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The Analysis of Value at Risk of the Mining Sector Shares in Indonesia Stock Exchange

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Abstract:- The High volatility in mining sector shares leads this sector as one of the sector with a high level of risk. It makes the risk of investment in mining sector shares become interesting to be studied. Measuring the risk of loss on investment in mining sector shares can be analyzed using the method approach of Value at Risk (VaR). Meanwhile, the estimation is analyzed using Volatility Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH). This study aims to form the optimum model of the ARCH-GARCH model for the Mining sector shares so that the value of investment risk can be estimated using the Value at Risk method approach. Value at Risk is currently run by financial managers as an important tool in the entire risk management process. The data of the study was obtained from Indonesia Stock Exchange (www.idx.co.id) and Yahoo Finance in the form of daily stock price per January 1, 2014 until December 31, 2018. This study revealed that the return data of the mining sector shares was the stationary data that does not have normal distribution. Besides, the measurement of Value at Risk (VaR) through the process of estimating volatility with the ARCH-GARCH model using a 95% confidence level and a holding period provides information on the maximum potential loss on each share return value. The conclusion was that the longer the holding period, the higher the level of loss. This study is expected to provide benefits for investors in considering the investment decision making. Besides, this study is also expected to bring the benefit to the company in the form of improving the performance of company management. This study can provide empirical evidence on the theory of risk analysis with the Value at Risk method.

Keywords: *The Mining Sector Shares, Return Stock, Value at Risk (VaR), ARCH/GARCH Model, Stationarity.*

I. INTRODUCTION

Mining is an activity to optimize the utilization of mining natural resources (minerals) from the earth. The mining industry in Indonesia is an industry that has a large contribution with a value of 8.24 billion US $ in increasing the value of exports to Indonesia (data from the Ministry of Industry), 11.06% for the average distribution of GDP in 2014-2017 (BPS 2014-2018), and IDR 90 Trillion for PNBP deposits in 2016 (ekon.go.id). The characteristic of the mining industry is that the mining industry requires very large investment costs, long-term, risk requirements, and high uncertainties in the risk process. It makes the funding issues as a major issue related to company development. Therefore, many mining companies enter the capital market to find investors in order to fulfill the capital and absorb investment to strengthen their financial position. There are approximately 21 mining sector companies are listed on the Indonesia Stock Exchange which are listed on the main board as mining sector companies from 1990 to April 2019.

An interesting phenomenon occurred in the mining sector shares which in 2014-2015 had decreased and rose again in 2016-2018 based on the data of share price movement. The comparison of LQ45 share price movements from 2014 to 2018, the data is shown in Graph 1.1.

Fig 1:- The Price Index of Stocks of Mining Sector, LQ45 and the Stock Return of Mining Sector
Source: Data processed by researchers

Fig 1 shows a high rate of return on mining sector shares. According to Alteza (2010), return is the level of profit gained from investment. Return is categorized into two types, the first one is the return that has occurred (actual return) is counted based on the historical data, and the second one is the expected return that is the return expected by the investor in the future. Tandelilin (2010) stated that risk is possible differences between the actual return received and the expected return". The investor expects returns in the future, but the number of those returns is rarely predicted correctly. The actual return is almost always different in value with the expected returns. The difference between the two values is called risk. One of the measurements used for risk is the standard deviation (volatility) of return.

The high volatility in the mining sector shares leads this sector as one of the sectors with a high level risk. Risk according to Jorion (2007) is the volatility from the unexpected result of asset value, equity, and earning. One of the newest approaches in estimating the risk value of investment is using Value at Risk method. Jorion (2007) mentioned in his book that Value at Risk is a method to measure risk by deploying the standard statistic technique and it is usually deployed in other fields.

The calculation of Value at Risk (VaR) is the measurement of the possibility of the worst losses in normal market conditions within the period t with a certain level of confidence. In order to obtain the value of VaR requires a measurement of volatility that measures the rate of change in stock prices on the distribution of return. The score of volatility is important to acknowledge and understand the general picture of the risks in investing so that it can be considered in decision making and policy of shareholders. The prediction of high volatility score indicates a high level of risk so that the investor will leave the market or sell assets to minimize risk.

One of the important aspects on the financial risk analysis is the model used to represent volatility that is Autoregressive Conditional Heteroscedasticity (ARCH) that was introduced by Engle in 1982. In 1998, Bollerslev introduced Generalized Autoregressive Conditional Heterocedasticity model (GARCH) that generated more realistic predictions if it is compared to ARCH. The GARCH model can be employed by the investor in choosing the right period to invest and to sell shares. The characteristics of the GARCH model can be seen from the volatility score.

Volatility is the distribution level of the results that might be obtained from a random variable that is frequently called as the standard deviation (Penza and Bansal, 2001). Penza and Bansal mentioned that the accurate prediction of volatility and correlation are keys to succeed within the risk analysis and management as the volatility provides important data regarding the probability of achieving desired results and portfolio management in the market. Forecasting on return that will be obtained from the investment and the calculation of the value of loss become the main basis in investment portfolio decision making. Considering the correlation between return on stock and the value of risk with the VaR model makes this research study and analyze the risk of investment on the mining sector shares. Thus, the goal of this study is to analyze the optimum model from the ARCH-GARCH model, estimate the value of risk with the Value at Risk method and analyze the risk using the Value at Risk method at the mining sector shares.

II. THEORETICAL FRAMEWORK

A. Financial Management

The financial management as an activity to obtain, employs, and manage funds and asset efficiently needs several goals and targets. The goal of the financial management is related to the decision in financial sector in order to maximize the value of the company. Decisions in the financial sector in improper financial management, pose risks that affect the company's financial performance. According to Azzahroh (2019) Assessment of risk is divided into 8 parts, namely credit risk, market risk, liquidity risk, operational risk, legal risk, strategic risk, compliance risk and reputation risk. Risk is unavoidable but can be minimized to achieve good financial performance. According to Herawati (2012), the performance of company's financial is a formal work done by the company in order to evaluate the efficiency and effectiveness of company's activities that have been done in a certain period. The financial performance gives a standard for the external parties to make decisions in investing their stock to the company.

B. Investment

Investment can simply be interpreted as an activity that aims to develop assets. Besides, the investment objective is a commitment upon a number of funds or other resources that have been carried out at this present time aiming to obtain a number of benefits in the future (Ahmad, 2009). Investors Behavioral take care about the information regarding stocks classified by asset class, specific risk premium, past return, style and diversification or weight of stocks in the portfolio (Bkhit , 2019).

C. Value at Risk

The risk measure that has been established since the 1990s in financial theory and practice is called as Value at Risk (VaR). Andreas de Vries in 2000 explained that the risk measure was popularized by J.P. Morgan's Risk Metrics. A database that provides the statistical data is important to calculate the derivative VaR. The VaR at this time is run by the financial manager as the important tool in the whole process of the management of risk.

