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THE IMPACT OF INFLATION RATES AND US DOLLAR EXCHANGE RATES ON INDONESIAN STOCK MARKET INDEX RETURN VOLATILITY

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Abstract

This paper studied the impact of inflation rates and US Dollar exchange rates in Indonesian stock market return volatility in the period of 2002-2012. Daily data of stock market return, inflation rates and US Dollar exchange rates were used to estimate the daily volatility of the stock return. The data of stock market price, inflation rates and US Dollar exchange rates were taken from Yahoo Finance, Indonesia statistics bureau and central bank of Indonesia, respectively. The result showed that both inflation rates and US Dollar exchange rates did not have a significant impact on the Indonesian stock market return volatility. Inflation rates contributed 0.03% change in daily stock market return volatility whereas a 1% appreciation of Rupiah contributed to a 0.0000001% change in daily stock market return volatility. This research finding was different from the result in Nigeria where Yaya's & Shittu's (2010) research had the same variables. Inflation rates and US Dollar exchange rates were to examine the impact on Nigeria stock market index return volatility.

Key words*: GARCH, inflation rates, investment, stock market return, US Dollar exchange rates*

As one of the emerging markets and also the biggest economy in the Southeast Asia, Indonesia experienced the tremendous development in their economy, despite the 2008 global financial crisis. Rahadiana & Chatterjee (2013) wrote its economic growth on 2012 was at the level of 6,2 percent when the rest of the world was at the level of 2,2 percent (World Bank, 2013). So it is considerably good performance. Indonesia is attractive for the investment because its abundant natural resources and the rising of the middle class consumers (BBC News, 2013).

As the explanation of economic indicators in the previous paragraph explained, there is also a steady increase in the number of stocks traded in the Jakarta Stock Exchange (JKSE). The number of stock traded in 2006 was 924.488.804.314 (Bapepam LK, 2012) and per December 14th 2012, the number reached 2.420.880.791.060. The details is shown on the Table 1.

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Table 1. IDX Number of Stocks Traded Period 2006-2012

Period	Number of Stocks
2006	924.488.804.314
2007	1.128.173.554.108
2008	1.374.411.626.346
2009	1.465.654.987.417
2010	1.894.828.442.341
2011	2.198.133.269.765
2012*	2.420.880.791.060

Source: BAPEPAM LK (2012)

Inflation and US Dollar Exchange Rates in Indonesia

Inflation is defined as the rise of price in a general level (Bodie *et al*., 2013). It is where the demand for product and services are exceeding the productive capacity. Inflation is an important factor to determine the stock price volatility, as it is the part of the calculation of real interest rates. Real interest rate is the adjusted inflation nominal interest rate. The higher the real interest rates; reducing the present value of future cash flow, thereby is not attractive for the investment.

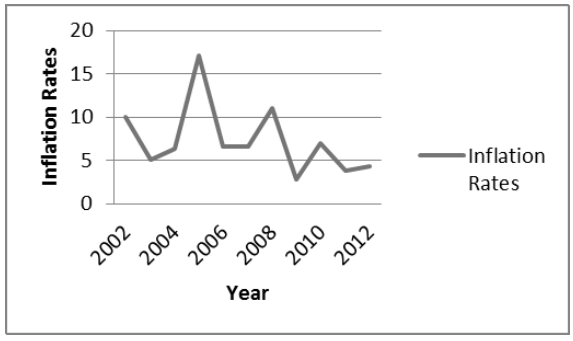

Figure 1. The Inflation Rates of Indonesia 2002-2012
Source: Badan Pusat Statistik

The graph in Figure 1 illustrates the inflation rate in the period of 2002-2012. The inflation rates reached its peak on November 2005 with the number of 17,11 percent. The soaring inflation rate was caused by the rising oil prices (BBC News, 2005). It then declined for the next 3 years until the global financial crisis hit the world economy, making the inflation rates rose again to the number of 11,06 percent in November 2008. After the global financial crisis, the inflation rates tend to decrease within 3 years, given the inflation rates on December 2012 on the number of 4,30 percent.

Exchange rate is also an important determinant of the stock market price volatility. Consider the investment also come from outside the country, exchange rate is critical to the attractiveness of the investment.

