Exchange Rate, Exchange Rate Volatility and Stock Prices: an Analysis of the Symmetric and Asymmetric Effect Using ARDL and NARDL Models

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Abstract

This article examined the symmetric and asymmetric effects of the IDR/USD exchange rate and its volatility on stock prices using the monthly time series data of the IDR/USD exchange rate and the Indonesian composite stock price index from January 2006 to July 2019. The data were analyzed using ARDL and NARDL models. The results showed that in the short term, the IDR/USD exchange rate has a symmetry effect on stock prices, while volatility lacks such a symmetric influence. However, these two variables asymmetrically affect stock prices, Furthermore, in the long term both the exchange rate and the volatility lack symmetric and asymmetric influence on stock prices.

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Keywords: Exchange rate, exchange rate volatility, stock prices, ARDL model, NARDL model.

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1. INTRODUCTION

In the global economy, foreign currency is used for international trading both in the real and financial sectors (Saidi et al., 2015; Adam et al., 2017). International trade may increase demand for foreign currency, which, in turn, change currency rates. Regarding investments, foreign currencies are traded in the financial markets. This allows investors to purchase and sell their currencies, leading to adjustments and volatility of exchange rates. According to Ma and Kao (1990), exchange rate volatility is on an upward trend from early 1970s and can impact stock prices. This has attracted studies on the relationship between exchange rate volatility and stock prices.

Ma and Kao (1990) and Dornbush and Fisher (1980) established theories on one-way causal relationships from exchange rates to stock prices. Ma and Kao (1990) developed a mathematical model involving variables of exchange rates as well as foreign and domestic stocks. While developing this model, it was assumed that only foreign and domestic stocks were traded in the market. The econometric test showed that in a dominant country in exports, currency appreciation reduces export competitiveness and negatively affects domestic stock prices. Conversely, in a country with a greater dominance over imports, currency appreciation lowers import costs, which positively affects stock prices. Dornbush and Fisher (1980) developed a theory of the goods market. The theory states that exchange rate changes affect a company's profits through import and export activities in the goods market. Such profits will ultimately affect stock prices. In investment portfolios, exchange risk is measured by exchange rate volatility. Importantly, an increased exchange rate volatility may influence investors' attitudes in choosing financial assets as part of their investment portfolios, raising the stock demand and prices (Wagner, 2019).

Empirical studies regarding the exchange rate effects on stock prices were conducted in different nations (Malliaropulos, 1998; Mgammal, 2012; Suriani *et al*., 2015). However, the findings of these studies have been inconsistent, probably due to two main factors. First, the researched countries' economic and socio-political conditions and cultural characteristics vary (Ozturk, 2010). Second, each of these studies used a distinct time-series data period (Novita and Nachrowi, 2005; Adam et al., 2015). The exchange rate volatility impact on stock prices has also been researched. Notable studies include Bag et al. (2017) and Mechri et al. (2018), while the asymmetric effect on stock prices were also investigated by others, including Bahmani-Oskooee and Saha (2016), and Merchri et al. (2018). Table 1 summarizes all the research mentioned above are summarized.

Several researches examined the symmetric and asymmetric effects of exchange rates on stock prices. However, studies on asymmetric effects are still scarce. Bahmani-Oskooee and Saha (2016) is the only research that investigated such an effect in Indonesia using a non-linear panel ARDL model for data analysis, whereas, this study used a non-linear ARDL. The question arises as to whether the exchange rate and its volatility have symmetric and asymmetric effects on stock prices in certain countries like Indonesia. This question is essential to address, primarily because none of the previous works has focused on the asymmetric impact of exchange rate volatility on stock prices in Indonesia, which is the focus of this research.

This research investigates the symmetric and asymmetric impacts of exchange rate and volatility on stock prices with monthly data from January 2006 to July 2019. It supplements economic literature on the symmetric and asymmetric impacts of these variables on stock prices as well as the use of ARDL and nonlinear ARDL. Specifically, the ARDL and nonlinear ARDL help determine the symmetry and asymmetric influences of these two variables, respectively.

