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Analysis of the Relationship Between Stock Price Index and Exchange Rate in Indonesia (Emerging Market) and in Singapore (Developed Market) using Vector Error Correction Model (VECM) Analysis

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ABSTRACT

The COVID-19 pandemic is a problem that occurs in all countries, both developed and developing countries. The impact of this pandemic is not only in the health and social fields, but also the most visible is the economic impact. Restructuring the economy requires investment, both domestic and international. The increase that occurs will make the domestic currency appreciate. Conversely, if there is a downward trend in stock prices, it will cause investors' real wealth to decrease, thereby causing a decrease in the demand for money. A decrease in the demand for money will result in a decrease in interest rates which will have an impact on foreign investment (capital inflow) and ultimately lead to a depreciation of the domestic currency. This study aims to examine the long-term relationship between stock prices (closing price) and the exchange rate in Indonesia as an emerging market and Singapore as a developed market.

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This study uses the Vector Error Correction Model (VECM) and the results of the study find that stock prices and exchange rates in Indonesia and Singapore have a co integration relationship and follow the approach Balanced Effects Portfolio.

1. Introduction

The COVID-19 pandemic is a problem that occurs in all countries, both developed and developing countries. The impact of this pandemic is not only in the health and social fields, but also the most visible is the economic impact. Restructuring the economy requires investment, both domestic and international. All investors, both domestic and foreign investors, will definitely look at stock prices when making investment decisions. Stock prices can be influenced by internal factors and external factors. When an investor invests in any asset, of course, there is a risk that can be minimized by using financial tools to determine the expected return desired by the investor. Some investors use the Capital Asset Pricing Model (CAPM) as the financial tools used. There are several problems inherent in this CAPM, including the absence of transaction fees, investors in borrowing and lending at a risk-free rate, when investors will make cross-country investments there is currency exchange risk. This led to the creation of an expanded CAPM model by adding another factor known as the International Capital Asset Pricing Model (ICAPM). ICAPM was first introduced by Adler and Dumas (1983) where this model uses the same input as the CAPM but also takes into account other variables in practice. The ICAPM extends the CAPM theory in that in addition to being compensated for the time value of money for taking existing market risks, investors must be paid exposure to exchange rates which can directly or indirectly affect the returns that will be given. ICAPM allows investors to add currency effects to the CAPM model to take into account the sensitivity to currency changes that can directly or indirectly affect profitability and desired returns, seeing the above, the speed of integration of various financial markets in countries affected by the pandemic will encourage liberalized relations between countries around the world. Faced with high integration factors, foreign investors seem to have more opportunities to diversify their portfolio investments internationally and of course in cross-border transactions, investors definitely have the potential to get exchanged risk (Liang, 2013). If we think logically, then an investor will generally invest if they consider the economic conditions or capital market of a country to be good and attractive. Automatically when this happens it will increase the demand for domestic money which will increase the interest rate of a country which in turn will increase capital inflows or foreign investment in a country. The increase that occurs will make the domestic currency appreciate. Conversely, if there is a downward trend in stock prices, it will cause investors' real wealth to decrease, thereby causing a decrease in the demand for money. A decrease in the demand for money will result in a decrease in interest rates which will have an impact on foreign investment (capital inflow) and ultimately lead to a depreciation of the domestic currency. it will cause the real wealth of investors to decrease, thereby causing a decrease in the demand for money. A decrease in the demand for money will result in a decrease in interest rates which will have an impact on foreign investment (capital inflow) and ultimately lead to a depreciation of the domestic currency. it will cause the real wealth of investors to decrease, thereby causing a decrease in the demand for money. A decrease in the demand for money will result in a decrease in interest rates which will have an impact on foreign investment (capital inflow) and ultimately lead to a depreciation of the domestic currency.

The Currency depreciation and appreciation have a relationship with the stock market which of course has enormous implications in influencing the state and economic development of a country. There are two theoretical approaches to the relationship between the two things above, namely the International Trading Effect which is often referred to as the "flow oriented model" where the exchange rate can affect stock prices and the second is the "Portfolio Balanced Effect" where stock prices can affect the exchange rate. Based on the flow-oriented model (Dorbusch and Fisher, 1980) exchange rate

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movements will affect international competitiveness and the position of the trade balance which will ultimately affect the real income/output of a company and stock prices (Geske and Roll, 1983). The next approach introduced by Branson and Frankel (1983) is the balanced effect portfolio. Based on this approach, investors will allocate their wealth among various alternative assets, including domestic bonds, domestic equities, and foreign securities (Moore and Wang, 2014). The movers of the capital market and exchange rates according to Moore and Wang (2014) are related to the exchange rate regime and trade relations, where an increase in the trade balance will increase the stock market and foreign exchange rates for a country's economy with the world.

