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Symmetric and Asymmetric Effects of Exchange Rate on Indonesia Stock Prices

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ABSTRACT: Understanding the effect of exchange rates on stock prices is essential essential because of how they are tied to various aspects of the economy. This study examines the symmetric and asymmetric effects of exchange rate changes on stock prices in Indonesia using both auto regressive distributed lag (ARDL) and nonlinear ARDL (NARDL) techniques. To determine short run and the long run association between the study variables. This study using Indonesia monthly data collected from January 2022 to December 2022. The study discovered a long-run equilibrium for both the ARDL and NARDL models, showing a symmetric short and longrun relationship between exchange rates and stock prices. Exchange rates have a negative effect on stock prices, which lowers investor trust in the market. Even in linear and nonlinear analysis, inflation has a negative impact on stock prices over the and long terms. High inflation can reduce consumer purchasing power, which can result in a drop in sales and profitability for businesses that significantly rely on consumer spending. authorities and investors require taking consider the relationship between exchange rates and stock prices to manage foreign exchange and stock markets.

KEYWORDS: Exchange Rates, Stock Prices, ARDL, Nonlinear ARDL

I. INTRODUCTION

Exchange rates play an important role in one's country economy especially, when foreign investment and trade has significant roles in the economy structure. We may say the exchange rate is a tools , to measure the value between two currencies . Exchange rates fluctuations may have an impact on a number of economic variables, including capital flows, competitiveness of imports and exports, and inflation. Fluctuations in exchange rates can influence various economic factors, such as inflation, import and export competitiveness, and capital flows. Consequently, affecting stock market as a whole. exchange rates may affect share prices since fluctuations in the exchange rate could lead to a rise or a decrease in the stock price. For example, depreciation of exchange rates suggests cheaper export prices allow the company to obtain more profit and experience an increase in their share prices. Export-oriented firms that benefit from export activities improve international competitiveness. so the exchange rate fluctuation plays essential role in decision that investors will take in relation to taking up investment opportunities. On the other hand, a rise in selling prices brought on by exchange rate appreciation will make the company less competitive in export business. Consequently, the firms' stock price would drop as sales and profits were reduced. Therefore , exchange rate fluctuation plays important role in investor's investment decision . Aside from that, the connection between these two variables is complicated and often influence by other internal and external factors. Researchers, decision-makers, and investors has garnered substantial attention to relationship between exchange rates and stock prices because of the broad impact it has on financial markets and economic performance. For creating successful effective investing strategies, selecting suitable monetary policies, and forecasting market movements, it is necessary to understand interaction between these financial factors. There are two classical theories that suggesting presence of a causal relationship between stock prices and exchange rates.

That are Flow-Oriented Theory by Dornbusch and Fischer (1980) and Stock-Oriented Theory by Branson and Frankel (1983). According to the Flow-Oriented Theory, claims that changes in exchange rates have an impact on a company's competitiveness. Since many may lend or funding their business operations in foreign currencies. Currency depreciation makes exporting goods more appealing and increases demand, which boosts company's profit and raises stock prices. While, currency appreciation makes exporting goods cost higher and lowers an company's profits. The empirical findings validated the stock-oriented model of exchange rates (Wu, 2000),(Phylaktis and Ravazzolo, 2005),(Yang, 2017). Next, Stock-Oriented Theory that

stress the role of capital account transaction. stock prices movement may influence exchange rates because investors' wealth and local currency demand is depend on the stock market performance. exchange rates are affected by demand and supply condition. A flourish stock market would draw in capital from overseas investors, possibly increasing the demand of a country's currency. On the other side, in cases of falling stock prices, investors would attempt to sell their equities in order to avoid and cut their losses. They would exchange country's currency in order to leave the country or market. The empirical evidence that supported the stock-oriented hypothesis of exchange rates (Ibrahim and Aziz, 2003),(Tsai, 2012), (Liang et al., 2013). As one of the most important macro-economic factors in any country, the effect of the foreign exchange rate on the stock market has been the subject of several studies. Academicians, scientists, and researchers have used a variety of approaches to ascertain the impact of exchange rates on stock prices.

The autoregressive distributed (ARDL) model (Pesaran et al., 2001) and the multivariate cointegration approach of Johansen-Juselius (1988) are a few of the often employed techniques. Many studies demonstrate a symmetrical relationship between exchange rates and stock returns. however, asymmetrical associations are comparatively less common. Due to the employment of various econometric techniques for various time periods, data frequencies, measures of stock prices and exchange rates, and types of economies the empirical evidence from these research remained inconsistent.With the recent advancement in nonlinear cointegration analysis, the nonlinear autoregressive distributed lag (NARDL) model is an extension of symmetric ARDL model. Asymmetry in both long-run connections and short-run correction processes can be incorporated using this new methods. The impact of exchange rates on stock prices has been the subject of extensive research; yet, there are still a number of issues that merit further study. Further more there are not enough studies on the same subject in Indonesia. particularly the one that suggest the possibility of a non linear relationship between exchange rates and stock prices. Based on these limitations, this study explores if there is possibility of nonlinear relationship between the exchange rate and stock prices in Indonesia. With this study, we intend to advance knowledge regarding the long-term correlation between exchange rates and stock prices. At the same time examine the role of symmetric and asymmetric effect of exchange rates fluctuations on stock prices. The study focused on symmetric and asymmetric relationships between variables, both in the short-run and long-run. The study employs the symmetric ARDL model of Pesaran et al. (2001) and the ARDL extension NARDL model of Shin et al. (2014). Using Indonesian monthly data from January 2003 to December 2022, stock prices, exchange rates, inflation, and broad money supply are included in the analysis.