Table 1: Summary of Relevant Previous Studies

Author (Year)	Variable	Analysis model	Period/Country	Results
Symmetry effect:				
Malliaropulos (1998)	Exchange rate, stock price	Panel data	1973:1-1992:3, OECD Countries	The exchange rate negatively affected stock prices
Mgammal (2012)	Exchange rate, interest rate, inflasi, the stock price	Linear regression	2008.1-2009.12, Saudi Arabia and the UEA	The exchange rate positively affected stock prices
Suriani et al. (2015).	Exchange rate, the stock price	Granger causality	2004.1-2009.12; Pakistan	The exchange rate did not affect stock prices
Bag et al. (2017)	Exchange rate volatility, the stock price	Simple linear regression	2003.1-2015.12, Pakistan	Exchange rate volatility had a positive effect on stock prices
Mechri et al. (2018)	Exchange rate volatility, inflation rate, interest rate, the stock price	Linear regression multiple	2002:1-2017:1, Turkey and Tunisia	Exchange rate volatility positively affected stock prices
Asymmetrical effect:				
Bahmani-Oskooee and Saha (2016)	The partial sum of positive and negative changes in the exchange rate and rate stock price	Non-linear ARDL	1973-2015, Canada, Brazil, Chile, Japan, Indonesia, Korea, Mexico, Malaysia and the U. K	The exchange rate had an asymmetric impact on stock prices
Azarbayjani et al. (2018)	The partial sum of positive and negative changes in the exchange rate, interest rate, real liquidity, consumer price index, the stock price	Non-linear ARDL	2001.1-2017/3, Iran	The exchange rate had an asymmetric effect on stock prices.

Section two of these research discusses the literature review, while the third one focuses on data and method. The fourth and the fifth sections are the findings, discussion and conclusion.

2. LITERATURE REVIEW

The value of currency between countries is referred to as exchange rate and change from the previous term to the current one is the exchange rate return in the investment context, while volatility is the standard deviation from variations in the exchange rate (Misra, 2018). In this subsection, several empirical studies of the symmetric and asymmetric effects of the exchange rate on stock prices are reviewed. It begins with the classification of these studies into three groups, including the effect of the exchange rate and volatility on stock prices. The study also classifies the asymmetric effect between these two variables. Importantly, the term effect in groups 1 and 2 is also called the symmetric effect.

Researches that belong to the first group include Ozbey et al. (2016), which investigated the impact of the TRY/USD exchange rate on stock prices in Turkey with monthly data from January 2009 to November 2015. The test results using the GARCH model indicated the

relationship between two variables. Furthermore, Ozbey et al. (2016) investigated the impact of the relationship between these variables in Turkey with monthly data from January 2009 to November 2015. The test results using the GARCH model indicated the influence of exchange rate on stock prices. Lastly, Gong and Dai (2017) studied influence of interest rate and the exchange rate of CNY/USD on China's stock prices using daily data from 21 July 2005 to 31 June 2016. The effect was assessed using nonlinear regression model of Chang et al. (2000). The results indicated that stock price is influenced by interest and exchange rates.

In the second group, several researches examined the relationship between these variables, including Olugbenga (2012), Mlambo et al. (2013), Parera (2016), Sichoongwe (2016), Najafzadeh et al. (2016) and Mrhari and Dadoui (2017). The long term and short term effects of the Naira/USD exchange rate volatility on Nigeria's stock prices was investigated by Olugbenga (2012) using monthly data from 1985-2009. Granger causality test results showed a short term and long term effect of exchange rate. The volatility of currency rates against South Africa's stock prices was investigated by Mlambo et al. (2013) using the GARCH model. The econometric test results on monthly data for the 2000-2010 period showed that exchange rate volatility negatively affected stock prices or stock market capitalization. Parera (2016) investigated the effect of exchange rate volatility on India's stock market returns using data from January 2010 to December 2015. The data was analyzed using the GARCH model. The analysis results showed a positive impact of the euro exchange rate volatility on stock returns. However, the USD exchange rate volatility and the British Pound exchange rate did not affect stock price returns. The study suggested that investors need to consider the exchange rate volatility in their investment decision making. Sichoongwe (2016) examined the exchange rate volatility of share prices in Zambia. An analysis of annual data from 2000 to 2015 using the GARCH model indicated that exchange rate volatility negatively influenced stock prices. The proposed policy implication was that exchange rate movement needed to be stabilized to attract foreign portfolio investment. Najafzadeh et al. (2016) researched exchange rate volatility influence on stock returns in the D8 countries (Iran, Pakistan, Bangladesh, Indonesia, Malaysia, Egypt, Nigeria, and Turkey). The results of the Panel-GARCH model test on monthly data from January 2008 to June 2016 showed the effect of exchange rate volatility on stock returns only in Pakistan, Indonesia, and Bangladesh. Mrhari and Dadoui (2017) examined the effect of exchange rate volatility on stock prices in Marocco. The VECM test on the data showed that exchange rate volatility affected stock prices.