According to Jorion (2011), the Value at Risk (VaR) in the context of financial is the risk prediction, with certain level of confidence, how many portfolios that will be lost during the certain horizon period. The portfolios can be in the form of single asset or compilation of several security assets. The VaR is a measure of downside risk that is

concentrated in the low probability events occurring in the lower tail of the distribution.

Asianto (2018) stated that the value of VaR is the worst loss expectation so that the easiest method that can be used is employing the return distribution of portfolios. Let P be the function of probability density of P and c a confidence interval, so the value of VaR in the horizon of time can be calculated with the following equation.

$$1 - c = \int_{-\infty}^{-VaR} f_{\Delta P}(x)dx \qquad (2.1)$$

The return of the portfolios is stated normally distributed with mean μ and standard deviation σ, so that the value of VaR can be calculated. The value of Z that suits the confidence level c can be found on the table of normal standard. If c is 95%, then Z that is suitable is 1.65. Given that c is 99%, then Z that is suitable is 2.33. Figure 2.1 explains that the VaR is stated suitable with the left tail, so that the secant line is -Z just like the illustration in the following figure.

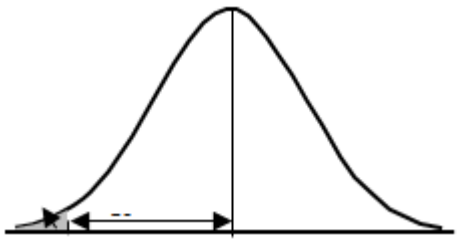

Fig 2:- Normal Distribution Curve

$$Z_\alpha = \frac{z - \mu}{\sigma} \qquad (2.2)$$

If z VaR and Z Z then $VaR = Z_\alpha \sigma - \mu$
If FP(x) is cumulative distribution function (cdf) of P, then

$$1 - c = \int_{-\infty}^{-VaR} f_{\Delta P}(x)dx = F_{\Delta p}(-VaR) \qquad (2.3)$$

The return from the consecutive periods is $R_{t,2} = R_t + R_{t-1}$

The risk factor is assumed to be identical and independently distributed in several periods, $\mu(R_t) \; \mu(R_t \; 1) \; \mu(R)$.

Thus $\mu(R_{t,2}) \; \mu(R_t) \; \mu(R_t \; 1) \; 2\,\mu(R)$

Whereas the value cov(R_t , $R_t \; 1$) 0 and ($R_{t,2}$) $\sqrt{2}R_t$

If the period of time is b = t, $\mu(R_{t,b})$ b . $\mu(R_t)$ and ($R_{t,b}$) $\sqrt{b}$. (R_t) then the general formula of the VaR calculation is

$$VaR = \left(\sigma_{t+1} . \sqrt{b}\right) . Z_\alpha . W \qquad (2.4)$$

Description: VaR is how much risk, b is the investment period, $Z\alpha$ is the critical point on the Z Table with the confidence interval equals to 95%, W is the value of investment, and σt+1 is the future standard deviation.

Jorion (2010) mentioned that the measurement of Value at Risk (VaR) is generally divided into two approaches, the non-parametric and the parametric approaches. The non-parametric approach is based on the historical data and it seldom estimates the distribution paametrics.

VaR for single asset according to Jorion is calculated with the following formula:

$$VaR = \alpha \times \sigma \times P \qquad (2.5)$$

where:
α = Confidence of Level
σ = Estimate of Volatility
P = The value of asset position
When the holding period is involved within the equation (2.6), then the equation of VaR will transform into:

$$VaR = \alpha \times \sigma \times P \times \sqrt{t} \qquad (2.6)$$

where:
t = *Holding period.*

D. Volatility

The volatility return is shown as varian or standard deviation (Jorion, 2010). Volatility is used to implement statistical measurements of the price variations of an instrument. In forecasting, volatility is generally assumed to be constant over time, although in reality it is not the same. Watsham (in Pribadi, 2008) mentioned that volatility that is constant over time is called as homoskedastic, while the non-constant volatility is called as heteroskedastic.

E. ARCH-GARCH

Juanda and Junaidi (2012) stated that the data time series frequently experience high volatility and its error variance is inconsistent. This behavior can be found on the stock index, exchange rate, inflation, option, and so forth. The aforementioned data is assumed to have heteroscedasticity effect. The data is processed with the OLS method that can generate uncommon and consistent parameter assumption. Nevertheless, the standard error and the value of interval confidence become too big so that the conclusion from the aforementioned model can be misleading. Engle in 1982 introduced the Autoregressive Conditional Heteroscedasticity model (ARCH) in order to solve the problem. Volatility data is reflected in residual variance that does not fulfill the assumption of

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homoscedasticity. The value of residual variance will be constant over time. Bollerslev (1986) developed ARCH into Generalized Autoregressive Conditional Heteroscedasticity (GARCH) in 1986.

The Error variance of the GARCH method is consisted of three components such as the constant variance (α_0), the last period volatility or it is called as ARCH (e^2_{t-p}), and the previous variance that is called as GARCH (σ^2_{t-q}). It is similar with the ARCH model, in order to make the variance turns into positive, then {var (et) > 0}. This model is also created as limitation $\alpha_0>0$, α_1 and $\lambda_1 \geq 1$, and $\alpha_1 + \lambda_1 < 1$ that can be estimated with the maximum likelihood technique. The formula of ARCH-GARCH will be given as follows.

$$\sigma_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \dots\dots + \alpha_p e_{t-p}^2 + \lambda_1 \sigma_{t-1}^2 + \dots\dots + \lambda_q \sigma_{t-q}^2$$

or

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i e_{t-1}^2 + \sum_{j=1}^{q} \lambda_j \sigma_{t-j}^2 \qquad (2.7)$$

Description: σ^2_t is the conditional variance, (α_0, α_1, λ_1) is constant, e^2_{t-i} is the squared error of the previous period, σ^2_{t-j} is the conditional variance of the previous period, p is lags of squared error, q is lags of conditional variance, and (i, j) is 0,1,2, ... n. The model within this equation is called as GARCH model (p, q).