This study aims to examine the long-term relationship between stock prices and exchange rates in Indonesia and Singapore considering the liberalization of trade that occurred between the two countries due to the pandemic. To reorganize the economy in these countries, bilateral relations in the economic field are always a priority. As we all know that currently Indonesia and Singapore are experiencing shocks due to the pandemic that has caused currencies both in emerging (Indonesia) and developed (Singapore) countries, the consequences of which have a negative impact on stock prices and affect investor perceptions of the relationship between prices. stocks and exchange rates, so investors will start to be careful to see the relationship between the two things (Lin, 2012).

2. Literature Review

Capital Asset Pricing Model(CAPM) was originally introduced by Sharpe and Lintner (1965). CAPM itself, as we all know, has been widely used by academics and practitioners because it is believed to be able to provide a strong explanation of risk and its relationship to expected return. However, some previous studies do not believe that beta (β) can be used as a benchmark to determine expected return. Beta (β) is a systematic risk factor for a security. The statement from Fama and French (2004) is related to several previous studies such as that conducted by Lintner (1965), Black, Jensen, and Scholes (1972), Fama and Macbeth (1973), which tried to test the validity of which was mentioned in the CAPM model. as a determining factor for the desired rate of return. These studies tend to lead to results that show the relationship between and the expected return expressed in the slope of the Security Market Line (SML) curve is not as strong as predicted by the CAPM model (Saleh, 2010). This of course raises a question "Are there really other factors besides that can determine the expected return?

Many academics have started to develop a model from the CAPM, such as Breeden (1979) who developed the CCAPM model where Breeden developed a consumption based capital asset pricing model, in contrast to the CAPM, asset risk is associated with the level of disruption in consumption levels and not associated with market risk. In addition, Merton (1973) provides a new development of the CAPM, namely the Intemporal Asset Pricing Model, where in this model Merton focuses on the behavior of individual investment decisions. Due to the start of the integration of trade, the CAPM was also developed by Adler and Dumash (1983) with the International Capital Asset Pricing Model (ICAPM). where this model uses the same inputs as the CAPM but also takes into account other variables in practice. ICAPM extends the CAPM theory where in addition to getting compensation for the time value of money for taking the existing market risk, investors must be paid for exposure to exchange rates which can directly or indirectly affect the returns that will later be given. ICAPM allows investors to add currency effects to the CAPM model to take into account the sensitivity to currency changes that can directly or indirectly affect profitability and desired returns. In other words, the exchange rate can affect returns which will have an impact on stock prices. ICAPM allows investors to add currency effects to the CAPM model to take into account the sensitivity to currency changes that can directly or indirectly affect profitability and desired returns. In other words, the exchange rate can affect returns which will have an impact on stock prices. ICAPM allows investors to add currency effects to the CAPM model to take into account the sensitivity to currency changes that can directly or

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indirectly affect profitability and desired returns. In other words, the exchange rate can affect returns which will have an impact on stock prices.

If the exchange rate can affect stock prices, then the problems that occur can be prevented by controlling the exchange rate. However, if on the contrary, it is the stock price that can affect the exchange rate, then governance is the most capable of making new policies so that the stock market becomes stable. If the two are interconnected, investors can use this information to predict one market by using information on the other market (Arivani, 2015).

The impact of exchange rates on stock prices is largely an unresolved issue in the financial literature and mixed results are shown from the relationship between exchange rates and stock prices. This research was initiated by Frank and Young (1972) to examine the relationship between exchange rates and stock prices and little evidence was found of the two relationships. Furthermore, research conducted by Aggarwal (1981) looked at the relationship between the two and the results were that the two variables were not related to each other. This study wants to prove whether the exchange rate factor has an effect on stock prices. Bahmani and Oskoe (1992) were the first researchers to investigate the cointegration relationship between stock prices and exchange rates and the results showed a significant bidirectional relationship between the two variables. But, The insignificant relationship between the two has been the result of research from Granger (2000). Granger et. al (2000) examined the Granger causality relationship between stock markets and exchange rates for emerging markets (Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines. Singapore, Thailand, and Taiwan) over the period January 3, 1986 to June 16, 1998. strengthened by research conducted by Kollias (2010).

