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Revisiting the J-Curve of Indonesia-China Bilateral Trade

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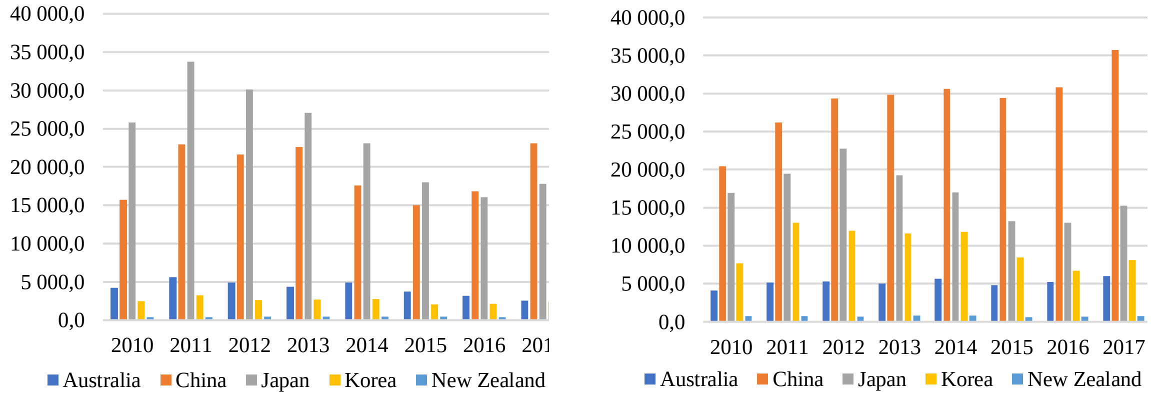
Abstract: *The phenomenon known as the J-curve paradox has predominantly been investigated concerning the cumulative commerce volume between certain nations. Most studies assume that the exchange rate affects the dynamics of aggregate trade balance symmetrically. This paper aims to address the existing vacuum in empirical research by reexamining the phenomenon known as the J-curve and doing an analysis of the impact of the Indonesian Rupiah in relation to the Chinese Yuan on the bilateral trade balance between Indonesia and China, whether symmetric or asymmetric. We employ nonlinear autoregressive distributed lag (ARDL) and its partial sum concept to analyze quarterly data from 2002: I to 2017: IV. The finding reveals that linearly, the short-run supports the evidence of the J-curve. However, the long-run analysis rejects it. On the contrary, the utilization of a nonlinear technique offers substantiation in the study of long-term outcomes, but it lacks support in the analysis of short-term effects. Based on our findings, it is determined that our study does not discover the existence of the J-curve paradox in bilateral commerce between Indonesia and China.*

Keywords: *ARDL; Bilateral trade; China; Exchange rate; J-Curve paradox; Indonesia*

1. Background

During the last decade, 2008-2017, Indonesia witnessed no visible improvement in the trade balances towards China. This phenomenon was similar to the Indonesian Rupiah (IDR), which dramatically depreciated on the Chinese Yuan (CNY) in 206-2007. Figure 1 shows that Japan has been the first export destination country for Indonesia. However, it was replaced by China in 2016. The value of exports from Indonesia to China increased from USD 15,692.6 million in 2010 to USD 16,790.8 million in 2016. It surpassed the exports from Indonesia to Japan and therefore noted that Australia, Korea, and New Zealand were the traditional markets for Indonesia in the last ten years. The flow of goods and services has significantly increased, especially after the implementation of ACFTA (Anindyntha, 2023; Hussain et al., 2023; Purna & Kamara, 2021; Suripto et al., 2023). Since 2015, the value of imports to Indonesia has been dominated by China, with more than 20%. The value of goods and services imported from China, around USD 20,424.2 million in 2010, increased to USD 35,766.8 million in 2017. However, in the last ten years, the Indonesian Statistical Bureau noted that Indonesia faces a trade deficit of around USD 12,683.7 million with China at the end of 2017.