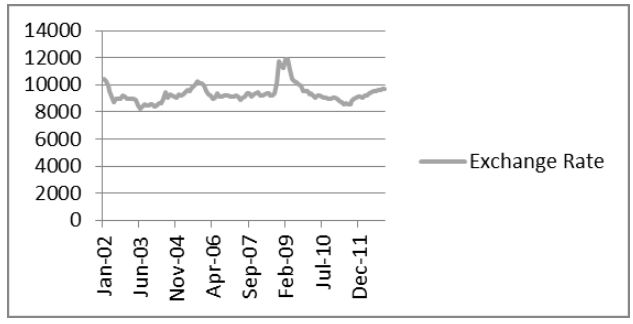

Figure 2. Exchange Rate
of Rupiah per US Dollar Period 2002-2012
Source: Central Bank of Indonesia

The exchange rate of Rupiah towards US Dollar on average is on the value of Rp 9.336 per US Dollar on the time span of 2002-2012. However, it experienced it highest peak during the 2008 global financial crisis. The highest exchange rate value of Rupiah per US Dollar was Rp 11.912 on February 2009, that could be said, was still affected by the global crisis. In the following years after its highest peak, Rupiah started to appreciate to the value of Rp 8.599 per US Dollar and fluctuate in the value around Rp 9.000-10.000 in the following years until December 2012.

Saryal (2007) initially researched the impact of inflation rates on the stock market return volatility. Yaya & Shittu (2010) also researched the impact of inflation rates in Nigeria and the US Dollar exchange rates against Nigerian Naira.

From the background above, the authors are interested to conduct similar research in Indonesia. The authors would like to research the impact on inflation rates and US Dollar exchange rates on the Indonesian stock market return index volatility. As a developing country which is generally high inflated and rely heavily on the foreign exchange market, the findings of the research might be beneficial to explain the volatility of Indonesian stock market.

ARCH Model

Autoregressive conditional heteroscedasticity or in short ARCH first proposed by Engle (1982). The model intends to model volatility clustering in financial time series, in which it exhibits periods of swings followed by periods of relative calm (Gujarati & Porter, 2009). In ARCH model, the error variance (σ_n^2) is influence by the error in the previous period (u_{n-1}^2). In short, the ARCH model is as follow:

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 \quad \text{.....(1)}$$

Where γ is the weight that is assigned to V_L or the long run variance and α is the weight that is assigned to u_{n-1}^2.

GARCH Model

GARCH (1,1) model first proposed by Bollerslev (1986). This model, which stands for Generalized Auto Regressive Conditional Heteroskedasticity, is the extension of the previous model, the ARCH model proposed by Engle. To ensure positive variance, Bollerslev add the variance error in the past $\boldsymbol{\sigma_{n-1}^2}$. In short, according to Hull (2009), the GARCH model is described as the model below:

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta\sigma_{n-1}^2 \text{.....(2)}$$

Previous Research

Saryal (2007) researched the impact of inflation in both developing and developed country. She used Turkey as the sample of the developing country and Canada as the sample of developed country. The finding from the research showed that inflation rates have stronger impact in Turkey rather than in Canada to predict the stock market volatility. She argued that the inflation rates posed as an important factor of the stock market volatility in the highly inflated country as it is the characteristics of a developing country.

Yaya & Shittu (2010) used QGARCH to research the impact of inflation rates and US Dollar exchange rates against Nigerian Naira. From the research, it could be seen that both inflation rates and US Dollar exchange rates pose a significant impact on the stock market volatility in Nigeria.

METHODOLOGY

This research studies the relationship between stock return, inflation, US Dollar exchange rates, and the stock market during 2002-2012. The data of exchange rate was obtained from the Central Bank of Indonesia (Bank Indonesia), data of inflation rates was obtained from Indonesia Bureau of Statistics and the data of stock return was obtained from the data processed by author after obtained the closing price from Yahoo Finance.