Lutfur (2009) tested the dynamic relationship between exchange rates and stock prices in South Asia Countries using monthly data for the period January 2003 to June 2008 using cointegration and VECM tests. The results show that there is no long-term relationship. Zhao (2010), tested the short-term dynamic relationship between the effective real exchange rate Yuan/Renminbi (RMB) and stock prices, during January 1991 to June 2009 using the cointegration test (VAR). The results do not find a long-run equilibrium relationship between the effective exchange rate of the RMB and stock prices. Liang et. al. (2013) examined the relationship between stock markets and exchange rates in ASEAN 5 using monthly data for the period August 2008 to June 2011. Using the multivariate cointegration (VECM) methodology. The results show that the exchange rate has a negative effect on stock prices through capital mobility. In the long term and short term, the causal relationship runs from the exchange rate to stock prices (unidirectional), this finding indicates that the monetary authorities for ASEAN 5 should continue to let the value of their currencies be determined by economic fundamentals instead of disturbing them just to stimulate export growth unless many short-term speculative funds pour into the foreign exchange market. Although previous research has clearly documented the relationship between exchange rates and stock prices, empirical results still provide conflicting results. As previously mentioned, two possible approaches can describe the adjustment mechanism in both the flow-oriented model market and the portfolio balance effect.

3. Data And Methodology

The data used in this study is the stock price (closing price) and the exchange rate of Indonesian and Singaporean currencies against the US dollar. The following is a procedure for conducting research:

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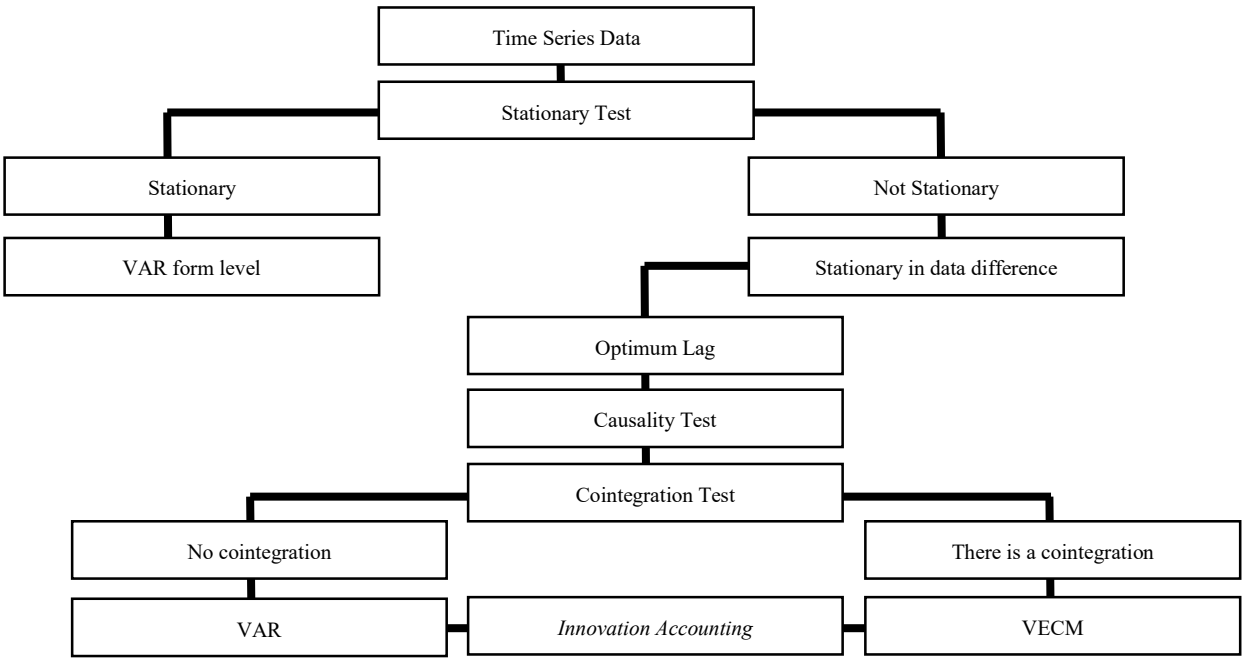
Figure 1: Research Procedure



The data used in this study is time series data. Time series data assumes that a data must be stationary (Gujarati, 2013). However, many studies have shown that time series data need not be stationary (Engle and Granger, 1987). Using non-stationary data in regression analysis can produce spurious regression. Therefore, before analyzing the data, this study will test the data with a unit root test. In this study, Augmented Dickey Fuller (ADF) was used.