II. LITERATURE REVIEW

This section discusses the major findings of the studies that examine the relationship between exchange rates and stock market performance. Literature on the relationship between exchange rates and stock prices is extensive in research findings, yet it is still open to question. start with studies that explored Granger causality between stock prices and currency rates (Granger et al., 2000),(Smyth and Nandha, 2003),(Pan et al., 2007),(Alagidede et al., 2011),(Kosapattarapim, 2017). applying The Hafner and Herwartz (2006) Lagrange multiplier (LM) principle, (Ho and Huang, 2015) examines the connections between BRIC countries exchange rates and stock indexes. The causality in variance test is used to look at the conditional volatility dependency between two variables, in contrast to the classic Granger causality test that concentrates on mean changes. The paper investigates 14 major currency/USD pairings' responses to oil and world equities returns from 1999-2017 under a VAR methodology (Mollick and Sakaki, 2019). there are further research employing versions of the GARCH model (Fang, 2002) , (Kumar, 2013) , (Caporale et al., 2014). Next, the selected studies represent a global perspective regarding linear ARDL. (Tian and Ma, 2010) Use the ARDL cointegration method to examine how financial liberalization has affected the relationships between the exchange rate and stock market performance in China. (Lin, 2012) examines the relationship between exchange rates and stock prices in Asian emerging markets. Bank of Ghana and monthly market returns calculated from the GSE All-Share Index. monthly inflation and exchange rate data from January 2000 to December 2013 are collected to analyze the impact of exchange rate and inflation on stock market returns in Ghana. The study's findings revealed a significant long-run link between inflation and GSE market returns. However, there was no meaningful short-term link between them. The outcome also demonstrated a notable long and short run linkage between exchange rate and GSE market performance (Kwofie and Ansah, 2018). The ARDL model is used in this study to examine the short and long term relationships between the study variables as they relate to the impact of exchange rates on stock returns on the Shenzhen Stock Exchange from January 2008 to December 2018. According to the projected ARDL results, exchange rate has a negative and considerable impact on the stock returns of the Shenzhen stock exchange. The effects of inflation and interest rates on stock returns are statistically significant negative factors. It is advised that the policymakers at the Central bank implement such policies that aid in the stabilization of the exchange rate based on the estimated study results (Khan, 2019). We examine the causal relation between oil prices, exchange rate and stock prices in the Indian context . using the Hiemstra and Jones (1994) nonlinear Granger causality and nonlinear ARDL tests. The results of the NARDL test reveal that

