VOLATILITY SPILLOVER BETWEEN USD-IDR EXCHANGE RATE CHANGES AND INDONESIA STOCK INDEX

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Abstract

Volatility spillover tells about the extent of the integration between different markets. This paper examines the existence of volatility spillover between the foreign exchange market and capital market which each market is represented byUSD-IDR exchange rate and Indonesia Stock Index or known as Jakarta Compsite Index (JCI). USD-IDR exchange rate and JCI continued to fluctuate and tend to weaken in May 20, 2013 to November 20, 2015. The fall of exchange rate and JCI are influenced by several factors such as, the imbalances from trade balance, the strengthening of the currency in the developed countries, and many foreign investors withdraw its shares from Indonesia stock market. This research used time series dataand will be analyzedbyEGARCH and Granger causality test to examine the volatility spillover between the foreign exchange market and capital market. The result showed thatthe time series data shows a heterocedasticityso we can continue the test with EGARCH. EGARCH shows there is volatility spillover from capital market to foreign exchange market, but not vice versa. So, only volatile on the capital markets led to volatile in the foreign exchange market. This research can be a source of information to investors that JCI could be used to predict the movement of the exchange rate at the foreign exchange market.

Keywords: capital market, EGARCH, foreign exchange market, volatility spillover

1. Introduction

Foreign exchange rates, also known as the exchange rate are a value that indicates the price of the currency when exchanged with another country's currency. Indonesia exchange rate always fluctuate to foreign currencies. This exchange rate changes happens every day in the foreign exchange market.

The capital market is one of the forms of financial markets to invest funds in the long term. Capital market is one way for companies to raise funds by selling ownership rights to public company in shares form. Shares owned by any company listed on the Stock Exchange continued to experience volatility of price changes. Indonesian capital market conditions in general can be seen from the value of JCI which was published in every trading day.

In 2013 to 2015, the exchange rate has experienced a lot of turbulence which tends to weaken. The weakening of the exchange rate is influenced by several factors, such as, the imbalances from trade balance, the strengthening of the currency in developed countries, and many foreign investors withdraw its shares from Indonesia stock market.

The volatility of the rupiah against the US dollar continues to happen in every trading day. Rupiah on May 20, 2013 is IDR9760.00/1 USD and continue to weaken until it was noted that on 20 November 2015 the exchange rate reached IDR 13739.00/1 USD.
The exchange rates are usually used as an indicator to see the stability of the country's economic conditions. If the country's exchange rates are not stable, it shows that economies of the country is not good or maybe fall on economic crisis.

The movement of the stock market will reflect a country's economy. While the country's economy is growing well, then the stock market will also increase Indonesia stock market in the past few months did not escape the influence of the global economy as the US economic recovery trend. Volatility in global economic conditions will have an impact on Indonesia's financial markets. Rupiah exchange rate against major currencies in the world fell, as well as JCI . JCI value on May 20, 2013 is IDR 5214.98 and continues to fluctuate to IDR 4561.33 on 20 November 2015.

Changes in one market will affect movements in other markets. If there is a change in the foreign exchange market, it can cause an impact on other markets. Changes that happen between the markets will not move away from each other.

2. Research Problem

There exists volatility in foreign exchange markets and capital markets, and there is a contagion effect (spillover) among changes in one market to other markets (foreign exchange market and capital market). In this study, the authors wanted to know the movement direction of the volatility spillover between the foreign exchange market with the capital market, where each market is represented by the change in USD-IDR exchange rate and Jakarta Composite Index (JCI) in May 20 2013–20 November 2015.

3. Literature Review

Volatility spillover is a condition where volatility in one market gives effect to volatility in other market. The term volatility spillover is used to express a condition where there is instability (shock) that is transmitted from one market to another. Volatility spillover stated that there is connectivity between different markets.

Stock prices affect the exchange rate in the form of a negative correlation. If there is an increase in stock prices, it will encourage the appreciation of IDR because many investors make transactions in the foreign exchange market in order to invest in capital markets. In simple terms, it is understood that there is a relationship between the exchange rate and stock prices .

Ibrahim (2000) coducted a study using Granger Causality which concluded that there is one way volatility spillover from capital market to foreign exchange market in Indonesia. It happens because the changes in stock price can affect the capital outflow and capital inflow in a country so it would affect the volatility of exchange rate.

Wiryono and Widjanarko (2009) conducted a study on volatility spillover between the capital market and foreign exchange market in Indonesia. EGARCH method used to determine the volatility spillover between the capital market and foreign exchange market in Indonesia. It is known that there is significant volatility spillover between the foreign exchange market to capital markets and vice versa in Indonesia.