The third group include Saman (2015) and Luqman and Kouser (2018). The asymmetric relationship between the exchange rate and stock prices in Romania was investigated by Saman (2015) using monthly data from March 2000 to March 2014. The test results on the data using the TAR-ECM and MTAR-ECM revealed the exchange rate has an asymmetric effect on stock prices in the long term and short term. Luqman and Couser (2018) investigated the asymmetric effect of exchange rates on stock market prices from G8 + 5 countries (Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Russia, South Africa, UK, USA) as well as Pakistan using annual data for the 2000-2016 period. The econometric test results through the NARDL model showed the exchange rate has an asymmetric influence on the stock price.

3. DATA AND METHOD

3.1. Data

Time-series data concerning the composite stock price index and exchange rate, specifically the monthly data from January 2006 to July 2019 were used in this research. The composite stock price index represented the stock prices. Similarly, the IDR/USD exchange rate

proxied exchange rates because the US currency is often used in intercontinental trade. In the analysis, a time series of exchange rate volatility developed from the IDR/USD exchange rate time series using the GARCH model was utilized. Fusion Media Limited provided the required data.

3.2. Method

The autoregressive distributed lag (ARDL) model by Pesaran and Shin (1999) and Heij et al. (2004) was used to test the symmetric effect of the IDR/USD (EXR) exchange rate on stock prices (STP). ARDL models with time lag p and q, written as ARDL (p, q, r), are as follows.

$$STP_t = C_1 + \sum_{i=1}^{p} \alpha_i STP_{t-i} + \sum_{j=0}^{q} \beta_j EXR_{t-j} + \sum_{k=0}^{r} \gamma_k EXV_{t-k} + \varepsilon_{1t} \quad (1)$$

Where $C_1$is the intercept, α_i $(i = 1, 2, \dots, p)$, β_j $(j = 0, 1, \dots, q)$and γ_k $(k = 0, 1, \dots, r)$ are the coefficients of the variable, and ε_{1t} is an error that is homoscedastic and has no autocorrelation. EXR and STP variables are logarithmic forms, while EXV is the exchange rate volatility, a measure of risk (Mishra, 2018). In model (1), the volatility $EXV = \sqrt{h_t}$ which is constructed using the GARCH(1,1) model in (2) as stated by Bahmani-Oskooee and Xi (2015), namely

$$\begin{aligned} EXR &= C_2 + EXR_{t-1} + \varepsilon_{2t} \\ h_t &= w + \alpha h_{t-1} + \beta \varepsilon_{2(t-1)} \end{aligned} \quad (2)$$

Equation (1) can be changed to equation (3), hereinafter called error correction model (ECM).

$$\begin{aligned} D(STP_t) = {} & \beta_0 D(EXR_t) + \gamma_0 D(EXV_t) + \Pi_1 EC_{1(t-1)} + \sum_{i=1}^{p-1} \alpha_i{}^* STP_{t-i} \\ & + \sum_{j=1}^{q-1} \beta_j{}^* EXR_{t-j} + \sum_{k=1}^{r-1} \gamma_k{}^* EXV_{t-k} + \varepsilon_{1t} \end{aligned} \quad (3)$$