ARCH/GARCH is usually deployed to obtain the volatility of the data. ARCH/GARCH is the continuation of the forecasting ARIMA model, in which the conditions used if the ARIMA model that is chosen does not meet the assumption of homoscedasticity. It means that the model still contains heteroscedastic. In short, the framework of this study can be explained as follows:

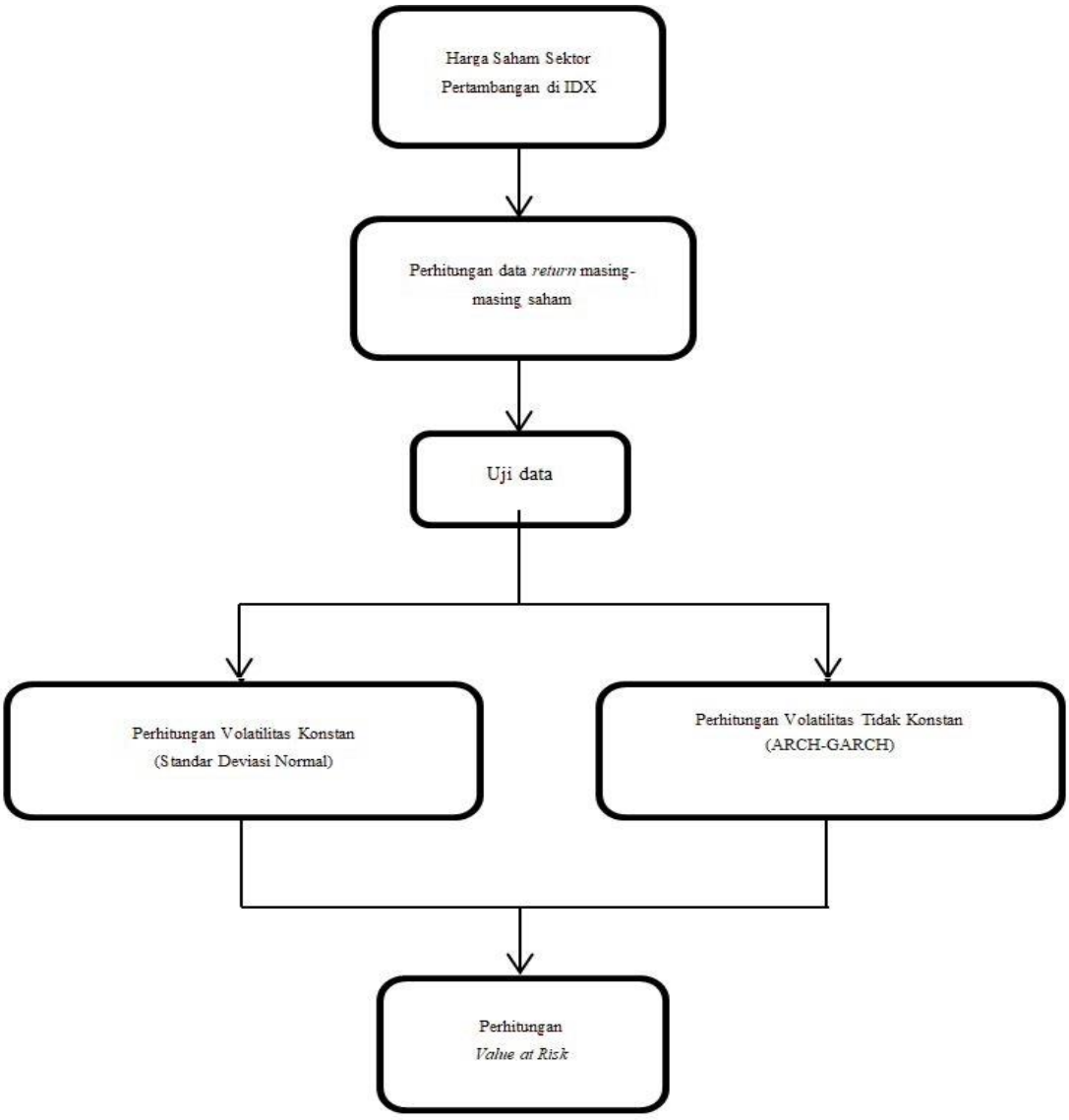

Fig 3:- The Framework of the Study
Source: the result of the author's work 2019

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III. METHODOLOGY

This study is a time series study as it is conducted with data on closing prices of mining sector shares. The data was obtained from finance.yahoo.com with a daily period from January 2014 to December 2018. The variable in this study is the share price of the mining sector listed on the Indonesia Stock Exchange, by calculating the return data of each mining sector stock price listed on the Indonesia Stock Exchange, calculating Value at Risk (VaR) and calculating volatility using the Autoregressive Conditional Heterocedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model.

The sampling technique used in this study is the non-probability technique that is purposive sampling. The criteria that have been set in this study will be explained as follows:

1. The mining sector shares that have been listed in Indonesia Stock Exchange with IPO before January 2014.
2. The mining sector shares that have been listed in Indonesia Stock Exchange during the period of January 2014 until December 2018.
3. Data mining returns and its components are processed using the method Value at Risk, ARCH/GARCH.
4. The analysis here employs Eviews software.

The risk analysis is implemented using the Autoregressive Conditional Heteroscedasticity-Generalized Autoregressive Conditional Heteroscedasticity (ARCH-GARCH) method until it obtains the optimum model. Then, the analysis of Value at Risk is applied based on the optimum model. Thus, the risk comparison of each stock and return price from the mining sector shares is obtained.

IV. RESULT AND DISCUSSION

The data employed in this study is the data of the closing stock price from the mining sector that has been listed in Indonesia stock exchange with a daily time period from January 1, 2014 to December 31, 2018 with a total data of 1250 points / closing price. The aforementioned data has fulfilled the criteria of the sampling technique by deploying the purposive sampling method that has been set in this study.

A. The Data Return Testing

Determining the data return of each stock price can be calculated using the natural logarithm approach from the current stock price ratio with the previous stock price. The result of the return calculation of several stocks can be seen from the table below.

NO	TANGGAL	ADRO.JK	INCO.JK	INDY.JK	MEDC.JK	PTBA	PTRO.JK	TINS.JK
1	02/01/2014	0	0	0	0	0	0	0
2	03/01/2014	-0.048318577	-0.051293294	-0.033901552	-0.062131781	-0.039220713	-0.00851069	-0.032158191
3	06/01/2014	-0.082521024	-0.087968773	-0.062242309	-0.0051414	-0.072570693	-0.008583744	-0.071098269
4	07/01/2014	-0.055262679	0.006872879	-0.018519048	0.025446666	-0.018996501	0.008583744	-0.039360322
5	08/01/2014	0.065957968	0.004555817	0	0.081973583	0.027028672	0.016949558	-0.00732629
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
1246	25/12/2018	0	0	0	0	0	0	0
1247	26/12/2018	-0.024292693	-0.012779727	-0.049392755	-0.029631798	0.01408474	-0.025533302	-0.027028672
1248	27/12/2018	0.016260521	0.037859411	0.006309169	0.036904557	0	0.005730675	0.020339684
1249	28/12/2018	-0.020367303	0.009245058	-0.003149609	-0.007272759	0.00232829	0.019802627	0.013333531
1250	31/12/2018	0	0	0	0	0	0	0

Table 1:- Stock Return
ADRO, INCO, INDY, MEDC, PTBA, PTRO, and TINS
Source: finance.yahoo.com, reprocessed by using excel application (2019)