To conduct the analysis of the volatility and the correlation, there are 6 steps. First, collect the data that are going to be used. In this analysis, the data that are going to be used are Indonesian stock market return, inflation rates and exchange rate of US Dollar against Rupiah. The data are sorted in the daily order. Second, computed the nominal stock return by using the formula:

$$R_i = \ln \frac{P_i}{P_{i-1}}$$

Third, conduct the preliminary analyses which are unit root test and white test. Unit root test analyzes whether or not the variable is stationary. In unit root test, the hypothesis for H_0 is there is not unit root exists in the variable (meaning that the data is stationary) and H_1 is there is unit root exists in the variable (the data is not stationary). White test analyzes whether or not the variable is heteroskedastic kind of data. In white test, the hypothesis for H_0 is the data is not heteroskedastic. While the alternate hypothesis, H_1, is there is heteroskedasticity in the data. Fourth, determine the appropriate model for the stock volatility calculation. In this research, assuming linearity, the model GARCH (1,1) is going to be used, that is:

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$

Fifth, once the constant for each coefficient (γ, α, dan β) is determined already using maximum likelihood method, the daily volatility could be then computed by substituting the value of the constant into the GARCH formula:)

$$(\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2)$$

Last, to check the validity of the analysis, post diagnostic analysis is conducted. In this research, the author uses normality test and ARCH-LM test. Normality test intends to analyze whether or not the data is normally distributed. For the normality test, the H_0 hypothesis is the data is not normally distributed. While the alternate hypothesis, H_1, is the data is normally distributed. If the *p* value smaller than á, it shall reject the null hypothesis. ARCH-LM test intend to detect whether ARCH effect is exists. The H_0 hypothesis is there is no ARCH effect exists while the alternate hypothesis would show that there is ARCH effect.

RESULT

Table 2 shows the descriptive statistics for all of the variables that is researched. The result from the indices indicates that average daily return of Jakarta Stock Exchange is 0,09% while the average daily inflation rates in Indonesia is 0,02 %. The maximum number of stock return and inflation rates are 0,07% and 0,29% respectively. This is the proof of fisher effect, where the higher of the inflation rates, the higher the nominal stock return (Mankiw, 2013).

Table 2. Descriptive Statistics of the Stock Return, Inflation, and Exchange Rate

	Return	Inflation	Exchange Rate
Mean	0.0009	0.000199	9236
Median	0.001386	0.0002	9114
Maximum	0.076234	0.0029	12338
Minimum	-0.109539	-0.0001	8124
ST.Dev	0.014801	0.000296	655.1515
Skewness	-0.740494	6.048613	1.866826
Kurtosis	9.924921	54.8233	7.973698
JarqueBera	5620.739	317537.7	4336.751
Probability	0	0	0
Sum	2.421009	0.53542	24856560
Sum Sq. Dev	0.589056	0.000235	1150000000
Obeservations	2691	2691	2691

Unit Root Test

Table 3. Unit Root Test Result for the Variables

Variable	Unit Root Test on	ADF	t-Statistic			Probability
			1% Level	5% Level	10% Level	
Return	Level	-46.2666	-3.43259	-2.86242	-2.56728	0.0001
Inflation	Level	-6.47357	-3.43261	-2.86242	-2.56729	0
Exchange	Level	-2.6145	-3.43259	-2.86242	-2.56728	0.0901
Exchange	1st Difference	-56.1573	-3.43259	-2.86242	-2.56728	0.0001

From Table 3, it could be seen that the variable return and inflation is stationary on its level. However, the variable exchange rate is not stationary on its level since the ADF value is higher than its value on t-Statistic. The variable exchange rate is stationary on its first difference level.

White Test

Table 4. White Test Result on the Variable Return

F-statistic	6.664357	Prob. F(5,2685)	0
Obs*R-squared	32.98687	Prob. Chi-Square(5)	0
Scaled explained SS	146.4552	Prob. Chi-Square(5)	0

It could be seen from the result that the value of observation times R squared is exceeding the value of Chi-Square, so the null hypothesis is rejected. That is, the heteroskedasticity exists in the time series.

ARCH-LM Test

Table 5. ARCH-LM Result on the residuals

F-statistic	0.664754	Prob. F(10,2670)	0.7581
Obs* R-squared	6.65835	Prob. Chi-Square(10)	0.7573

It could be seen from the result that the value of observation times R-squared is exceeding the Chi-Square value. So it shall reject the null hypothesis, and agreed that there is ARCH effect on the model.

