table 2 Indonesian Manufacturing Company Stock Exposures

Stock	Lot	Share Volume	Closing Price	Portfolio Value	Weight
ASII	932. 481	93.248. 100	6.450	601.450.245.000	39,49%
CPIN	154. 889	15.488. 900	3.345	51.810.370.500	3,40%
GGRM	14. 341	1.434. 100	58.350	83.679.735.000	5,49%
ICBP	45. 212	4.521. 200	14.450	65.331.340.000	4,29%
INDF	179. 966	17.996. 600	6.200	111.578.920.000	7,33%
INTP	54. 173	5,417, 300	19.700	106.720.810.000	7,01%
KLBF	1.027. 517	102.751.700	1.335	137.173.519.500	9,01%
SMGR	166. 838	16.683. 800	11.050	184.355.990.000	12,11%
UNVR	49. 255	4.925. 500	36.700	180.765.850.000	11,87%
Total		262.467.200		1.522.866.780.000	100%

Source: Processed data, 2021

Classic Assumption Test

The type of classical assumption test used is the normality test. This test is conducted to determine whether the nine stocks return distribution data is normally distributed or not/ skewed. Based on the normality test showed that the overall 9 stock experienced a data abnormality in as right value Asymp. SIG (two-tailed) were smaller than at 0,05. Therefore, in calculating Variance-Covariance need to calculate z-score used Cornish Fisher. After her test for normality, in the know that the data is experiencing lack of normal late the data, therefore it is necessary for the recalculation of the value of α.

The α value used in the normal distribution comes from the normal use of the Z-score value. While the value on the distribution of abnormal use is generated from an adjustment through the correction Z. Customization performed on the data form α Skewness normality to wear Expansion Cornish-Fisher.

In addition to the normality test, heteroscedasticity test is also conducted to determine homoscedasticity or heteroscedasticity data. Based on the results of the data, the return obtained is homoscedasticity because the t-significance is more than 0,05. For this reason, the calculation of return volatility using the Exponentially Weighted Moving Average (EWMA) approach is no longer necessary.

Calculation of Variance Covariance VaR for each share

The following is the stage of calculating the variance covariance of each stock:

Table 3 Matrix Calculation V

Code	ASII	CPIN	GGRM	ICBP	INDF	INTP	KLBF	SMGR	UNVR
ASII	0,02148								
CPIN		0,03082							
GGRM			0,02093						
ICBP				0,02037					
INDF					0,02140				
INTP						0,02434			
KLBF							0,02128		
SMGR								0,02332	
UNVR									0,02087

Source: Processed data, 2021

Table 4 Matrix Calculation C

Code	ASII	CPIN	GGRM	ICBP	INDF	INTP	KLBF	SMGR
ASII	1	0,47436	0,32224	0,37442	0,45320	0,49842	0,42130	0,51168
CPIN	0,47436	1	0,42188	0,36999	0,39591	0,44034	0,40725	0,47591
GGRM	0,32224	0,42188	1	0,31617	0,33692	0,35293	0,33643	0,36954
ICBP	0,37442	0,36999	0,31617	1	0,36814	0,33278	0,43199	0,30018
INDF	0,45320	0,39591	0,33692	0,36814	1	0,48233	0,40005	0,40269
INTP	0,49842	0,44034	0,35293	0,33278	0,48233	1	0,43545	0,68637
KLBF	0,42130	0,40725	0,33643	0,43199	0,40005	0,43545	1	0,41835
SMGR	0,51168	0,47591	0,36954	0,30018	0,40269	0,68637	0,41835	1

Source: Processed data, 2021

Table 5 Calculation of Matrix CV

UNVR	0,42408	0,40942	0,34128	0,34605	0,41037	0,37137	0,46918	0,38095	1
Code	ASII	CPIN	GGRM	ICBP	INDF	INTP	KLBF	SMGR	UNVR
ASII	0,000461	0,000314	0,000145	0,000164	0,000208	0,000261	0,000193	0,000256	0,000190
CPIN	0,000314	0,000949	0,000272	0,000232	0,000261	0,000330	0,000267	0,000342	0,000263
GGRM	0,000145	0,000272	0,000437	0,000135	0,000151	0,000180	0,000150	0,000180	0,000149
ICBP	0,000164	0,000232	0,000135	0,000414	0,000160	0,000165	0,000187	0,000143	0,000147
INDF	0,000208	0,000261	0,000151	0,000160	0,000457	0,000251	0,000182	0,000201	0,000183
INTP	0,000261	0,000330	0,000180	0,000165	0,000251	0,000592	0,000226	0,000390	0,000189
KLBF	0,000193	0,000267	0,000150	0,000187	0,000182	0,000226	0,000452	0,000208	0,000208
SMGR	0,000256	0,000342	0,000180	0,000143	0,000201	0,000390	0,000208	0,000543	0,000185
UNVR	0,000190	0,000263	0,000149	0,000147	0,000183	0,000189	0,000208	0,000185	0,000435