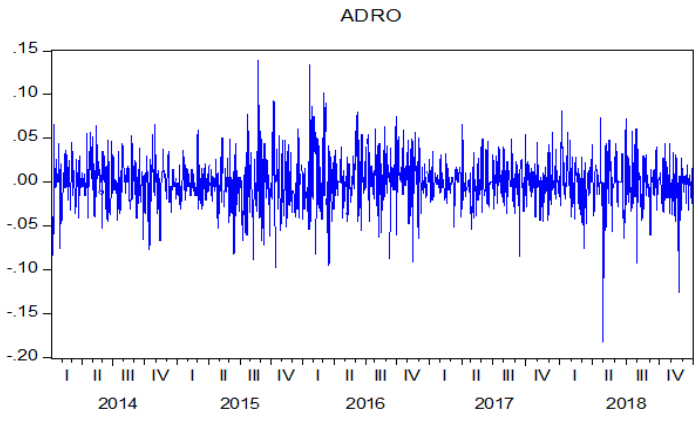

Fig 4:- The Data plot of the Stock Return ADRO
Source: finance.yahoo.com, reprocessed by using excel application (2019)

The result of the data plot of the stock return in Graphic 4.1 can be seen from the ADRO stock that is stationary. Nevertheless, the data return of the stock needs to be retested in order to make the decision making more accurate with formal ADF testing.

B. The Stationary Testing

The stationary testing is applied by deploying the Augmented Dickey Fuller Test (ADF-Test) method on each data return of the mining sector shares with the help of Eviews software. It is obtained the value of ADF Test Statistic for the data return of ADRO shares that equals to -35.39415 < test critical value 5%, then the MacKinnon level equals to -3.413413. Thus, it can be drawn a conclusion that the data return of the ADRO shares is stationary.

Null Hypothesis: ADRO_JK_ has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=22)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-35.39415	0.0000
Test critical values:	1% level	-3.965410	
	5% level	-3.413413	
	10% level	-3.128744	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ADRO_JK_)
Method: Least Squares
Date: 07/27/19 Time: 13:02
Sample (adjusted): 1/03/2014 12/31/2018
Included observations: 1249 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ADRO_JK_(-1)	-1.002700	0.028330	-35.39415	0.0000
C	0.000398	0.001627	0.244750	0.8067
@TREND("1/02/2014")	-4.62E-07	2.26E-06	-0.204829	0.8377

R-squared	0.501350	Mean dependent var	-5.56E-20
Adjusted R-squared	0.500549	S.D. dependent var	0.040663
S.E. of regression	0.028737	Akaike info criterion	-4.258858
Sum squared resid	1.028971	Schwarz criterion	-4.246536
Log likelihood	2662.657	Hannan-Quinn criter.	-4.254225
F-statistic	626.3730	Durbin-Watson stat	1.998044
Prob(F-statistic)	0.000000		

Table 2:- The Result of ADF Testing for the stock Return of AALI
Source: The result of Eviews 10 data processing. (2019)

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No	Kode	Emiten	ADF Test	Critical Value 5%	Stationary
1	ADRO	Adaro Energy Tbk.	-35.39415	-3.413413	Stationary
2	ANTM	Aneka Tambang Tbk.	-36.00851	-3.413413	Stationary
3	APEX	Apexindo Pratama Duta Tbk.	-14.76138	-3.413413	Stationary
4	ARTI	Ratu Prabu Energi Tbk	-31.02626	-3.413413	Stationary
5	BYAN	Bayan Resources Tbk.	-18.58263	-3.413413	Stationary
6	DEWA	Darma Henwa Tbk	-13.54888	-3.413413	Stationary
7	DSSA	Dian Swastatika Sentosa Tbk	-11.79798	-3.413413	Stationary
8	ELSA	Elnusa Tbk.	-35.33355	-3.413413	Stationary
9	ESSA	Surya Esa Perkasa Tbk.	-27.41412	-3.413413	Stationary
10	HRUM	Harum Energy Tbk.	-32.06688	-3.413413	Stationary
11	INCO	Vale Indonesia Tbk.	-31.39033	-3.413413	Stationary
12	INDY	Indika Energy Tbk.	-34.30522	-3.413413	Stationary
13	ITMG	Indo Tambangraya Megah Tbk.	-32.45375	-3.413413	Stationary
14	KKGI	Resource Alam Indonesia Tbk.	-35.24047	-3.413413	Stationary
15	MEDC	Medco Energi Internasional Tbk	-31.70407	-3.413413	Stationary
16	MYOH	Samindo Resources Tbk.	-27.64901	-3.413413	Stationary
17	PTBA	Bukit Asam Tbk.	-35.33869	-3.413413	Stationary
18	PTRO	Petrosea Tbk.	-31.95503	-3.413413	Stationary
19	TINS	Timah Tbk.	-33.11262	-3.413413	Stationary
20	TOBA	Toba Bara Sejahtra Tbk.	-29.37408	-3.413413	Stationary

Table 3:- The Result of ADF Testing for the Stock Return on the mining sector
Source: finance.yahoo.com, reprocessed with Eviews application (2019)

The table 3 above reveals that all mining sector shares are stationary.

C. The Normality Testing

This normality test is conducted to see whether the ARCH/GARCH model residuals obtained are normally distributed or not. The test is implemented using the Jarque Bera test, meaning that there is a violation in the residual assumption test as the residual contains a heteroscedasticity effect. It implies that the variance is not constant, so it is necessary to set the variance with the GARCH model that can identify models with non-constant variants.

The normality test result of data return of the stock that uses Eviews software is depicted in Figure 5. Based on Figure 5, it can be seen that the result of Jarque Bera (JB) counting of ADRO stock return is 432.6011. This value is greater than Chi-Square X2 (a = 5%, df = 2) of 5.99146 or probability (0.00000) < 5%, so that it can be concluded that the data return of the stock is not normally distributed.