The ADF test is carried out with the following hypotheses and criteria:

H0 : data is non-stationary

H1 : data is stationary

Reject H0 if the probability value is greater than the 5% alpha significance level, and accept H0 if the probability value is greater than the alpha value. The indicated variable has a cointegration relationship if it is not stationary at the same differencing level.

Furthermore, when the ADF results show non-stationary data at the data level and stationary at the first differents, the Granger Causality test is then carried out. The Granger Causality Test will be entered to indicate whether the stock price and exchange rate variables have a two-way relationship, or only one way. However, it should be noted that the Granger test that is seen is the influence of the past on current conditions. The model used for granger causality is as follows:

$SPt = 0 + 1i\ SPt\text{-}1 + 2i\ ERt\text{-}1 + e1t \sum_{i=1}^{q} \quad \sum_{i=1}^{q}$

$ERt = 0 + 1i\ ERt\text{-}1 + 2i\ SPt\text{-}1 + e1t \sum_{i=1}^{q} \quad \sum_{i=1}^{q}$

Where SPt and ERt are stock prices and exchange rates. e1t and e2t are uncorrelated stationary random processes, and t is the time period. Accept H0 : 21 = 22 = ... = 2q = 0 which means the exchange rate does not granger the stock price. On the other hand, reject H0 : 11 = 12 = ... = 1q = 0 which means the stock price does not increase the exchange rate.

If there is a good relationship that the stock affects the exchange rate or even vice versa, then proceed

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with the cointegration test. This cointegration test was originally discovered by Engle and Granger (1987) and developed by Johansen and Juselius (1990). This test states that it is possible for a linear combination of some non-stationary data to become stationary. Cointegration testing procedure for multivariate cases in the form of VAR where all variables are assumed to be endogenous variables. The following is an autoregressive model of order p:

$Yt = At\ Yt\text{-}1 + ... + ApYt\text{-}p + B\ Xt + et$

Where Yt is vector k of non-stationary I(1) variable, Xt is vector d of deterministic variable and et is innovation vector. The Johasen method has two likelihood ratio test specifications, the first test is the maximum eigen value statistic and the second is a trace statistic which will then be compared with the value of the Critical Value.

If there is a cointegration between stock prices and exchange rates, a Vector Error Correction Model (VECM) is needed to test this relationship. By using a combination of first difference and cointegrated variables, VECM itself can see whether there is a long-term equilibrium relationship between stock prices and exchange rates. The following is a model of VECM:

$yt = 1\Delta xt + 2\ (yt\text{-}1 – yxt\text{-}1) + ut$

Where (yt-1 – yxt-1) is the error correction term, y is the long-term relationship between stock price variables (y) and the exchange rate (x) and 1 is the short-term relationship between changes in x and changes in y and 2 is the Speed of adjustment to return to the equilibrium point.

4. Research result

Stationary test results can be seen in table 1. It can be seen that the overall data both JKSE-IDR and STI-SGD are not stationary at the data level (> 5% significance level). Therefore, first differencing was carried out using dlog, the results showed that all data were stationary at a significance level of 5% and integrated at degree 1 or I(1).

Table 1: Stationary Test

Country	ADF		PP	
	Data Level	First Difference	Data Level	First Difference
Indonesia	0.9452	0.0000	0.9359	0.0000
Singapore	0.4374	0.0000	0.362	0.0000

After testing the stationary data, the next step that must be taken is to determine the length of the lag to be used to test the Granger Causality, Johohansen Test, and VECM. Based on the existing results, the optimum lag used by Indonesia and Singapore is lag 1. Looking at the 5 indicators that can determine the optimum lag, lag 1 meets the requirements as the optimum lag (table 2).