(a) (b)

Figure 1. Value of Bilateral Export (a) and Import (b) of Indonesia Based on Share of Trading Partner Countries, (Source: Indonesian Statistical Bureau, Accessed: June 2019).

Depreciation of a currency is associated with the surplus of trade balance through increasing exports and decreasing imports (Chiu & Ren, 2019; Shabani & Shahnazi, 2018). However, the result of Chiu & Ren (2019) the direct causal cointegration between the net export of Indonesia and China and the exchange rate between them has not been empirically established. We Follow the explanation of Bahmani-Oskooee & Fariditavana (2016) that the deterioration of the net export following the depreciation of currency based on the lag of period in the cointegration relationship between currency values and international trade imbalance will lead to a J-curve hypothesis.

Exchange rate forecasts are more negative at shorter lags and more positive at longer delays, forming a J-curve. The development in the interpretation of the J-curve has continued (Bahmani-Oskooee & Saha, 2017). A bulk of studies examined the link involving currency unit and net export, also known as which focuses on whether depreciation improves trade ratio in the long term and if it influences the trade account in the short term. Wang et al. (2012) find a real appreciation of the Chinese Yuan decrease China's trade balance between the three trading partners, while the other five partners are increasing in the long run. Moreover, Jamilov (2013) explains that evidence of diminishing the term of trade ratio follows the depreciation of the currency unit in the long run. However, this explanation is predicated on the limiting assumption that changes in the value of a currency's appreciation or depreciation have a linear effect on the dynamics of a country's trade balance. A single estimate of the currency value and the net export elasticity defines this assumption.

Bahmani-Oskooee et al. (2018) briefly explain a weakness of symmetry assumption, which can hide the natural link between blateral trade balance, currency rate, and other macroeconomic variables. Moreover, it would generate an unreliable forecast. Asymmetrically, Nusair (2013) explains that the J-curve is something that can be understood when there is a reduction in the price of currency that is accompanied by a growth in the trade surplus in the longer term and a fall in the commercial imbalance in the immediate aftermath. Empirically, Delatte & López-Villavicencio (2012) find a piece of evidence that currency depreciation passes through the price in the model of nominal currency theory according to the two directions of partial sums. Moreover, Nusair (2013) witnessed the J-curve paradox by finding that the appreciation variable improved short-term improvement in the net export while having a negative impact in the future. Thus, we expect that the volatility of the currency affects the net export asymmetrically.

According to the phenomena of China-Indonesia bilateral commerce and their currency movements, we follow Bahmani-Oskooee & Fariditavana (2015), who looked at a linear relationship and a nonlinear trade surplus or shortage and currency connection using autoregressive distributed lag (ARDL), found no significant differences. We render support for the asymmetry based on the aggregation bias of their study that used aggregate trading value data between China and its commercial fellows. The implementation of macro data to represent trade balance in this case study will assume that we apply the commercial trading dynamic between Indonesia and all of the counterparties. Thus, we used bilateral trade data between China and Indonesia to improve the reserach and avoid the limitation of aggregate data. Bahmani-Oskooee et al. (2018) explained that using bilateral trade data in the case of a trading partner could reduce the possibility of bias and be more effective. Besides, implementing the bilateral data level is essential to recommend policies and obtain a deeper understanding of the occupancy of the J-curve paradox.

The purpose of this research is to administer both the symmetric and asymmetric ARDL scheme to the link between Indonesia and China's international trading correspondence and the currency between them. We present such an examination by breaking the aggregate trade between Indonesia and China. We also address weaknesses and missing cointegration in Bahmani-Oskooee Fariditavana (2015). Besides, previous studies see Delatte & López-Villavicencio (2012); Nusair (2013) employed aggregate data on trade between countries sample that may decrease the cointegration. Therefore, we use bilateral trade data between Indonesia and China.