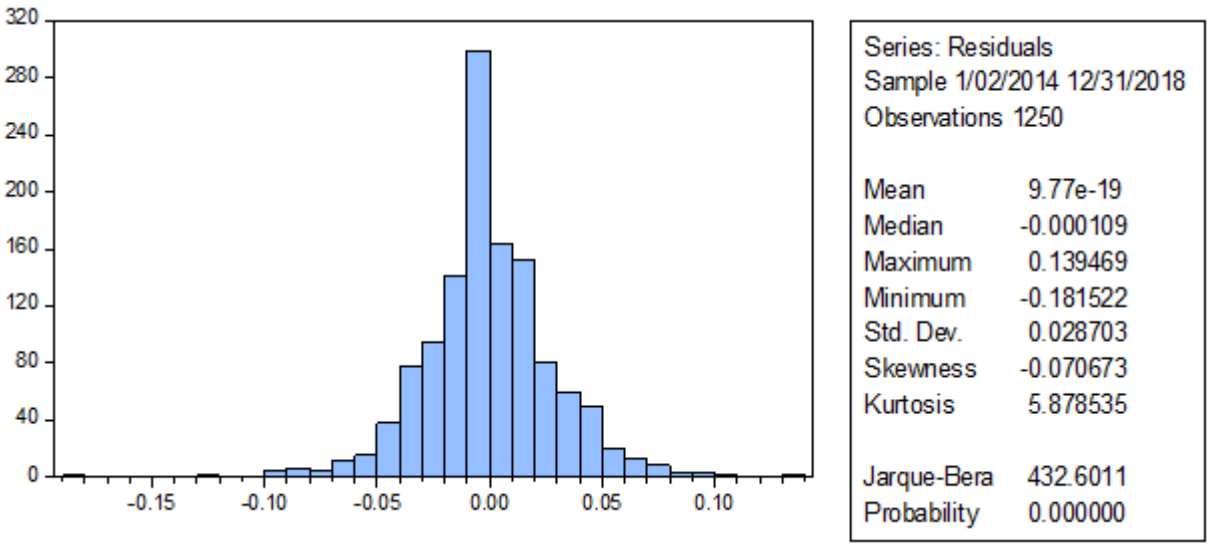

Fig 5:- The Result of Normality Testing of ADRO Stock Return

The complete result of normality test of the data return of mining sector shares can be seen in Table 4 According to the analysis of Table 4, it can be drawn a conclusion that the data return of the stock is not normally distributed, thus *a* should be checked by using Cornish Fisher Expansion. It can be used for the estimation calculation of Value at Risk. The detail result of Cornish Fisher Expansion calculation is shown in Table 5.

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No	Kode	Jorque-Berra	Probability	Chi-Square (X2)	Normality
1	ADRO	432.6011	0.00000	5.99146	Not Normal
2	ANTM	9108.163	0.00000	5.99146	Not Normal
3	APEX	452522.5	0.00000	5.99146	Not Normal
4	ARTI	12968.48	0.00000	5.99146	Not Normal
5	BYAN	90865.82	0.00000	5.99146	Not Normal
6	DEWA	409737.1	0.00000	5.99146	Not Normal
7	DSSA	58317.78	0.00000	5.99146	Not Normal
8	ELSA	1348.103	0.00000	5.99146	Not Normal
9	ESSA	3048.882	0.00000	5.99146	Not Normal
10	HRUM	3680.521	0.00000	5.99146	Not Normal
11	INCO	326.1377	0.00000	5.99146	Not Normal
12	INDY	15923.55	0.00000	5.99146	Not Normal
13	ITMG	386.483	0.00000	5.99146	Not Normal
14	KKGI	4501.344	0.00000	5.99146	Not Normal
15	MEDC	1535.973	0.00000	5.99146	Not Normal
16	MYOH	24780.57	0.00000	5.99146	Not Normal
17	PTBA	793.3044	0.00000	5.99146	Not Normal
18	PTRO	3492.369	0.00000	5.99146	Not Normal
19	TINS	443.5682	0.00000	5.99146	Not Normal
20	TOBA	2758.274	0.00000	5.99146	Not Normal

Table 4:- The Result of Normality Testing of Stock Return
Source: finance.yahoo.com, reprocessed by using Eviews application (2019)

No	Kode	Emiten	Koefisien Skewness	α (0.95)	$\alpha' \over \alpha - \frac{1}{6}(\alpha^2 - 1)\xi$
1	ADRO	Adaro Energy Tbk.	-0.070673	1.64485	1.664939172
2	ANTM	Aneka Tambang Tbk.	1.962835	1.64485	1.086903839
3	APEX	Apexindo Pratama Duta Tbk.	1.501658	1.64485	1.217995824
4	ARTI	Ratu Prabu Energi Tbk	0.516694	1.64485	1.497977016
5	BYAN	Bayan Resources Tbk.	0.155614	1.64485	1.600615903
6	DEWA	Darma Henwa Tbk	2.782729	1.64485	0.853844662
7	DSSA	Dian Swastatika Sentosa Tbk	-0.45078	1.64485	1.772986583
8	ELSA	Elnusa Tbk.	0.966455	1.64485	1.370130089
9	ESSA	Surya Esa Perkasa Tbk.	0.872909	1.64485	1.396721031
10	HRUM	Harum Energy Tbk.	1.075872	1.64485	1.339027732
11	INCO	Vale Indonesia Tbk.	0.342148	1.64485	1.547592633
12	INDY	Indika Energy Tbk.	1.604306	1.64485	1.188817591
13	ITMG	Indo Tambangraya Megah Tbk.	0.231042	1.64485	1.579175098
14	KKGI	Resource Alam Indonesia Tbk.	1.116988	1.64485	1.327340293
15	MEDC	Medco Energi Internasional Tbk	0.968338	1.64485	1.369594836
16	MYOH	Samindo Resources Tbk.	1.584445	1.64485	1.194463184
17	PTBA	Bukit Asam Tbk.	-0.110386	1.64485	1.6762278
18	PTRO	Petrosea Tbk.	1.132366	1.64485	1.322969015
19	TINS	Timah Tbk.	0.751283	1.64485	1.43129386
20	TOBA	Toba Bara Sejahtra Tbk.	0.302275	1.64485	1.558926743

Table 5:- The Calculation Result of Cornish Fisher Expansion
Source: finance.yahoo.com, reprocessed by using Eviews application (2019)

According to Table 5, the value of a of corrected data return of ADRO stock is 1.664939172. This value is greater than the value of *a* because it has a negative skewness coefficient. This value of *a'* is applied for the calculation of Value at Risk of ADRO stock return.

D. The White Heteroscedascity Testing

This White Heteroscedasticity testing aims to find out whether the return variance is constant or not constant (time varying). If the variance of the return is constant (homoscedastic), thus the standard deviation can be calculated by using statistical standard deviation. If the result shows a heteroscedastic or not constant (time varying), then the standard deviation cannot be calculated by statistical standard deviation. Thus, it must be calculated by using ARCH/GARCH volatility model. The equation used to calculate the volatility using ARCH/GARCH method is Equation (2.7). The result of White Test of data return of the stock is shown in Table 6.

No	Kode	Probability F-Statistic	Condition	Conclution
1	ADRO	0.00000	P Value < 5%	Heterocedastic
2	ANTM	0.00000	P Value < 5%	Heterocedastic
3	APEX	0.00000	P Value < 5%	Heterocedastic
4	ARTI	0.00000	P Value < 5%	Heterocedastic
5	BYAN	0.00000	P Value < 5%	Heterocedastic
6	DEWA	0.00000	P Value < 5%	Heterocedastic
7	DSSA	0.00000	P Value < 5%	Heterocedastic
8	ELSA	0.00000	P Value < 5%	Heterocedastic
9	ESSA	0.00000	P Value < 5%	Heterocedastic
10	HRUM	0.00000	P Value < 5%	Heterocedastic
11	INCO	0.00000	P Value < 5%	Heterocedastic
12	INDY	0.00000	P Value < 5%	Heterocedastic
13	ITMG	0.00000	P Value < 5%	Heterocedastic
14	KKGI	0.00000	P Value < 5%	Heterocedastic
15	MEDC	0.00000	P Value < 5%	Heterocedastic
16	MYOH	0.00000	P Value < 5%	Heterocedastic
17	PTBA	0.00000	P Value < 5%	Heterocedastic
18	PTRO	0.00000	P Value < 5%	Heterocedastic
19	TINS	0.00000	P Value < 5%	Heterocedastic
20	TOBA	0.00000	P Value < 5%	Heterocedastic

Table 6:- The Result of White Testing of Stock Return
Source: finance.yahoo.com, reprocessed by using Eviews application (2019)

In accordance to Table 6, the data return of each mining sector shares is heteroscedastic.