where Π_1 is called the error correction coefficient leading to the equilibrium condition, and the error correction variable $EC_{1(t-1)}$ satisfies equation (4). The coefficients β_0, γ_0, $\alpha_i{}^*$, $\beta_j{}^*$ and $\gamma_k{}^*$ are short term multipliers of $D(STP_t)$

$$EC_{1(t-1)} = STP_{t-1} - \frac{\sum_{j=0}^{q} \beta_j}{1-\sum_{i=1}^{p} \alpha_i,} EXR_{t-1} - \frac{\sum_{j=0}^{r} \gamma_j}{1-\sum_{i=1}^{p} \alpha_i,} EXV_{t-1} - \frac{C_1}{1-\sum_{i=1}^{p} \alpha_i,} \quad (4)$$

where $\left(\frac{\sum_{j=0}^{q} \beta_j}{1-\sum_{i=1}^{p} \alpha_i,}, \frac{\sum_{j=0}^{r} \gamma_j}{1-\sum_{i=1}^{p} \alpha_i,} \right)$ is the vector of a long term multiplier. If EXR, EXV and STP are not cointegrated, then equation (3) will be the ARDL (p-1, q-1, r-1) equation at first difference. In this case, the term $\Pi_1 EC_{1(t-1)}$ is omitted.

In estimating the ARDL model, the following steps were followed. The stationarity of EXR, EXV and STP variables were first tested. The stationarity test is also called the unit root test or integration order test. The Augmented Dickey-Fuller (ADF) test put forward by Dickey and Fuller (1979) and the Phillips-Peron (PP) by Phillips and Peron (1988) were used to determine the stationarity of the variables. The null hypothesis of both stasionary tests is the time series has a unit root. Afterward, the cointegration between EXR, EXV and STP was examined. The test is performed in case the variables are stationary at the first difference or integrated of order 1, I (1). The Engle-Granger and Phillips-Ouliaris cointegration tests proposed by Engle and Granger (1987) and Phillips and Ouliaris (1990) are used when all of them are stationary at the first difference. The null hypothesis of both cointegration tests is the three-time series EXR, EXV and STP, which are not cointegrated. The three-time series EXR, EXV and STP cointegrate in case the residual RES_1=EC_1in equation (4) is stationary at the level. The Engle-Granger cointegration test

follows the ADF test procedure. In comparison, the Phillips-Ouliaris cointegration test follows the PP test procedure. Subsequently, the regression parameters were estimated and interpreted.

The NARDL model was employed to test the asymmetric effect of exchange rates and volatility on stock prices. Essentially, the NARDL is the development of the ARDL proposed by Shin et al. (2014). It involves four variables covering the partial sum of positive changes in exchange rates (ERP), the partial sum of negative changes in exchange rates (ERN), the partial sum of positive changes in exchange rate volatility (EVP), and the partial sum of negative changes in exchange rate volatility (EVN). ERP and ERN are referred to as depreciation and appreciation of currency. The four variables of ERP, ERN, EVP, and EVN are defined as follows.

$$ERP_t = \sum_{i=1}^{t} \max[\Delta EXR_i, 0] = \sum_{i=1}^{t} \max[D(EXR_i),0]$$
$$ERN_t = \sum_{i=1}^{t} \min[\Delta EXR_i, 0] = \sum_{i=1}^{t} \min[D(EXR_i),0]$$
$$EVP_t = \sum_{i=1}^{t} \max[\Delta EXV_i, 0] = \sum_{i=1}^{t} \max[D(EXV_i),0]$$
$$EVN_t = \sum_{i=1}^{t} \min[\Delta EXV_i, 0] = \sum_{i=1}^{t} \min[D(EXV_i),0]$$

where $D(EXR_i) = \Delta EXR_i = EXR_i - EXR_{i-1} = EXR - EXR(-1),\ i = 1, 2, \dots, t$ are the exchange rate change.