Table 2: Determination of Lag

Country	lag	LR	FPE	AIC	SC	HQ
Indonesia	1	15,45472*	1.89e-06*	-7.502878*	-7361190	-7449368*
Singapore	1	10,79352*	1.58e-06*	-7,679351*	-7.547663	-7,7625840

Table 3: Granger Causality Test Results

Country	Results	Probability	Connection
Indonesia	IDR does not Granfer Cause JKSE	0.4140	*Undirectional* (shares to exchange rate)
	JKSE does not Granger Cause IDR	0.0017	
Singapore	SGD does not Granger Cause STI	0.5344	*Undirectional* (shares to exchange rate)
	STI does not Granger Cause SGD	0.0193	

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The Granger Causality test found that both Indonesia and Singapore have a unidirectional relationship (shares against the exchange rate), this can be seen from the probability that JKSE does not Granger Cause IDR is 0.0017 and STI does not Granger Cause SGD is 0.0193 where both probabilities are less than 5% significance level. The results of the Granger causality test can be seen in table 3. It can certainly be said that the relationship between stock prices and exchange rates in these two countries follows the Portfolio Balanced Effect approach.

Table 4: Cointegration Test Results

Country	Trace	5% Critical Value	Prob.	Max. Eigen Statistics	5% Critical Value	Prob.
Indonesia	46,06173	15,49471	0.0000	25,44269	14,26460	0.0006
	20.61904	3.841466	0.000	20.61904	3.841466	0.0000
Singapore	163,0373	15,49471	0.0001	100.8908	14,26460	0.0000
	62.14644	3.841466	0.0000	62.14644	3.841466	0.0000

After seeing a causal relationship between the two variables in Indonesia and Singapore, then a co-integration test was carried out using the Johansen Test. The results of the co-integration test can be seen in table 4. Based on this test Indonesia and Singapore are cointegrated at a significance level of 5%. It can be concluded that stock prices and exchange rates have a linear combination which is stationary in this case cointegrated.

The stock prices and exchange rates have a long-term relationship in this case cointegrated, then the next data processing is carried out using the Vector Error Correction Model (VECM). The results of this model can be seen in table 5. For Indonesia, the exchange rate made adjustments by reducing its speed very quickly, namely 123% to reach the equilibrium position. Meanwhile, the stock price itself needs to increase its speed by 55% to reach the equilibrium point. Similar to Indonesia, Singapore also needs to reduce the speed of its exchange rate and increase the speed of its share price to reach the equilibrium point by 114% and 46%, respectively. Overall, showing that stock prices are more responsive to long-run equilibrium when compared to exchange rates, this could be because the stock markets in Indonesia and Singapore are more liquid than the forex market. The VECM coefficient for the equation can be seen in table 6.

Table 5: Vector Error Correction Model (VECM) Results

Country	Equation Result
Indonesia	D(IDR) = -1.23103548871*(LNIDR(-1) + 0.272371300993*JKSE(-1) – 0.00721875913429) + 0.125329463525*D(IDR(-10) + 0.851801350061*D(JKSE(-1)) + 0.000116350263564
	D(JKSE) = 0.5510799515762*(IDR(-1) + 0.272371300993*JKSE(-1) - 0.00721875913429) – 0.0268186045574*D(IDR(-1)) – 0.408097727157*D(JKSE(-1)) – 0.0010180435581
Singapore	D(SGD) = -1.14749483603*(SGD(-1) + 0.241021518425*STI(-1) - 0.00439911696513) + 0.160944539355*D(SGD(-1)) + 0.0729440116987*D (STI(-1)) + 0.000222804988889
	D(STI) = 0.463168038367*(SGD(-1) + 0.241021518425*STI(-1) – 0.00439911696513) – 0.346472556187*D(SGD(-1)) – 0.533175497394*D(STI(-1)) – 0.000495876769367

The last step is to perform the Impulse Response Function (IRF). This IRF was conducted to see the contemporary influence of the two variables. The results of the IRF can be seen in Figure 2. Based on

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the results, the response given by the IDR exchange rate due to the stock price index shock (JKSE) showed a negative response from the first day to the tenth day, and based on the results the normal point would be reached on The third day. A negative response was also given by the stock price index (JKSE) due to the shock of the IDR exchange rate, but the normal point will occur on the fourth day. The same thing happened in Singapore. The response given by the SGD exchange rate to the shock of the stock price index (STI) and the response given by the stock price index (STI) to the SGD exchange rate,