Choi (2009) conducted a study on volatility spillover between New Zealand capital market returns and exchange rate changes before and after the Asian financial crisis in 1997. This study used the EGARCH method. The results showed that there was a spillover in both directions between the volatility of capital markets and volatility return NZD-USD exchange rate in the period before the Asian financial crisis and spillover occurs only between NZD-USD volatility with a return of capital markets in the period after the Asian financial crisis.

Palakkod (2012) conducted a study on volatility spillover between capital markets, commodity markets, and money markets by using AR-GARCH approach. Research findings show that there

is volatility spillover between the money market and commodity markets with capital markets. Volatility spillovers also occur from the capital market to the money market and there is no spillover from commodity markets to money markets.

The result of the volatility spillover between the markets does not provide a consistent conclusion. The study results depend on the choice of countries, the sample period, the frequency of the data, and methodology.

4. Methodology

Time series data generally has a autocorrelation problem, the data are not stationary, and heteroskedasticity. Several methods are used to analyze the data in this study with statistical software Eviews 8.

Augmented Dickey-Fuller Test (ADF Test)

The unit root test (unit root test) assumes that the data are not correlated. While time series data, tend to have an autocorrelation problem. If the data has autocorrelation problems, then the data will be not stationer. To test the stationary of the data, Dickey-Fuller unit root test develop into Augmented Dickey-Fuller (ADF) test. With the following formula:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \cdots + \alpha_m m + \epsilon_t \quad (1)$$

Where m is the length of lag used, y is the observed variable, and t is time trend.

EGARCH (Exponential Generalized Autoregressive Conditional Heterocedasticity)

ARCH models developed by Robert Engle and modified by Mills. GARCH is intended to improve the ARCH and developed by Tim Bollerslev.And then, EGARCH is another varian of GARCH which is developed by Nelson.

GARCH models assume that the variant is not constant (heteroskedasticity) is not a problem, but can be utilized for forecasting. GARCH is a data analysis technique that limits the period of past events that influence contemporary events and has become a common model that is often used in financial research to study the volatility. EGARCH model is one of GARCH varian and this model can effectively capture the asymmetic effect on volatility in stock market and foreign exchange market in the same time.

GARCH model can be described in the following models:

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

Where$\alpha_0$is constant, e_{t-1}^2 explainthe p-number of previous volatility, and σ_{t-1}^2 explain the p-number of previous varian volatility.

Granger Causality Test

A causal relationship can be one-way or two-way. If the two-way causal relationship, then a variable can affect and be affected. That kind of relationship is called a simultaneous relationships.

Basically, Granger causality test is a test to determine whether sutau variable has a two-way connection or only in one direction only. Granger test the influence of the past on current conditions, so that the data used is the form of time series.

$$X_t = \Sigma a_j X_{t-i} + \Sigma b_j Y_{t-i} + \varepsilon_t \quad (3)$$

$$Y_t = \Sigma c_j X_{t-i} + \Sigma d_j Y_{t-i} + \varepsilon_t \quad (4)$$

Where X and Y is the variables were observed, Xt-1 and Yt-1 explain the variable observed at t-1 (previous period), and Ɛt is the error terms.

After Granger causality test using Eviews is done, note the probability value. If the probability ≤ 0.05, the Null Hypothesis is rejected and there is a causal relationship between the exchange rate and stock index.

5. Data Analysis

This study used time series data in May 20 2013–20 November 2015., which is time series data generally have autocorrelation problem, not stationary, and it has heteroskedasticity. To analyze the volatility spillover, the entire time series data of exchange rates and JCI were converted into a return data. Table 1 describes the descriptive statistic to get a quick overview about the data used in this study.

Table 1: Descriptive Statistic

	Exchange Rate Return	JCI Return
Mean	0.000535	-0.000141
Median	0.000450	7.30E-05
Maximum	0.023891	0.046486
Minimum	-0.022041	-0.055844
Std. Dev	0.005120	0.011260
Skewness	-0.369175	-0.286695
Kurtosis	6.719062	6.067201
Observations	655	655

Source : Data processed by author

In a 655 days observation, all of the time series data return showed a tendency of non normality data, because it shows a high kurtosis and the skewness level are below normal distribution.

The unit root test with Augmented Dickey Fuller (ADF) is used to test the stationary of time series data. Table2 is a result of the stationary test with Augmented Dickey Fuller (ADF) conducted at the level and first difference.