The NARDL (p, q_1, q_2, r_1, r_2) model that shows a one-way asymmetric correlation between the exchange rate and volatility on stock price is

$$STP_t = C_3 + \sum_{i=1}^{p} \theta_i STP_{t-i} + \sum_{j=0}^{q_1} \vartheta_j ERP_{t-j} + \sum_{k=0}^{q_2} \varphi_k\, ERN_{t-k} + \sum_{l=1}^{r_1} \phi_l EVP_{t-l} + \sum_{m=0}^{r_2} \psi_m EVN_{t-m} + \varepsilon_{3t} \quad (5)$$

where $C_3,\ \theta_i(i = 1, 2, \dots, p),\ \vartheta_j(j = 0, 1, \dots, q_1),\ \varphi_k(k = 0, 1, \dots, q_{12}),\ \phi_l(l = 0, 1, \dots, r_1)$, and $\psi_m\ (m = 0, 1, \dots, r_2)$ are the parameters of the regression equation, and ε_{3t} is the error. Equation (4) can be changed to (6), which is the ECM-NARDL model.

$$D(STP_t) = \vartheta_0 D(ERP_t) + \varphi_0 D(ERN_t) + \phi_0 D(EVP_t) + \psi_0 D(EVN_t) + \Pi_2 EC_{2(t-1)} + \sum_{i=1}^{p-1} \theta_i{}^* D(STP_{t-i}) + \sum_{j=1}^{q_1-1} \vartheta_j{}^* ERP_{t-j} + \sum_{k=1}^{q_2-1} \varphi_k{}^* D(ERN_{t-k}) + \sum_{l=1}^{r_1-1} \phi_l{}^* D(EVP_{t-l}) + \sum_{m=1}^{r_2-1} \psi_j{}^* D(EVN_{t-m}) + \varepsilon_{3t} \quad (6)$$

where $\vartheta_0, \varphi_0, \phi_0, \psi_0, \theta_i{}^*, \vartheta_j{}^*, \varphi_k{}^*, \phi_l{}^*$ and $\psi_j{}^*$ are variable or short term coefficients. The short term asymmetric effect occurs in case $\vartheta_0 \neq \varphi_0 \text{dan} \vartheta_j{}^* \neq \varphi_k{}^*$, $\phi_0 \neq \psi_0$ and $\phi_l{}^* \neq \psi_j{}^*$. The coefficient Π_2 is called the error correction coefficient. $EC_{2(t-1)}$ in equation (6) satisfies the equation (7)

$$EC_{2(t-1)} = STP_{t-1} - \frac{\sum_{j=0}^{q_1} \vartheta_j}{1 - \sum_{i=1}^{p} \theta_i} ERP_{t-1} - \frac{\sum_{k=0}^{q_2} \varphi_k}{1 - \sum_{i=1}^{p} \theta_i} ERN_{t-1} - \frac{\sum_{l=0}^{r_1} \phi_l}{1 - \sum_{i=1}^{p} \theta_i} EVP_{t-1} - \frac{\sum_{m=0}^{r_2} \psi_m}{1 - \sum_{i=1}^{p} \theta_i,} EVN_{t-1} - \frac{C_3}{1 - \sum_{i=1}^{p} \alpha_i,} \quad (7)$$

where $\left(\frac{\sum_{j=0}^{q_1} \vartheta_j}{1 - \sum_{i=1}^{p} \theta_i}, \frac{\sum_{k=0}^{q_2} \varphi_k}{1 - \sum_{i=1}^{p} \theta_i}, \frac{\sum_{l=0}^{r_1} \phi_l}{1 - \sum_{i=1}^{p} \theta_i}, \frac{\sum_{m=0}^{r_2} \psi_m}{1 - \sum_{i=1}^{p} \theta_i,}\right)$ is the cointegration vector or the long term multiplier vector of the asymmetric effect of ERP, ERN, EVP and EVN variables on STP if these four variables are cointegrated or time series RES_2=EC_2 in equation (7) is stationary at level. The long term asymmetric effects of exchange rate and exchange rate volatility on stock prices occur in case $\frac{\sum_{j=0}^{q_1} \vartheta_j}{1 - \sum_{i=1}^{p} \theta_i} \neq \frac{\sum_{k=0}^{q_2} \varphi_k}{1 - \sum_{i=1}^{p} \theta_i}$, $\frac{\sum_{l=0}^{r_1} \phi_l}{1 - \sum_{i=1}^{p} \theta_i} \neq \frac{\sum_{m=0}^{r_2} \psi_m}{1 - \sum_{i=1}^{p} \theta_i,}$. The testing procedure of the significance of the NARDL model's parameters is similar to that of the linear ARDL model.