previous month positive and negative shocks in oil prices have positive (negative) significant impact on exchange rate (stock prices). confirming the asymmetric impact of oil prices on exchange rates and stock prices(Kumar, 2019). Analyze the impact of Turkish sectoral stock price indexes on exchange rate changes. (Adeniyi and Kumeka, 2020) explore the symmetry and asymmetry of the exchange rate-stock price nexus for 54 companies listed on the Nigerian Stock Exchange (NSE).(Aziz, 2020) study the asymmetrical effect of the rupiah exchange rate on the stock prices of the banking sector on the Indonesian stock exchange using the Non-Linear Autregressive Distributed Lag (NARDL) method. (Dada, 2022) examines the as impact of real exchange rates on the economic expansion of 20 African nations from 2005 to 2019. (Osman et al., 2019) examines inflation in Saudi Arabia from 1980-2018 using the Auto Regressive Distributed Lag (ARDL) model. inflation, broad money supply, the stock price index, the real GDP, the oil prices, and the world inflation rate was included. Results show that inflation is positively influenced by broad money supply, oil prices, and real GDP, while negatively by the stock price index. The world inflation rate has a significant positive effect in the long run, but not in the short run. The impulse response functions and the variance decomposition analysis test were employed; the findings showed that inflation in Saudi Arabia, in the long run, is mostly determined by broad money supply and the world inflation rate. (Kirikkaleli et al., 2021) investigates the influences of the exchange rate, gold price, and the BIST100 Borsa Istanbul Index on the price of real estate shares on the Turkish stock market using monthly data from 2004 to 2016. investigates the relationship between domestic macroeconomic forces and the Indian equity market using monthly observations from 2012 to 2019. Results show cointegration between the market and macroeconomic forces, with significant long-run coefficients of foreign exchange rate and money supply. Short-run coefficients reveal money supply, inflation, and foreign exchange rate significantly influencing the market (Bhattacharjee and Das, 2021). explores the correlation between the stock market and exchange rate in South Africa from 1980 to 2020 using the Autoregressive Distributed Lag (ARDL) model. Results show a long-term negative relationship between interest rates, exchange rate movement, and inflation. The study suggests that exchange rate innovations impact stock market behavior, potentially influencing policy decisions and allowing investors and portfolio managers to hedge against risk and predict future market movements (Javangwe and Takawira, 2022). The research listed above primarily are literature about linear relationship. However, it is also crucial to include non linear relationship between variables . as in several recent studies that focused on asymmetric impact of exchange rates on stock prices. Investigating dollar value and U.S. sectoral stock indices' asymmetric cointegration (Bahmani-Oskooee and Saha, 2016) show that although the effects are primarily short-term, exchange rate movements have asymmetric effects on stock prices. The Nonlinear ARDL approach to cointegration and error-correction modeling was integrated with the monthly data from Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. Using data from the United States, recent study on the asymmetric effects of exchange rate changes on the S & P 500 index showed that these effects are asymmetric in the short run but not in the long term. (Bahmani-Oskooee and Saha, 2016) reveals that exchange rate changes have asymmetric effects on stock prices, mainly in the short-run, despite previous research assuming symmetric effects. Using monthly data from Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. The study uses the nonlinear ARDL technique to cointegration and error-correction modeling after introducing nonlinearity into the adjustment process. (Bahmani-Oskooee and Saha, 2018) demonstrates that the relationship between stock prices and exchange rates may be asymmetric, and that the introduction of nonlinearity supports asymmetric cointegration more strongly than symmetric cointegration. The study uses monthly time-series data from 24 countries and the nonlinear ARDL method.(Cheah et al., 2017) examines the relationship between stock prices and currency rates in Malaysia. According to the estimated NARDL models, changes in the exchange rate have a sizable short and long term impact on Malaysian stock prices, and the stock market reacts asymmetrically to currency appreciation and depreciation. In other words, over time, KLCI fluctuations solely reflect RM depreciation and not RM appreciation. explores asymmetric impact of exchange rate changes on stock prices in Vietnam. applying nonlinear autoregressive distributed lag analysis on time series data from January 2001 to May 2018. (Habibi and Lee, 2019) claims that exchange rates can affect stock prices asymmetrically. results shows that , exchange rates and stock prices have asymmetric effects both in the short run and long run. The study has significant implications for Vietnam's regulators in managing the stock and foreign exchange markets (Dang et al., 2020). (Wong, 2022) The study focuses at how real exchange rates, particularly asymmetric real exchange rates, affect real stock prices in Malaysia, the Philippines, Singapore, Korea, Japan, the UK (UK), Germany, Hong Kong, and Indonesia. The asymmetric ARDL approach discovers more economic factors to be statistically significant than the ARDL approach.

III. RESEARCH METHODS

The selection of variables was influenced by (Bahmani-Oskooee and Saha, 2015)， where a multivariate model was used to prevent the bias caused by omitted factors. Four variables from Indonesian monthly data are used in this study. monthly time series data from January 2022 to December 2022. All data are obtained from Bank Indonesia , except that stock prices are obtained from Yahoo Finance and all series are expressed in natural logarithms. We choose IDX market index, as a proxy for

Indonesia stock market index. IDX Composite is an index of all company or stocks listed in Indonesia Stock Exchange to cover all industries of Indonesia's economy. The study uses the US/IDR Middle rate to represent foreign currency exchange rate. A increase in the real exchange rate's value denotes a decline in the value of the domestic currency, while a decline in its value denotes an appreciation of the domestic currency. inflation measure an overall rise/fall in average prices rather than a particular increase/decrease in the price per unit of a particular good or service. Broad money supply M2 is indicator used to measure monetary policy. The Indonesia Stock Exchanges Stock Prices denoted by SP, EX is the symbol for exchange rate , Inflation denoted as INFL and money supply denoted as M2.

ARDL Model

There are numerous techniques that can be used for examining cointegration relations for variables. The multivariate cointegration technique developed by (Johansen and Juselius, 1990) and two-step (Granger and Engle, 1987) procedure are two frequently used among the often employed techniques. This method, which was developed by (Pesaran and Pesaran, 1997) also reffered as bounds cointegration technique . Some developments are carried by (Pesaran and Shin, 2001). The reasons ARDL model is chosen in this study over other options. the Engle Granger technique is only applicable in the situation of bivariate analysis, so it's not applicable since we have more variables. The Johansen Juselius method is multivariate structure designed, However it require all variables to be integrated in the same order. When employing the ARDL model, this criterion is not necessary because the ARDL model can be estimated if each variable is integrated at an order lower than two (Cheah et al., 2017) .The tests were conducted only to make sure that there is no variables stationary at I(2) . ARDL applicable for smaller sample sizes (Ghatak and Siddiki, 2001) , by applying ARDL the short and long run effects of independent variables on explanatory variables can be solved in a single equation without solving multiple simultaneous equations (Bentzen and Engsted, 2001) . Existing research divided into two groups. The first is a bivariate model , only stock price and the exchange rate is included in the studies. and the multivariate model, where supplementary variable are included . multivariable model application is to prevent inaccurate estimation from ommited variables as in the bivariate model (Bahmani-Oskooee and Saha, 2015) . In order to determine asymmetry impact of stock prices on exchange rate in Indonesia. We use the revised multivariate model, widely employed in prior research (Moore and Wang, 2014) , (Boonyanam, 2014),(Bahmani-Oskooee and Saha, 2016, 2015) and others to take additional factors' impacts into consideration as follows:

$$SP_t = \beta_0 + \beta_1 \mathrm{EX} + \beta_2 \mathrm{INFL} + \beta_3 \mathrm{M2} + \varepsilon_t \qquad (1)$$