Source: Processed data, 2021

Table 6 Calculation of Matrix VCV

Code	ASII	CPIN	GGRM	ICBP	INDF	INTP	KLBF	SMGR	UNVR
ASII	0,000461	0,474359	0,322242	0,374418	0,453203	0,498423	0,421304	0,511683	0,424078
CPIN	0,474359	0,000949	0,421882	0,369994	0,395911	0,440341	0,407253	0,475913	0,409423
GGRM	0,322242	0,421882	0,000437	0,316169	0,336921	0,35293	0,336426	0,369543	0,341284
ICBP	0,374418	0,369994	0,316169	0,000414	0,368141	0,332778	0,431989	0,300177	0,346048
INDF	0,453203	0,395911	0,336921	0,368141	0,000457	0,482328	0,400054	0,402692	0,410373
INTP	0,498423	0,440341	0,35293	0,332778	0,482328	0,000592	0,435452	0,686373	0,371374
KLBF	0,421304	0,407253	0,336426	0,431989	0,400054	0,435452	0,000452	0,418354	0,469185
SMGR	0,511683	0,475913	0,369543	0,300177	0,402692	0,686373	0,418354	0,000543	0,380949
UNVR	0,424078	0,409423	0,341284	0,346048	0,410373	0,371374	0,469185	0,380949	0,000435

Source: Processed data, 2021

Table 7 Calculation of Variance Covariance Value at Risk in a period of 1 day, 5 days, 10 days, and 20 days

Code	Price Exposure	St. Deviation	Z correction	VaR A Day	VaR 5 Days	VaR 10 Days	VaR 20 Days
ASII	6.450,00	0,02148	2,47909216	343,38947	767,84220	1085,892853	1535,6844
CPIN	3.345,00	0,03082	2,646182746	272.80133	610,002308	862,6735373	1220,00462
GGRM	58.350,00	0,02093	2,327553661	2.842,41023	6355,8225	8988,490381	12711,645
ICBP	14.450,00	0,02037	2,577873584	758,63385	1696,35686	2399,010879	3392,71372
INDF	6.200,00	0,02140	3,109308725	412,46173	922,292466	1304,318513	1844,58493
INTP	19.700,00	0,02434	2,65294	1.272,01305	2844,30765	4022,458452	5688,6153
KLBF	1.335,00	0,02128	2,491867898	70,79996	158,31352	223,8891277	316,627041
SMGR	11.050,00	0,02332	2,844247963	732,80188	1638,59482	2317,323011	3277,18963
UNVR	36.700,00	0,02087	1,804364288	1.381,75932	3089,70778	4369,506645	6179,41556

Source: Processed data, 2021

The VaR value shows the maximum possible (potential) loss on a financial asset or portfolio in a utilization period with a certain level of confidence. In the table above is known that the value of VaR is the highest in the period of 1 day per share occurred on GGRM shares amounting to Rp 2.842,41, while the value of VaR most low occurred on KLBF

shares amounting to Rp 70,79. For the value of VaR in the period of time 5 days ahead, the highest occurred in GGRM shares amounting to Rp 6.355,82 while the lowest occurred in s AHAM KLBF amounting to Rp 158,31. For the VaR value within the next 10 days, the highest was GGRM shares amounting to Rp 8.988,49, while the lowest occurred in KLBF shares with Rp 223,88. Finally, for the value of VaR in the period of the next 20 days per share, the highest in the shares GGRM Rp 12.711,64, while the lowest value of VaR exist on KLBF shares worth Rp 316,62.

VaR Model Testing

After calculating the VaR value, to determine whether the value is accurate or not, a Backtesting test is performed (Jorion, 2007). One of the backtesting models is done with the Kupiec test (Kupiec, 1995), namely by comparing the test results between the predicted values of the actual VaR return data. Testing Back through Test Kupiec by using the data submarines a year. In Test Kupiec is carried Test in which the level of trust Kupiec that is used is 95% and is done with a test 252 transaction data for a period of 1 year. The following Kupiec test is evaluated:

1. If the failure rate (N) numbering is between 6 < N <21, then the VaR model is considered valid for measuring potential losses.
2. If N < 6 then the model is considered too conservative to measure potential losses.
3. If N > 21 then the model is considered too moderate to measure potential losses.
4. The following is the result of VaR backtesting testing

Table 8 VaR Backtesting Results

Code	Difference-Covariance	Validity (<21)
ASII	8	Valid
CPIN	8	Valid
GGRM	10	Valid
ICBP	7	Valid
INDF	7	Valid
INTP	16	Valid
KLBF	10	Valid
SMGR	7	Valid
UNVR	18	Valid

Source: Processed data, 2021

From the results table above stated that the failure rate generated by the model Variance-Covariance very small as evidenced by value 6 <N <21. This shows that the calculation of the Variance-Covariance Model is a valid model and can be used to measure the value of risk and is valid in measuring potential losses.

CONCLUSIONS AND RECOMMENDATIONS

Risk market measured on stock investments individually and portfolio models Variance Covariance VaR by using Variance-Covariance Models included into the model of a valid/accurate and they may be useful early to measure the value of risk. This shows that the calculation of the Variance-Covariance Model is a valid model and can be used to measure the value of risk and is valid in measuring potential losses. So it would be better if the risk calculation both individually and in a portfolio using the Variance-Covariance method in order to get accurate results and be able to measure potential losses with validity.

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