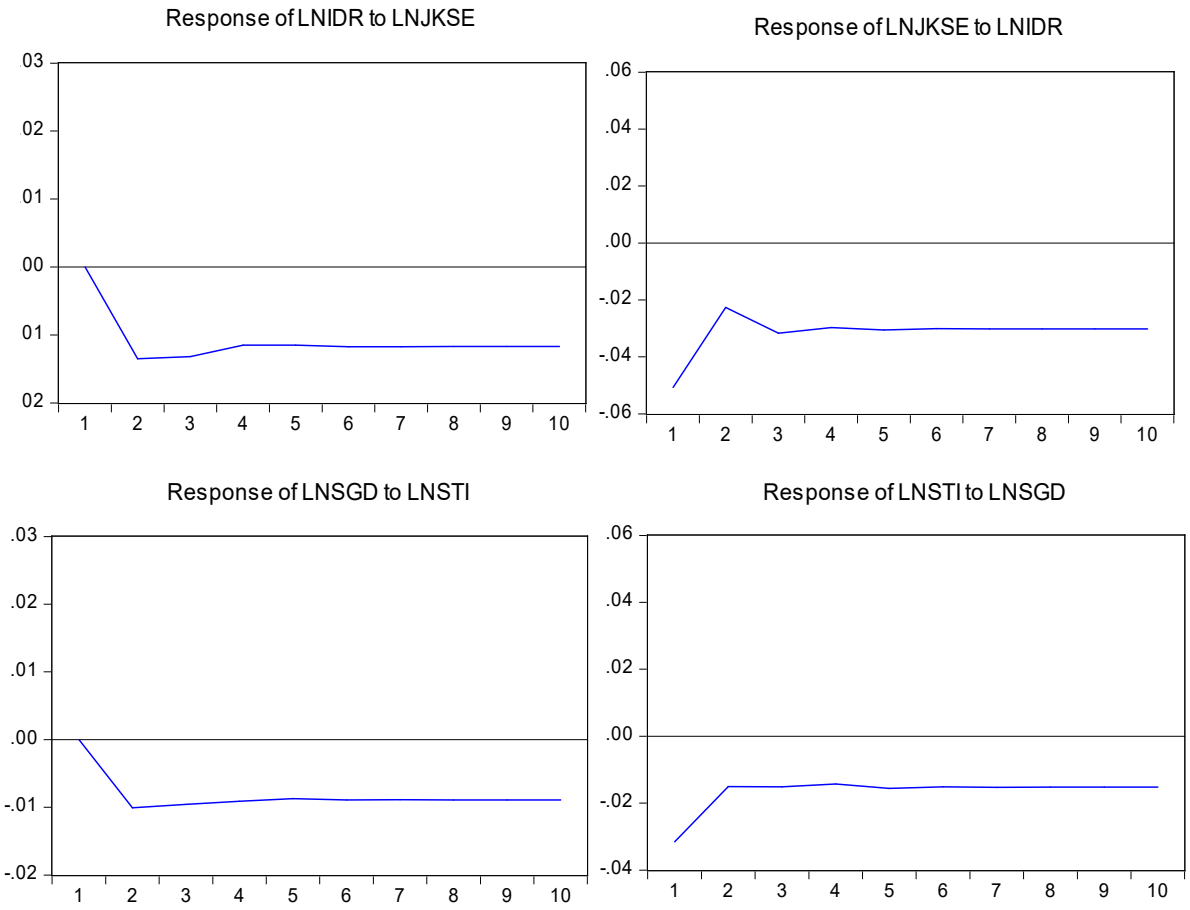

Figure 2: Results of the Impulse Response Function

5. Conclusion

This study aims to examine the long-term relationship between stock prices and exchange rates in two ASEAN countries, namely Indonesia and Singapore, which are emerging market and developed market countries. The results of this study found that stock prices and exchange rates in Indonesia and Singapore have a long-term relationship and follow the Portfolio Balance Effect approach. Which means the stock price can affect the exchange rate. Where when the stock price of a country falls, there will be a capital outflow where investors withdraw their funds and will place their portfolios in countries that will provide better returns so that the currency of a country will depreciate.

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