Where β_0 is the constant term , SP denotes Indonesia's stock prices index. EX is exchange rate , INFL as inflation measurement, M2 is a measure of the broad money supply and ε_t is the error term. all the variables are in natural logarithms. The coefficient of β_1 is the constant term might be positive or negative according to the exchange rate-driven model of the exchange rate, depending on whether the decline in the value of the domestic currency results in higher export revenues or higher production costs (Dang et al., 2020).

According to (Pesaran and Shin, 2001) If we rewrite Equation (1) and (2) in an error-correction model form, we can also infer both the short-run and long-run effects. standard linear ARDL error-correction model can be represented in the following ways, respectively:

$$\begin{aligned}\Delta \mathrm{SP}_t &= \delta_0 + \delta_1 \mathrm{SP}_{t-1} + \delta_2 \mathrm{EX}_{t-1} + \delta_3 \mathrm{INFL}_{t-1} + \delta_4 \mathrm{M2}_{t-1} \\ &+ \sum_{i=1}^{p} \lambda_i' \Delta \mathrm{SP}_{t-i} + \sum_{i=0}^{q} \lambda_i' \Delta \mathrm{EX}_{t-i} + \sum_{i=0}^{r} \lambda_i' \Delta \mathrm{INFL}_{t-i} \qquad (2) \\ &+ \sum_{i=0}^{s} \lambda_{i_i}' \Delta \mathrm{M2}_{t-i} + \mu_t,\end{aligned}$$

Δ represents the first difference operator of the variables, δ_0 represents constant, μ implies the iid process, δ_n and λ_p represents short and longrun coefficients. The test involves computing the F-statistic which is compared against the lower bound and upper bound tested in order to determine whether a long-term relationship exists. The following is cointegration model null hypotheses H0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ and alternative hypothesis H1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$. if the calculated F statistics value is greater than the upper bound value, means there is cointegration exist . in the other hand, if the calculated F statistics value is less than the lower bound value means there is no cointegration lastly, When the F statistics value is in between the lower and upper bounds, the decision is inconclusive, and the integration order should be reexamined.

Symmetric and Asymmetric Effects of Exchange Rate on Indonesia Stock Prices

NARDL Model

The standard ARDL model and other approaches that assume symmetric dynamics only assumes linear or symmetric relationships. and are unable to fully capture for any potential nonlinearity or asymmetry that may exist in the link between stock prices and exchange rate changes. Therefore , this work applying the NARDL technique. NARDL model applied to investigate whether there is asymmetric impact of volatility and exchange rates on stock prices .The NARDL model is intended to preserve all advantages of the standard ARDL technique while capturing both short run and long run asymmetries in an interest variable. The NARDL model is modificated from standard linear ARDL model , an asymmetric expansion from model proposed by (Pesaran and Shin, 2001). Following previous study (Bahmani-Oskooee and Saha, 2016, 2015). We evaluate the symmetric versus asymmetric effects of exchange rate changes and compare the effects of depreciations and appreciations to see if they have the same sign and size. We divide the movement of the EX_t into positive and negative. where EX_i^+ and EX_i^- are partial sum processes of positive and negative changes in EX_t . EX_i^+ for the partial sum of positive changes in EX_t (currency appreciations), and EX_i^- for the partial sum of negative changes in EX_t (currency depreciations). As was previously said, an exchange rate appreciation may have a different effect on stock prices than an exchange depreciation. EX_t decomposed into $EX_t = EX_0 + EX_i^+ + EX_i^-$, More specifically:

$$EX_t^+ = \sum_{j=1}^{t} \Delta EX_i^+ = \sum_{j=1}^{t} \max(\Delta EX_i, 0), \quad (3)$$
$$EX_t^- = \sum_{j=1}^{t} \Delta EX_i^- = \sum_{j=1}^{t} \min(\Delta e EX_i, 0), \quad (4)$$

The two new constructs of variables EX_i^+ and EX_i^- transform the linear model into a nonlinear model. by combining equations (3) and (4) with equation (1), we get the nonlinear long-run equation (5):

$$SP_t = \beta_0 + \beta_1^+ EX_t^+ + \beta_1^- EX_t^- + \beta_2 INFL_t + \beta_3 M2_t + \varepsilon_t, \quad (5)$$