4. RESULTS AND DISCUSSION

4.1. Results

Table 2 indicates the likely outcomes of the ADF and PP tests projected outcomes. All-time series of variables, including the IDR/USD exchange rate and volatility, the partial sum of positive and negative changes in IDR/USD exchange rate and volatility, and stock price are stationary at first difference or process I(1).

Table 2: Unit Root Test

Variable	ADF Test Statistics		PP Test Statistics	
	Constant	Constant and Linear Trend	Constant	Constant and Linear Trend
EXR	-0.579919	-2.085768	-0.680336	-2.268168
D(EXR)	-11.58400*	-11.55846*	-11.57453*	-11.54721*
EXV	-5.203340	-5.266204	-5.203152	-5.272139
D(EXV)	-14.67729*	-14.63171*	-24.38246*	-24.38626*
STP	-1.952148	-2.845072	-1.885498	-2.731696
D(STP)	-9.760884*	-9.800091*	-9.826386*	-9.859287*
ERP	-0.946830	-2.182563	-0.844601	-2.148863
D(ERP)	-8.749410*	-8.755537*	-8.876080*	-8.878190*
ERN	-1.983364	-1.320811	-1.736594	-1.555538
D(ERN)	-11.97093*	-12.14121*	-12.31584*	-12.36917*
EVP	-0.721262	-2.478257	-0.723569	-2.514418
D(EVP)	-12.39876*	-12.37352*	-12.41605*	-12.39036*
EVN	-0.656475	-2.278403	-0.631523	-2.238779
D(EVN)	-6.595082*	-6.585193*	-11.97802*	-11.95885*

Note: * significant at 1% level. Source: Own processing

Table 3 summarized the result of the Engle-Granger and the Phillips-Ouliaris cointegration tests. Since the RES_1 and RES_2 variables are not stationary at level, the hypothesis H_o from the cointegration test is accepted. This means no cointegration exists between the IDR/USD exchange rate, its volatility and stock price. Similarly, the partial sums of positive and negative changes in IDR/USD exchange rates and exchange rate volatility, and stock price are not cointegrated. The cointegration test show no symmetric and asymmetric IDR/USD exchange rate and volatility influence on stock price in the long term.

Table 3: The Engle-Granger and Phillips-Ouliaris Tests for Cointegration

Variable	Engle-Granger Test/ADF Test Statistics		Phillips-Ouliaris Test/PP Test Statistics	
	Constant	Constant and Linear Trend	Constant	Constant and Linear Trend
RES_1	-2.202746*	-3.131414*	-3.739646*	-2.988071*
RES_2	-3.212365*	-3.751675*	-4.053339*	-4.755535*

Note: * mean insignificant (or the null hypothesis of cointegration test is accepted).

To test the short term symmetric and asymmetric influence of the IDR/USD exchange rate and the IDR/USD volatility on stock prices, the ARDL and the NARDL in the first difference was estimated. The length of the time lag based on the Akaike Information Criterion (AIC). Based on this criterion, the ARDL(3,3,0) and the NARDL(1, 0, 0, 0, 1) models were obtained. Table 4 shows all statistical values related to the estimation of the ARDL(3,3,0) and the NARDL(1, 0, 0, 0, 1).