Normality Test

Normality test is conducted to determine whether the data is well modeled by a normal distribution and also whether the underlying data set to be normally distributed. One method to confirm the normality of the data is the graphical method. That is to be said that the histogram of the residuals should follow the bell-shaped.

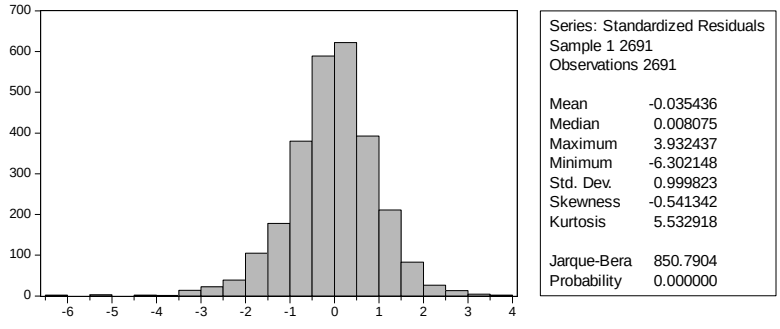

Figure 3. Histogram of the Residuals

Coefficient Estimation

Table 6. Coefficient Estimation for the Variables

Parameters	c	ω	α (ARCH)	β_0 (GARCH)	β_1 (Inflation)	β_2 (Exchange Rates)
Estimated Coefficient	0,000796000	0,000014600	0,133889000	0,838284000	0,000356000	-0,000000001
	(0,8345)	(0,0475)	(0,0000)	(0,0000)	(0,8608)	(0,3192)
Standard Errors	0,003810000	0,000007350	0,009171000	0,010142000	0,002030000	0,000000001
Estimated Sample Variance (Long Run Variance)				$\frac{\omega}{1-\alpha-\beta} = 0.00052467$		

Figure 3 shows that the residuals of the data are normally distributed since the probability is below the 5%.

DISCUSSION

Table 6 shows the coefficient for inflation and exchange rates are 0,000356000 and -0,000000001 respectively. It is indicating that every 1% increase on daily inflation rates, it actually contributes to 0,03% increase on the daily stock market return volatility. While Rupiah exchange rates against US Dollar turns out behave differently. The appreciation of Rupiah would actually causes to 0,0000001% increase on the daily stock market return volatility.

The coefficient for α; ARCH part of the equation is 0,13 and for α_0 or the GARCH part is 0,83. The result shows that the causes of the stock market return volatility is within family or influenced by the previous return and volatility itself. The previous return contributes 13% increase on the volatility while every increment on the previous volatility causes 83% increase on the stock market return volatility.

From the coefficient estimation, it could be seen that the independent variables that are used in this research do not have significant impact on the stock market volatility. Instead, what influenced the most are the previous return and the previous volatility itself. The finding in this research is different from Saryal (2007) since the inflation rates in Indonesia do not pose a significant impact on the stock market volatility. Result from this research is also different from Yaya & Shittu (2010).

CONCLUSION AND SUGGESTION

Conclusion

After the research has completed, there are several points of conclusions that could be drew from this research. The conclusions are, based on the research conducted, the findings showed that the significant causes of the stock market return volatility is within family causes or in other word it is caused by its own previous return and previous volatility. Whereas the dependent variables used in this research; the inflation rates and the exchange rate, does not exhibit a significant impact on the stock return volatility. The impact of the previous return and previous volatility is 13% and 83% respectively. While the independent variables (inflation rates and exchange rates) contributes to 0,03% and -0,0000001% impact on the stock market return respectively. The result shows that, a 1% increase on the daily inflation rates would cause the stock market return volatility rises by 0,03%. While the exchange rate exhibits a negative number, it means every 1% appreciation of Rupiah against US Dollar would cause the stock market return more volatile by the percentage of 0,0000001.

Suggestion

For further research, to capture the asymmetry, it is better for to use another model in the GARCH family model. Several notable models that are quite often to be used are QGARCH, EGARCH, GARCH-M (GARCH in Mean), and TGARCH. Asymmetrical is important to be captured since positive and negative have different impact on the conditional volatility.

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