Returning to error-correction Model (2) , the next step is to replace EX_t by EX_t^+ and EX_t^- variables as shown in Equation (6). And NARDL error correction model , as follows:

$$\begin{aligned}\Delta SP_t &= \delta_0 + \delta_1 SP_{t-1} + \delta_2^+ EX_{t-1}^+ + \delta_2^- EX_{t-1}^- + \delta_3 INFL_{t-1} \\ &+ \delta_4 M2_{t-1} + \sum_{i=1}^{p} \lambda_i' \Delta SP_{t-i} \\ &+ \sum_{i=0}^{q} \left(\theta_i^{+\prime} \Delta EX_{t-i}^+ + \theta_i^{-} \Delta EX_{t-i}^-\right) + \sum_{i=0}^{r} \gamma_i' \Delta INFL_{t-i} \quad (6) \\ &+ \sum_{i=0}^{s} \vartheta_i' \Delta M2_{t-i} + \mu_t,\end{aligned}$$

Once Equation (6) is estimated, each component of the exchange rate's long-term estimates are $\beta^+ = -\delta_2^+ / \delta_1$ for the price appreciation, and $\beta^- = -\delta_2^- / \delta_1$ for the price depreciation. The short-term estimates of price increases and discounts are denoted by $\theta_i^{+\prime}$ and $\theta_i^{-\prime}$, respectively. Now that we have equation (3), we can examine whether changes in the exchange rate have asymmetric impacts on stock prices both in the short and long terms. The ARDL method of (Pesaran and Shin, 2001) was proven by (Shin et al., 2014) to be applicable to the nonlinear model in equation (6), Accordingly, (Pesaran and Shin, 2001) standard F-test cointegration may also be applicable to evaluate long-term asymmetric relationships between variables. The null hypothesis is H0: $\delta_1 = \delta_2^+ = \delta_2^- = \delta_3 = \delta_4 = 0$. and alternative hypothesis H1: $\delta_1 \neq \delta_2^+ \neq \delta_2^- \neq \delta_3 \neq \delta_4 \neq 0$. We can infer that there is a long-term relationship between stock price and the macroeconomic variables if the F-statistics is higher than the upper bound.

IV. RESULT AND DISCUSSION

Descriptive Statistics

In this section we examines the data distribution using mean, median and standard deviation. The results are shown in Table 1 and Figure 1 presented variables trends . SP had a wide range between its maximum value of 8.885844 and its minimum value of 5.962146. The difference between EX highest and minimum values, 9.6720 and 9.0154 is not particularly noticeable.

Gap is more obvious between the INFL maximum -1.693907 and minimum values -4.327538. M2 maximum value of 15.9588 and its minimum value of 13.68047 difference is not particularly wide.

Table 1: Descriptive Statistics

	SP	EX	INFL	M2
Mean	8.042578	9.317610	-3.018337	14.87966
Median	8.358986	9.241093	-2.979876	15.00171
Maximum	8.885844	9.672024	-1.693907	15.95887
Minimum	5.962146	9.015426	-4.327538	13.68047
Std. Dev.	0.751877	0.205354	0.564001	0.690194