E. The Calculation of VaR by Using ARCH/GARCH Volatility Model

The best way to determine ARCH/GARCH model is conducting an experiment towards mean and variance process by ARCH or GARCH model. This model is obtained by conducting several iterations towards mean and variance. The selection of the best ARCH/GARCH model of stock return uses a significant parameter by comparing the value of Adjusted R-Squared, Akaike Info Criterion (AIC) and Schwarz Criterion (SC). The detail of the best model of stock return is shown in Table 7.

No	Return Saham	ARCH/ GARCH	Model	Probability	Adjusted R Square	AIC	SC	Significant
1	ADRO	ARCH (2,0)	ADRO(-1)	0.9892				
			RESID(-1)^2	0.0003	-0.000807	-4.298616	-4.278079	Significant
			RESID(-2)^2	0.0000				
2	ANTM	ARCH (2,0)	ANTM(-1)	0.5031				
			RESID(-1)^2	0.0015	-0.000469	-4.462729	-4.442192	Significant
			RESID(-2)^2	0.0021				
3	APEX	GARCH (0,2)	APEX(-1)	0.0000				
			GARCH(-1)	0.0000	0.056229	-4.881333	-4.860796	Significant
			GARCH(-2)	0.0000				
4	ARTI	GARCH (0,1)	ARTI(-1)	0.0000	0.015581	-4.405301	-4.388871	Significant
			GARCH(-1)	0.0000				
5	BYAN	GARCH (2,2)	BYAN(-1)	0.0000				
			RESID(-1)^2	0.0000				
			RESID(-2)^2	0.0000	0.024673	-5.318647	-5.289895	Significant
			GARCH(-1)	0.0000				
			GARCH(-2)	0.0000				
6	DEWA	ARCH (2,0)	DEWA(-1)	0.0000				
			RESID(-1)^2	0.0000	0.030891	-5.89936	-5.878824	Significant
			RESID(-2)^2	0.0000				
7	DSSA	GARCH (0,1)	DSSA(-1)	0.0000	0.000854	-4.488656	-4.472227	Significant
			GARCH(-1)	0.0000				
8	ELSA	ARCH (2,0)	ELSA(-1)	0.8887				
			RESID(-1)^2	0.0035	-0.000839	-4.144745	-4.124208	Significant
			RESID(-2)^2	0.0000				

9	ESSA	GARCH (0,2)	ESSA(-1)	0.1620				
			GARCH(-1)	0.0000	0.000029	-3.889189	-3.868653	Significant
			GARCH(-2)	0.0000				
10	HRUM	GARCH (0,2)	HRUM(-1)	0.0002				
			GARCH(-1)	0.0000	0.008266	-4.383607	-4.36307	Significant
			GARCH(-2)	0.0000				
11	INCO	GARCH (0,2)	INCO(-1)	0.0000				
			GARCH(-1)	0.0439	0.012849	-4.173757	-4.15322	Significant
			GARCH(-2)	0.0001				
12	INDY	GARCH (0,2)	INDY(-1)	0.0021				
			GARCH(-1)	0.0000	-0.001519	-3.652189	-3.631652	Significant
			GARCH(-2)	0.0000				
13	ITMG	GARCH (1,1)	ITMG(-1)	0.0055				
			RESID(-1)^2	0.0000	0.006417	-4.390035	-4.369498	Significant
			GARCH(-1)	0.0000				
14	KKGI	GARCH (0,1)	KKGI(-1)	0.9973	-0.000813	-4.125413	-4.108983	Significant
			GARCH(-1)	0.0006				
15	MEDC	GARCH (2,2)	MEDC(-1)	0.0036				
			RESID(-1)^2	0.0000				
			RESID(-2)^2	0.0000	0.010412	-4.073598	-4.044846	Significant
			GARCH(-1)	0.0000				
			GARCH(-2)	0.0092				
16	MYOH	GARCH (0,2)	MYOH(-1)	0.0063				
			GARCH(-1)	0.0000	-0.001176	-4.860866	-4.84033	Significant
			GARCH(-2)	0.0100				
17	PTBA	ARCH (1,0)	PTBA(-1)	0.9600	-0.000807	-4.379835	-4.363405	Significant
			RESID(-1)^2	0.0001				
18	PTRO	GARCH (0,1)	PTRO(-1)	0.0000	0.00905	-4.267229	-4.250799	Significant
			GARCH(-1)	0.0000				
19	TINS	GARCH (0,2)	TINS(-1)	0.0080				
			GARCH(-1)	0.0317	0.003272	-4.525009	-4.504472	Significant
			GARCH(-2)	0.0000				
20	TOBA	GARCH (2,2)	TOBA(-1)	0.0003				
			RESID(-1)^2	0.0000				
			RESID(-2)^2	0.0000	0.008461	-4.743659	-4.714908	Significant
			GARCH(-1)	0.0000				
			GARCH(-2)	0.0002				

Table 7:- The Best ARCH/GARCH Model of Each Stock
Source: finance.yahoo.com, reprocessed by using Excel and Eviews application (2019)

F. The Calculation of Value at Risk

The result of forecast variance and volatility return of each stock is used to conduct VaR calculation of each stock return. The calculation of Value at Risk is conducted with confidence level of 95% and the holding period of 1 day. The ARCH model (2.0) of ADRO stock return shows that the movement of ADRO stock return is affected by residual volatility of the two previous periods and residual variance of the previous period without asymmetric residual volatility of the previous period. The GARCH Model (1.1) of ITMG stock return shows that the movement of stock return is affected by residual volatility of the previous period and asymmetric residual volatility of the previous period. The other volatility models of stock return can be seen in Table 7. The following is the result of daily Value at Risk Calculation by ARCH volatility model (2.0) from December 1, 2018 until December 31, 2018 towards ADRO stock return.