Table 2:Result of Unit Root test with Augmented Dickey-Fuller

	Level		First Difference	
	USD-IDR Exchange Rate	JCI	USD-IDR Exchange Rate	JCI
Augmented Dickey-Fuller test statitic p-value	0.4631	0.2666	0.0000	0.0000

Source: Data processed by author

With a significance level (α) of 5%, USD-IDR exchange rate data and JCI data are not stationary at level because the t-statistic value> α. Data that is not stationary and need to be stationary in advance by using the first-level differentiation (first difference). In the first difference, USD-IDR exchange rate data and JCI data are stationery by changing the daily data into return data. Results of the first difference are that the data has been stationary. T-statistic values <α, which means the USD-IDR exchange rate data and JCIdata already stationary in the first difference.

After the USD-IDR exchange rate data and JCI data are stationary, we continue to test the heteroskedasticity with ARCH. Table3 is the result of heteroskedasticity test with ARCH.

Table3 Result of Heteroskedasticity Test with ARCH

Heteroskedasticity Test : ARCH			
F-statistic	17.03993	Prob. F (1,652)	0.0000
Obs* R-squared	16.65688	Prob. Chi-Square (1)	0.0000

Source: Data processed by author

Results of the Heteroskedasticity Test with ARCHis that the value of the p-value Obs * R-squared = 0.0000 <α, so that there is heteroskedasticityexistence and we can proceed with EGARCH modeling because EGARCH model does not assume heteroskedasticity as a problem, but it can be used to create forecasting models. Table 4 shows model of EGARCH.

Table4 EGARCH Model

Dependent Variable: RIHSG
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 11/28/15 Time: 18:54
Sample: 5/20/2013 11/20/2015
Included observations: 655
Convergence achieved after 17 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000132	0.000356	0.371836	0.7100
RKURS	-0.459902	0.058564	-7.852979	0.0000
Variance Equation				
C(3)	-0.268330	0.064032	-4.190529	0.0000
C(4)	0.103511	0.026167	3.955846	0.0001
C(5)	-0.096757	0.019849	-4.874675	0.0000
C(6)	0.979369	0.005611	174.5520	0.0000

R-squared	0.055732	Mean dependent var	-0.000141
Adjusted R-squared	0.054286	S.D. dependent var	0.011260
S.E. of regression	0.010950	Akaike info criterion	-6.403355
Sum squared resid	0.078294	Schwarz criterion	-6.362274
Log likelihood	2103.099	Hannan-Quinn criter.	-6.387426
Durbin-Watson stat	1.860614		

Source: Data processed by author

EGARCH models indicate that the probability of RKURS = 0.000000 <α, so it shows that there is volatility spillover between the foreign exchange market and capital markets (USD-IDR exchange rate and JCI).

EGARCH analysis results still need to be evaluated by performing several tests that serial correlation test, ARCH-LM test, and test for normality. After the test, be concluded that there is no autocorrelation EGARCH models, there are no ARCH effects, but the data is not normally distributed.

Then, the Granger casualty test is performed to determine the movement direction of the volatility spillover. In this study, Granger causality test is performed to determine whether the variable rate USD-IDR and variable JCI has unidirectional causality, bidirectional causality, or do not cause each other using 655 days observation data. Table5 shows the results of Granger causality test of the exchange rate and JCI.

Table5 Result of Granger Causality Test

Null Hypothesis	Observations	Probability
ExchangeRate does not Granger Cause JCI	653	0.7640
JCI does not Granger Cause ExchangeRate		0.0023

Source: Data processed by author

Based on the results of the Granger causality test, we can see the probability of excahnge rate to JCI = 0.7640> 0.05, so the exchange rate does not affect (not cause) JCI. The probability value of JCI to excahnge rate = 0.0023 <0.05, so JCI affect (cause) excahnge rate.

It can be concluded that there is a one-way relationship fromJCIto exchange rate. In this case, only volatileonJCI will affect the exchange rate, but volatile on the USD-IDR exchange rate will not affect JCI.

Conclusions

From this research, it's concluded that the time series data shows a heterocedasticity. The EGARCH model shows there is a volatility spillover between foreign exchange market and capital market. Granger causality test shows that the volatility spillover happens in unidirectional from capital market to the foreign exchange market. Thus, the only volatile on the capital markets led to volatile in the foreign exchange market. However, volatile in the foreign exchange market does not cause volatile in the capital markets.

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