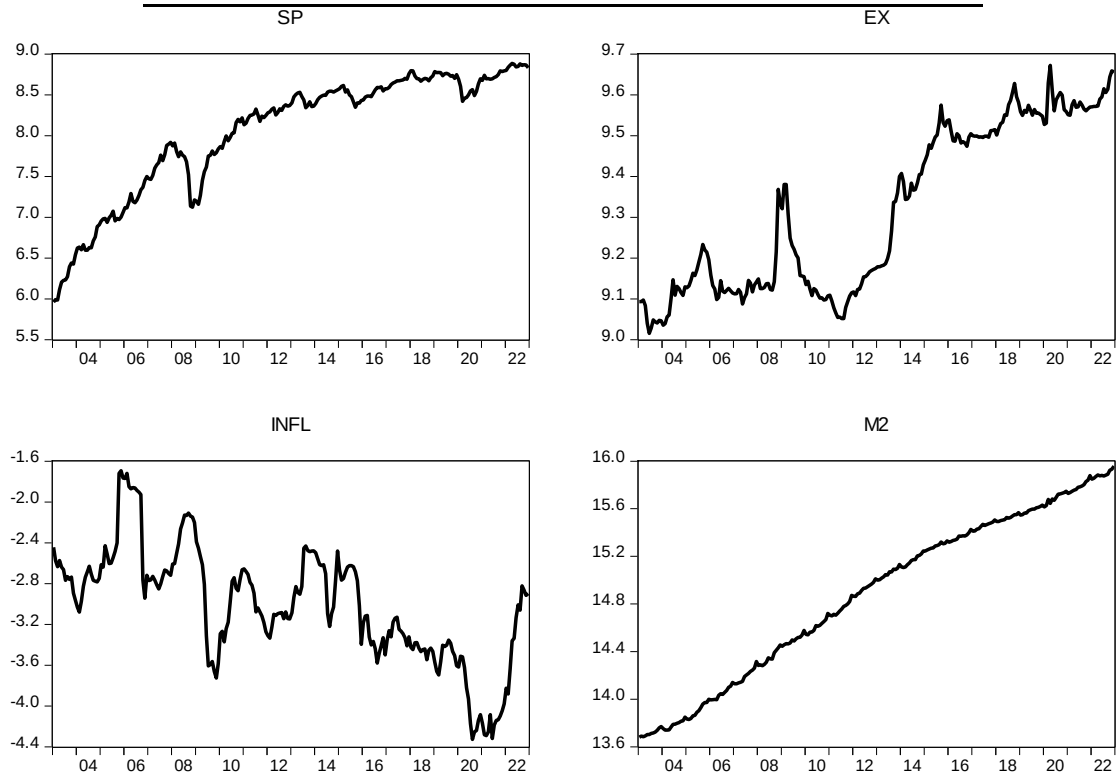

Figure 1: Variables Trends

Unit Root Test

Table 2: Unit Root Test Results

Variable	Level		First Difference	
	ADF	PP	ADF	PP
SP	-2.824268	-2.762088	-12.50596***	-12.56779***
EX	-2.548913	-2.481532	-7.954266***	-11.92101***
INFL	-3.202301*	-2.990759	-6.744614***	-11.78201***
M2	-0.961577	-0.762052	-3.737435**	-19.82389***

*,**,*** represent null rejection at 10% , 5% and 1% level of significant

Despite the fact that the ARDL and NARDL enables estimate of a cointegrating vector with both I(1) , I(0) series or even combination , it is still critical to figure out the chance that any of the series are I(2). To figure out whether the variables are stationary, we carried out two unit root tests including the ADF and PP test.The results of the ADF test suggest that only INFL is stationary at level, and all other variables are integrated of order 1 or I(1). while , PP test suggest that all variables are stationary in first difference. It is clear from the results of the ADF and PP unit root tests that none of the variables stationary at I(2). So now we may apply the bounds tests procedure.

Symmetric and Asymmetric Effects of Exchange Rate on Indonesia Stock Prices

Cointegration Test Results

Table 3: Cointegration Test Results

Model	F-statistic	Level of Significant	I(0)	I(1)	Conclusion
ARDL	17.18765 (k=3)***	1%	3.65	4.66	Accepted
		5%	2.79	3.67	
		10%	2.37	3.2	
NARDL	15.45254(k=4)***	1%	3.29	4.37	Accepted
		5%	2.56	3.49	
		10%	2.2	3.09	

After testing for stationarity we are going to perform both ARDL and NARDL. But before that we will choose optimum lag for the study and apply cointegration bound tests. Optimum lag is selected for further analysis, this study using the AIC for selecting the optimum number of lag. and the outcomes of lag selection shows that AIC recommend lag 2 as optimum. Equations (2) for the symmetric cointegration test and (6) for asymmetric. the bound test approach by (Pesaran and Shin, 2001) can be used to determine whether there is a short and long-term relationship between the price of a stock and its influencing factors. If the F-statistics is greater than the upper bound critical values (Pesaran et al., 2001), We may assume that the stock price and the factors have a long-term relationship (Cheah et al., 2017). Based on the bound test cointegration in both ARDL and NARDL model. ARDL model F-statistic results is known to be 17.18765. The critical area in this test is indicated by an upper bound limit of 4.66 and a lower bound limit of 3.65. which is above the upper bound, I(1) and is greater than the critical values at all levels of significant. NARDL model F-statistic is 15.45254. upper bound limit of 4.37 and lower bound limit of 3.29. Based on the decision rules, it is known that the F-statistic value is greater than the upper bound in all level of significant. so it is concluded that both of the model has cointegration or there is a long-term relationship.

ARDL Short Run Estimation Results

Table 4: Short Run Coefficients using the ARDL

Variable	Coefficient	Std. Error	t-statistic	p-value
ΔSP_{t-1}	-0.083271	0.071673	-1.161.812	0.2465
ΔER_t	-1.235.202***	0.137053	-9.012.579	0.0000
ΔER_{t-1}	0.223921*	0.131278	1.705.706	0.0894
$\Delta INFL_t$	-0.039442*	0.020880	-1.888.944	0.0602
$\Delta INFL_{t-1}$	-0.017056	0.021187	-0.805016	0.4217
$\Delta M2_t$	-0.074055	0.176613	-0.419305	0.6754
$\Delta M2_{t-1}$	0.045355	0.178305	0.254370	0.7994
ECT_{t-1}	-0.906046***	0.096879	-9.352.329	0.0000

*,**,*** represent null rejection at 10% , 5% and 1% level of significant

Short-run of the linear ARDL model to see if stock prices are influenced in short-run. First of all , the exchange rate has an impact on the stock prices in the Indonesia Stock Market, Both the first and second lag's coefficients are significant. But still unable to confirm the direction of the exchange rate effect on stock prices in the short run due to the contradictory indications exchange rate effect on the stock prices in the short run. The effect of inflation negative statistically significant only in the lag 0. This implies that an increase in inflation will push down the stock prices in the short run. the result shows that Broad money is insignificant, means that Money Supply may not affect the stock prices in short run. the ECM results when the dependent variable is SP. The coefficient of the ECM is negative significant (-0.906046) and statistically significant at 1 percent since the P-value is 0.0000. Since the coefficient of the ECM is negative it shows convergent correction mechanism for deviations from the long-term equilibrium of the estimated model.