Date	Forecast Variance σ	Position	Cornish Fisher Expansion	Holding Period Day	VaR
03/12/2018	0.00003033	1305	1.664939172	1	11.96629785
04/12/2018	0.00002538	1300	1.664939172	1	10.90388002
05/12/2018	0.00003365	1285	1.664939172	1	12.41086021
06/12/2018	0.00003698	1295	1.664939172	1	13.11200256
07/12/2018	0.00002868	1300	1.664939172	1	11.59108942
10/12/2018	0.00003035	1310	1.664939172	1	12.01597354
11/12/2018	0.00002872	1285	1.664939172	1	11.46497871
12/12/2018	0.00004027	1255	1.664939172	1	13.25970097
13/12/2018	0.00004214	1280	1.664939172	1	13.83395772

14/12/2018	0.00002354	1285	1.664939172	1	10.38087105
17/12/2018	0.00003033	1280	1.664939172	1	11.73705842
18/12/2018	0.00003368	1240	1.664939172	1	11.98080748
19/12/2018	0.00004562	1245	1.664939172	1	14.00115442
20/12/2018	0.00003028	1255	1.664939172	1	11.49760104
21/12/2018	0.00002857	1250	1.664939172	1	11.12458171
24/12/2018	0.00003372	1250	1.664939172	1	12.08460771
25/12/2018	0.00003200	1250	1.664939172	1	11.77372121
26/12/2018	0.00003200	1220	1.664939172	1	11.4911519
27/12/2018	0.00004243	1240	1.664939172	1	13.44724257
28/12/2018	0.00002503	1215	1.664939172	1	10.12039344
31/12/2018	0.00004074	1215	1.664939172	1	12.91199653
Jumlah	**0.00069445**	**26560**	**34.96372261**	**21**	**253.10992847**
Rata-rata	**0.00003307**	**1264.76**	**1.66493917**	**1**	**12.05285374**

Table 8:- Daily VaR Calculation of ADRO Return Stock by ARCH Volatility Model (2.0) within the Period of December 1, 2018 until December 31, 2018
Source: finance.yahoo.com, reprocessed by using Excel and Eviews application (2019)

According to Table 8 with the confidence level of 95%, the maximum of potential loss happened for one day in January 1, 2019. Based on ARCH volatility model (2.0) calculation, the position of the value of ADRO stock of Rp 1,212.00 was Rp 12,912.00. In other words, there was a possibility of 5% that the next loss caused by the position of ADRO stock of Rp 1,215.00 would be greater than the value of VaR of Rp 12,912.00. The information related to the calculation result of VaR with ARCH/GARCH volatility model during 1 month, 3 months, and 6 months periods can be seen in Table 9.

Return	Period	Forecast Variance σ	Position	Cornish Fisher Expansion	Holding Period Day	VaR
Return ADRO						
Total	1 Month	0.0006945	26560	34.963723	21	253.10993
Mean		3.307E-05	1264.7619	1.6649392	1	12.052854
Total	3 Month	0.0022868	98575	109.88599	66	953.51825
Mean		3.465E-05	1493.5606	1.6649392	1	14.447246
Total	6 Month	0.0043277	218275	218.10703	131	2039.9155
Mean		3.304E-05	1666.2214	1.6649392	1	15.571874
Return ANTM						
Total	1 Month	0.0107069	15780	22.824981	21	311.97819
Mean		0.0005099	751.42857	1.0869038	1	14.856104
Total	3 Month	0.0287805	47965	71.735653	66	951.75811
Mean		0.0004361	726.74242	1.0869038	1	14.420577
Total	6 Month	0.0593775	103190	142.3844	131	2133.7262
Mean		0.0004533	787.70992	1.0869038	1	16.287986
Return APEX						
Total	1 Month	0.2223551	31440	25.577912	21	2710.9786
Mean		0.0105883	1497.1429	1.2179958	1	129.09422
Total	3 Month	0.6011529	106755	80.387724	66	8169.4421
Mean		0.0091084	1617.5	1.2179958	1	123.77943
Total	6 Month	0.6286925	222455	159.55745	131	11070.131
Mean		0.0047992	1698.1298	1.2179958	1	84.504814
Return ARTI						
Total	1 Month	0.0164449	1050	31.457517	21	44.015033
Mean		0.0007831	50	1.497977	1	2.095954
Total	3 Month	0.0516841	3300	98.866483	66	138.33296
Mean		0.0007831	50	1.497977	1	2.095954
Total	6 Month	0.1025851	6550	196.23499	131	274.56997
Mean		0.0007831	50	1.497977	1	2.095954
Return BYAN						
Total	1 Month	0.0250368	408350	33.612934	21	16880.982
Mean		0.0011922	19445.238	1.6006159	1	803.85627
Total	3 Month	0.0809059	1292825	105.64065	66	55992.695
Mean		0.0012258	19588.258	1.6006159	1	848.37416
Total	6 Month	0.2505586	2515825	209.68068	131	129936.83
Mean		0.0019127	19204.771	1.6006159	1	991.88423
Return DEWA						
Total	1 Month	0.0119644	1050	17.930738	21	21.399494
Mean		0.0005697	50	0.8538447	1	1.0190235
Total	3 Month	0.0376023	3300	56.353748	66	67.255552
Mean		0.0005697	50	0.8538447	1	1.0190235
Total	6 Month	0.0746349	6550	111.85365	131	133.49208
Mean		0.0005697	50	0.8538447	1	1.0190235