Table 4: ARDL and NARDL Estimation

Independent Variable	Coefficient	t-statistic or χ^2-statistic	Probability
A. ARDL (3,3,0) Model. Dependent Variable: D(STP)			
D(STP (-1))	0.1777**	2.0913	0.0382
D(STP(-2))	0.0706	0.8525	0.3953
D(STP(-3))	0.1911**	2.3197	0.0217
D(EXR)	-1.2904*	-8.9267	0.0000
D(EXR(-1))	0.2428	1.4019	0.1630
D(EXR(-2))	0.1115	0.6404	0.5229
D(EXR(-3))	0.3487**	2.0461	0.0425
D(EXV)	0.4252	1.5169	0.1314
Breusch-Godfrey Serial Correlation LM Test		0.0269	0.9866
Heteroscedasticity ARCH Test		12.257	0.0565
B. NARDL(1, 0, 0, 0, 1) model. Dependent Variable: D(STP)			
D(STP(-1))	0.1181***	1.8406	0.0676
D(ERP)	-1.7186*	-8.6199	0.0000
D(ERN)	-0.9673*	-4.1895	0.0000
D(EVP)	1.4278*	3.9788	0.0001
D(EVN)	-1.4317*	-2.8609	0.0048
D(EVN(-1))	-0.8645***	-1.8077	0.0726
Breusch-Godfrey Serial Correlation LM Test		1.2621	0.5320
Heteroscedasticity ARCH Test		2.1667	0.1410

Note: sign *, ** or *** means significant at significant level 1%, 5% or 10%.

Table 4 in Panel A shows that the coefficients of the variables D(EXR) and D (EXR(-3)) are significant at 1% and 5%, respectively, though D(EXV) is insignificant. This means that a symmetric effect of the IDR/USD on stock prices exists. There is no symmetric effect of IDR/USD exchange rate volatility. This conclusion is valid because the ARDL(3,3,0) model residual is homoscedastic and does not have autocorrelation.

The coefficients of the variables D(ERP), D(ERN), D(EVP), D(EVN), and D(EVN(-1)) are significant at 1%, and the coefficient variable D(EVN(-1)) is 10% significant with different coefficients (see Panel B of Table 4). Since the coefficient D(ERN) is negative, the Indonesian currency exchange rate's appreciation against the United States currency negatively affects the stock prices. This indicates asymmetric effects of both the IDR/USD exchange rate and volatility. Since the NARDL(1,0,0,0,1) model residual is homoscedastic and has no autocorrelation, this conclusion is valid.

The exchange rate's symmetric and asymmetric effect of exchange rate and volatility on stock prices is robust. The coefficients of exchange rate, volatility, and the partial sum of positive and negative changes are significant at 1%.

4.2. Discussion

Exchange rate symmetrically affect stock prices. Precisely, the domestic exchange rate appreciation negatively impacts stock prices. However, this finding is short term in nature. Theoretically, it is in line with the theory put forward by Ma and Kao (1990), in which Indonesia's trade balance rose yearly from 2006 t02018 (FRBSL, 2019). This means that exports were more dominant than imports. Furthermore, this finding is empirically in line with Ozbey et al. (2016), Gong and Dai (2017), and Zarei et al. (2019). There is also no symmetric effect of volatility, a finding which contradicts Obegue (2012), Mlambo et al. (2013), Parera (2016), Sichoongwe

(2016), Najafzadeh et al. (2016), and Mhari and Dadoui (2017). Economic and socio-political conditions and the cultural characteristics of the countries researched may account for varied results (Ozturk, 2010). Variation in time-series data analyzed may also explain this condition (Novita and Nachrowi, 2005; Adam et al., 2015). Furthermore, such a difference can be caused by the analysis method. For example, Najafzadeh et al. (2016) used panel data model analysis in which the conclusions apply to several countries altogether. However, this study utilizes a different analysis since it only focuses on a single country, Indonesia.

No long term symmetric or asymmetric effect of both the exchange rate and volatility is found. The absence of long term effect may be attributed to the dominant impact of the prevailing market mechanisms, such as supply and demand factors (Suriani et al., 2015).

This research recommends that the Indonesian government continue implementing and developing monetary policy to appreciate the IDR currency under control. Consequently, the stock prices listed on the ISE will increase, encouraging investors to invest in the stock market.

5. CONCLUSION

This research examined the symmetric and asymmetric impact of IDR/USD exchange rate and volatility using monthly time series data from January 2006 to July 2019 of the exchange rate and the composite stock price index. The ARDL and NARDL models determined the IDR/USD exchange rate's symmetric and asymmetric effects as well as the volatility on stock prices.

According to results, the IDR/USD rate influence stock prices in the short run symmetrical, different from volatility. However, these two variables asymmetrically affect stock prices, though they lack either a symmetric and an asymmetric influence in the long run.

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