ARDL Long Run Estimation Results

Table 5: Long Run Coefficients using the ARDL

Variable	Coefficient	Std. Error	t-statistic	p-value
ER	-1.039653***	0.293504	-3.542215	0.0005
INFL	-0.075966*	0.041951	-1.810826	0.0715

M2	-0.319182	0.560243	-0.569721	0.5694
C	0.017350***	0.006204	2.796596	0.0056

*,**,*** represent null rejection at 10% , 5% and 1% level of significant

The result of the long-run relationship between stock prices, exchange rate, inflation and money supply in Table 5 shows that the coefficient of exchange rates and inflation have negative significant impact on stock prices. since exchange rates and inflations p-value are less than 0.05.This means that exchange rates and inflation have a significant long-run effect on stock prices. In line with (Bhattacharjee and Das, 2021) results that indicated , negative relationship among exchange rates and stock prices indicates that as the value of the local currency declines relative to others , the stock market will drop. Due to the firms' reliance on imports, there is a bad correlation between foreign exchange rates and domestic stock markets. Imports become more expensive as local currency weakens. Imports that are more expensive have a negative impact on the company's profit, which lowers investor expectations for dividends and deters investors from buying the company's stock. Higher goods price caused by inflation hikes tend to slow down operations and lower firm profits (Khan, 2019). Not the case for money supply, its p-value more than 0.05, means there is not significant long-run effect on stock prices.

ARDL Diagnostic Tests Results

Table 6: ARDL Diagnostic Test Results

Diagnosis test	test statistic	p-value
Normality test	438.9474***	0.0000
Serial Correlation LM Test	0.235642	0.7903
Heteroscedasticity Test	35.89177***	0.0002
Ramsey RESET Test	0.747290	0.4557

Note:
*,**,*** represent null rejection at 10% , 5% and 1% level of significant
Normality test , Ho: Residuals are normally distributed. Serial Correlation LM Test, Ho: No serial correlation. Heteroscedasticity Test, Ho: Residuals are homoscedastic. Ramsey RESET Test, Ho: The functional form of the model is correct.

The study applied some tests to determine whether the regression model is appropriate. Residual diagnostic tests including Jarque-Bera normality test, LM serial correlation test, Heteroscedasticity test and Ramsey RESET test . Normality Jarque-Berra test less than 0.05, means residuals are not normally distributed. According to the results represented above by table 4.9, we can't reject the null hypothesis and thus we accept it and conclude that no serial correlation. This is based on the LM test P-value (0.7903) which is greater than 0.05. Based on results above it can be concluded that error term suffer from heteroskedasticity because the P-value is 0.0002 which is less than 0.05 at 5 percent significance level. Then, Ramsey RESET probability is 0.4557 which is greater than 0.05, fail to reject null hypothesis, means model is correctly specified. shows that the linear model violates two assumptions including heteroskedasticity and normal distribution.

NARDL Short Run Estimation Results

Table 7: Short Run Coefficients using the NARDL

Variable	Coefficient	Std. Error	t-statistic	p-value
ΔSP_{t-1}	-0.023810	0.074149	-0.321112	0.7484
ΔEX_t^+	-1.545140***	0.222252	-6.952190	0.0000
ΔEX_{t-1}^+	0.719855**	0.245770	2.928983	0.0038
ΔEX_t^-	-0.951015***	0.197831	-4.807200	0.0000
ΔEX_{t-1}^-	0.018279	0.165658	0.110340	0.9122
$\Delta INFL_t$	-0.037953*	0.020539	-1.847840	0.0660
$\Delta INFL_{t-1}$	-0.015263	0.020831	-0.732692	0.4645
$\Delta M2_t$	-0.088482	0.172910	-0.511722	0.6094
$\Delta M2_{t-1}$	0.009481	0.176817	0.053623	0.9573
ECT_{t-1}	-0.984552***	0.101112	-9.737191	0.0000

*,**,*** represent null rejection at 10% , 5% and 1% level of significant

Symmetric and Asymmetric Effects of Exchange Rate on Indonesia Stock Prices

In this section, we derive from the short-run regression results similar with ARDL. Instead, in the linear model there are three exogenous variables. the model now has four exogenous variables after we devided exchange rate movements into positive components (representing currency appreciation) and negative compositions (representing currency depreciation). stock prices are impacted by changes in exchange rates in the short term, similar to results predicted by linear model. dividing variables into two, Positive and negative components. one another are statistically significant, with the exception of the negative component exchange rate at the first lag is insignificant. The sign of the coefficients is still inconsistent, just like in the ARDL model estimation. As a result, we were unable to verify whether the direction（appreciation/depreciation) of the exchange rate effect on the stock prices in the short run. Similar with the ARDL, the NARDL results also show negatively significant short-run relationship between inflation and stock prices in lag 0 and again there isn't any relationship between money supply M2 and stock prices in short run. The term ECT is statistically negative and highly significant (-0.984552) at 1% level. This confirms the presence of long-run causal relationship between dependent and independent variables. This coefficient indicates that after the system shock, about 98.4552% deviation is corrected within a month. This shows the volatility of the stock market in a way.