Return DSSA						
Total	1 Month	0.0069435	293300	37.232718	21	2949.4492
Mean		0.0003306	13966.667	1.7729866	1	140.44996
Total	3 Month	0.0191101	922550	117.01711	66	11820.215
Mean		0.0002895	13978.03	1.7729866	1	179.09417
Total	6 Month	0.1200091	2116750	232.26124	131	69112.972
Mean		0.0009161	16158.397	1.7729866	1	527.57994
Return ELSA						
Total	1 Month	0.0033283	7080	28.772732	21	115.84566
Mean		0.0001585	337.14286	1.3701301	1	5.5164601
Total	3 Month	0.0121273	23062	90.428586	66	407.7293
Mean		0.0001837	349.42424	1.3701301	1	6.1777166
Total	6 Month	0.0240461	45938	179.48704	131	809.27455
Mean		0.0001836	350.67176	1.3701301	1	6.1776683
Return ESSA						
Total	1 Month	0.0254892	6364	29.331142 21		283.89958
Mean		0.0012138	303.04762	1.396721	1	13.519028
Total	3 Month	0.0710269	19716	92.183588	66	823.87502
Mean		0.0010762	298.72727	1.396721	1	12.482955
Total	6 Month	0.1418573	35768	182.97046	131	1505.1338
Mean		0.0010829	273.03817	1.396721	1	11.489571
Return HRUM						
Total	1 Month	0.0344883	30695	28.119582	21	1538.449
Mean		0.0016423	1461.6667	1.3390277	1	73.259475
Total	3 Month	0.1364897	118950	88.37583	66	6624.7144
Mean		0.002068	1802.2727	1.3390277	1	100.37446
Total	6 Month	0.2527619	284560	175.41263	131	15072.266
Mean		0.0019295	2172.2137	1.3390277	1	115.05547
Return INCO						
Total	1 Month	0.0478215	66090	32.499445	21	4264.1405
Mean		0.0022772	3147.1429	1.5475926	1	203.05431
Total	3 Month	0.1737708	208510	102.14111	66	14944.783
Mean		0.0026329	3159.2424	1.5475926	1	226.4361
Total	6 Month	0.3555858	465080	202.73463	131	33534.523
Mean		0.0027144	3550.229	1.5475926	1	255.98872
Return INDY						
Total	1 Month	0.0187111	37870	24.965169	21	1260.5859
Mean		0.000891	1803.3333	1.1888176	1	60.027902
Total	3 Month	0.0735361	147040	78.461961	66	5350.6959
Mean		0.0011142	2227.8788	1.1888176	1	81.07115
Total	6 Month	0.1365028	352450	155.7351	131	12313.403
Mean		0.001042	2690.458	1.1888176	1	93.995441
Return ITMG						
Total	1 Month	0.026808	427400	33.162677	21	21595.546
Mean		0.0012766	20352.381	1.5791751	1	1028.3594
Total	3 Month	0.1128191	1507225	104.22556	66	90048.211
Mean		0.0017094	22836.742	1.5791751	1	1364.3668
Total	6 Month	0.2493524	3212800	206.87194	131	204629.41
Mean		0.0019035	24525.191	1.5791751	1	1562.0565
Return KKGI						
Total	1 Month	0.0011986	7264	27.874146	21	72.840282
Mean		5.708E-05	345.90476	1.3273403	1	3.4685849
Total	3 Month	0.0037709	23566	87.604459	66	236.42494
Mean		5.713E-05	357.06061	1.3273403	1	3.5821961
Total	6 Month	0.0074898	46372	173.88158	131	465.42798
Mean		5.717E-05	353.98473	1.3273403	1	3.5528854
Return MEDC						
Total	1 Month	0.0666085	14965	28.761492	21	986.84653
Mean		0.0031718	712.61905	1.3695948	1	46.992692
Total	3 Month	0.1791421	52150	90.393259	66	3329.9683
Mean		0.0027143	790.15152	1.3695948	1	50.454064
Total	6 Month	0.3414843	110935	179.41692	131	6856.9348
Mean		0.0026068	846.83206	1.3695948	1	52.343014
Return MYOH						
Total	1 Month	0.0082224	21500	25.083727	21	475.86244
Mean		0.0003915	1023.8095	1.1944632	1	22.660116
Total	3 Month	0.0359437	62780	78.83457	66	1603.5749
Mean		0.0005446	951.21212	1.1944632	1	24.29659
Total	6 Month	0.0682946	117255	156.47468	131	2961.2552
Mean		0.0005213	895.07634	1.1944632	1	22.605001
Return PTBA						
Total	1 Month	0.0129336	88530	35.200784	21	3682.489
Mean		0.0006159	4215.7143	1.6762278	1	175.35662

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Total	3 Month	0.040507	287630	110.63103	66	11941.824
Mean		0.0006137	4358.0303	1.6762278	1	180.93673
Total	6 Month	0.0804783	560390	219.58584	131	23276.482
Mean		0.0006143	4277.7863	1.6762278	1	177.68307
Return PTRO						
Total	1 Month	0.025408	37325	27.782349	21	1516.8841
Mean		0.0012099	1777.381	1.322969	1	72.232576
Total	3 Month	0.1216356	123060	87.315955	66	6220.9375
Mean		0.001843	1864.5455	1.322969	1	94.256629
Total	6 Month	0.3119325	237430	173.30894	131	13367.116
Mean		0.0023812	1812.4427	1.322969	1	102.03905
Return TINS						
Total	1 Month	0.0196484	15495	30.057171	21	617.02674
Mean		0.0009356	737.85714	1.4312939	1	29.382226
Total	3 Month	0.0584123	45795	94.465395	66	1799.808
Mean		0.000885	693.86364	1.4312939	1	27.269818
Total	6 Month	0.116885	97335	187.4995	131	3803.7147
Mean		0.0008923	743.01527	1.4312939	1	29.03599
Return TOBA						
Total	1 Month	0.0605521	8660	32.737462	21	661.20686
Mean		0.0028834	412.38095	1.5589267	1	31.486041
Total	3 Month	0.1883734	27968.75	102.88917	66	2156.2286
Mean		0.0028541	423.76894	1.5589267	1	32.670131
Total	6 Month	0.3168256	58538.75	204.2194	131	4110.0132
Mean		0.0024185	446.86069	1.5589267	1	31.374147

Table 9:- The Calculation Result of VaR with ARCH/GARCH Volatility Model During 1 Month, 3 Months, and 6 Months Periods

Source: finance.yahoo.com, reprocessed by using Excel Eviews application (2019)

According to Table 4.8 with the confidence level of 95%, the maximum of potential loss happened for one day in January 1, 2019. Based on ARCH volatility model (2.0) calculation, the position of the value of ADRO stock of Rp 1,212.00 was Rp 12,912.00. In other words, there was a possibility of 5% that the next loss caused by the position of ADRO stock of Rp 1,215.00 would be greater than the value of VaR of Rp 12,912.00. The information related to the calculation result of VaR with ARCH/GARCH volatility model during 1 month, 3 months, and 6 months periods can be seen in Table 4.9.

V. CONCLUSION

Based on the result and the discussion about VaR with ARCH/GARCH volatility model of the mining sector shares, it can be drawn the following conclusions.

1. In accordance to the test of data return of stocks, it is acknowledged that the data return of the stocks of ADRO, ANTM, APEX, ARTI, BYAN, DEWA, DSSA, ELSA, ESSA, HRUM, INCO, INDY, ITMG, KKGI, MEDC, MYOH, PTBA, PTRO, TINS, and TOBA is stationary and not normally distributed.
2. The data return of the stocks of ADRO, ANTM, APEX, ARTI, BYAN, DEWA, DSSA, ELSA, ESSA, HRUM, INCO, INDY, ITMG, KKGI, MEDC, MYOH, PTBA, PTRO, TINS, and TOBA has a heteroscedastic volatility, so the VaR was calculated by using ARCH/GARCH volatility model.
3. The calculation result of VaR by ARCH/GARCH model with confidence level of 95% and the holding period of 1 day provides information that the potential of maximum loss would occur in January 1, 2018, that the VaR of ITMG stock return is greater than the VaR of ADRO, ANTM, APEX, ARTI, BYAN, DEWA, DSSA, ELSA, ESSA, HRUM, INCO, INDY, ITMG, KKGI, MEDC, MYOH, PTBA, PTRO, TINS, and TOBA.
4. VaR is the maximum loss (biggest loss) along the target horizon, so there is a small possibility that the actual loss is bigger and the longer the holding period makes the higher the level of loss to be received.

Then the suggestions of the study are given as follows.

1. For the Investors

a. Conduct the VaR calculation of the stocks by using the best volatility calculation model so that the value at risk of the stocks can be predicted more accurately.

b. The calculation of VaR is affected by the holding period that is used, so the holding period needs to get attention in estimating the risk of stock return by using VaR.

2. For the Researchers

Develop the calculation of VaR by developing the other GARCH models.

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