NARDL Long Run Estimation Results

Table 8: Long Run Coefficients using the NARDL

Variable	Coefficient	Std. Error	t-statistic	p-value
ΔEX^+	-1.073933***	0.275054	-3.904.452	0.0001
ΔEX^-	-1.061898***	0.275569	-3.853.481	0.0002
INFL	-0.062042	0.039664	-1.564.188	0.1192
M2	-0.376237	0.511835	-0.735076	0.4631
C	0.030702***	0.009876	3.108.644	0.0021

*,**,*** represent null rejection at 10% , 5% and 1% level of significant

Since the symmetric ARDL model cannot separate between both positive and negative components of exchange rate changes, we extend our analysis to the asymmetric ARDL model to explain if there are possible long and short-run asymmetric effects of exchange rate changes on stock prices. The long-run coefficient of the Inflation and Broad money supply is statistically insignificant in exerting influence on stock prices. This suggests that the exchange rate does not increase stock prices performance in the long run. The signs and sizes of the coefficient of ΔEX+ and ΔEX− show how positive and negative changes exchange rate would impact on stock prices in Indonesia. Considering the sign of the coefficients, the long-run estimates show that positive and negative shock in exchange rates have a negative coefficients that are significant at 1% level. nonlinear autoregressive distributed lag model results when whole sample period is selected. positive and negative shocks to exchange rates have an asymmetrical effect on stock prices in long run. the sizes of the long-run coefficients of ΔEX+ and ΔEX− are -1.073933 and -1.061898, respectively. These estimates show that a 1% increase in exchange rates increases,decreasing Indonesia stock prices by an average of 1.074% in the long run. Similarly, 1% decrease in exchange rates decreases stock market performance by an average 1.062 in the long run. Comparatively, the impact of negative shocks in the influence of exchange rates on stock prices in Indonesia. Both positive and negative shocks to exchange rates cause depreciation in stock prices

NARDL Diagnostic Tests Results

Table 9: NARDL Diagnostic Test Results

Diagnosis test	test statistic	p-value
Normality test	580.4966***	0.0000
Serial Correlation LM Test	0.178719***	0.8365
Heteroscedasticity Test	41.14504	0.0002
Ramsey RESET Test	0.833397	0.4055

Note:
*,**,*** represent null rejection at 10% , 5% and 1% level of significant
Normality test (Jarque–Bera), Ho: Residuals are normally distributed.
Breusch–Godfrey Serial Correlation LM Test, Ho: No serial correlation.
Heteroscedasticity Test, Ho: Residuals are homoscedastic.
Ramsey RESET Test, Ho: The functional form of the model is correct.

At last we conduct diagnostic tests for the nonlinear model. Similar results as linear model. Residual diagnostic tests including Jarque-Bera normality test, LM serial correlation test, Heteroscedasticity test and Ramsey RESET test. Normality Jarque-Berra test less than 0.05, means residuals are not normally distributed. According to the results represented above by table 9, we can't reject the null hypothesis and thus we accept it and conclude that no serial correlation. This is based on the LM test P-value (0.8365) which is greater than 0.05. Based on results above it can be concluded that error term suffer from heteroskedasticity because the P-value is 0.0002 which is less than 0.05 at 5 percent significance level. Then, Ramsey RESET probability is 0.4055 which is greater than 0.05, fail to reject null hypothesis, means model is correctly specified. shows that the nonlinear model also violates two assumptions including heteroskedasticity and normal distribution.

V. CONCLUSION

Analyzing the impacts of exchange rate shocks on stock prices, has been conducted by the linear autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) approaches. Using Indonesia monthly data in the period of January 2022 to December 2022. including stock price index, exchange rate, inflation, and broad money supply, For both symmetrical and asymmetrical models, we estimate and compare the empirical findings. We conduct ADF and PP test for stationarity, and have found are stationary at first difference, only inflation stationary at both level and first difference when testing for ADF. Cointegration test was applied and found a long-run equilibrium for both ARDL and NARDL.The Empirical results shows that there is a short-run and long-run symmetric effect in relationship between exchange rate and the stock price, when applying ARDL model. exchange rates have negative significant impact on stock prices. We confirmed that exchange rate also have both short and long term asymmetric effects on stock prices when applying NARDL. Long-term stock prices are negatively impacted by changes in exchange rates. signifies that exchange rates fluctuations affecting investors' confidence to invest in the market. inflation have negative effects on stock prices in the short run and long run even when using linear and nonlinear analysis. Meanwhile, in the long run inflation only affects stock prices in the linear model. Consumer purchasing power may decline as a result of high inflation decreasing consumer purchasing power. Firms that depend substantially on consumer spending may see their revenues and profitability decline. These circumstances could cause uncertainty, make investors lose confidence and lower the stock prices. This factor might have an unfavorable impact on stock prices. However, none of the results for the money supply indicate that it has an impact on stock prices in both short- and long-terms, or in linear or nonlinear analysis. The findings of this study might be practical for policymakers and investors in the economy. Future research will be required to compare the results of additional nations, factors and different time periods. ARDL and NARDL implementation is done with the goal of obtaining a more diverse viewpoint on the favorable and unfavorable effects of stock price variations.

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