Moreover, comparing the similar case of Indonesia and China's bilateral trade, the study of Chiu & Ren (2019) employed GMM to find cointegration between international trading correspondence and the currency between them. However, we employed ARDL to extend the nonlinear ARDL. Our result shows a rejection of the J-curve paradox in the bilateral net export of Indonesia and China both linearly and nonlinearly. At last, we summarize this part and set the stage for the following one, the scholarly survey. The analytical procedure is presented in Section 3. In Section 4, we offer the scientific finding and discuss about them. In the fifth part, we sum up the findings.

2. Literature Review

Since countries are changing, we have a better understanding of the connection between the value of currencies and the trade surplus or deficit. The limitation of the assumptions of the linear adjustment process will become less implemented. Wang et al. (2012b) spilled that the strengthening of the RMB has an unfavorable impact on Chinese's trade account in the course of time, according to a test of the short- and long-term J-curve determined by the influence of the exchange rate of China and 18 major trading nations on its trade position. Their finding supports the presence of the J-curve paradox of Chinese economy and its trading associates. Jamilov (2013) used the Johansen approach to estimates linked and error correction model to proof of the J-curve between Azerbaijan and European countries. He explains that the Azerbaijani Manat has been shown to have a short-term unfavorable impact on the country's trade position, but in the long term, it has been found to have a positive effect. However, the studies improved these phenomena in implementing the nonlinear adjustment process.

Delatte & López-Villavicencio (2012) estimate the impact of currency's volatility on the consumer prices index (CPI), whether linear or nonlinear. They applied symmetric and asymmetric ARDL framework to estimate quarterly data from 1980.I to 2009.III for selected important full-grown economies such as Germany, Japan, the UK, and the US. The discovery reveals that the depreciation of the Chinese Yuan enhances the international commerce position between China and its trading partner. Besides, China's economic growth positively affects its trade balance.

Bahmani-Oskooee and Fariditavana (2015) analyzed the amount of trade simulation for Canada, China, Japan, and the USA was estimated utilizing cumulative import and export statistics. Their method is based on the symmetric and asymmetric ARDL to carry out quarterly data from 1973.I to 2014.II. All of the independent variables (exchange rate, Canadian GDP, and the world's GDP) significantly affect Canada's trade balance. Implementing the nonlinear effect reveals that an appreciation of the Canadian's currency decreases the net export in the long run. Nonetheless, the depreciation variable no impact. The case of China demonstrates a less significant effect than for Japan. Their argument of the USA provides a discovery of J-curve, especially in the nonlinear model. The using of aggregate trade in the model will suffer from aggregation bias. Thus, they suggest that bilateral trade balance is more beneficial for the future estimation of the J-curve paradox.

Nusair (2013) estimated the paradox of the J-curve for 16 European countries by comparing the result between the symmetric and asymmetric manner of ARDL. The study regards the examination of Bahmani-Oskooee and Fariditavana (2015, 2016), which used an empirical method of Shin et al. (2011). He revealed that there needed to be more hold for the J-curve analysis caused by the symmetricity assumption. The result shows that the ARDL model cannot produce an affirmative and significant impact of the currency's volatility on the net export, except for Russia and Ukraine. However, these two countries still need to prove the discovery of a J-curve. Contradictorily, the asymmetric ARDL model can find the discovery of a J-curve in 12 of the 16 economies he compared. Thus, he highly suggests implementing the asymmetric model to estimate the J-curve paradox.

Bahmani-Oskooee et al. (2018) studied the currency's volatility and net export relationship between China and 21 trading partner countries. They estimate quarterly data from 2000.I to 2015.IV used linear and nonlinear ARDL models. They linearly find a shred of evidence for their case of France, Germany, Italy, Mexico, Russia, Spain, and the US, in which the observed variable of the conversion currency demonstrates a favorable and statistically substantial connection, which means the decrease in currency value affects the improvement of net export in the long run. The nonlinear manner substantially affects the currency's volatility for the shred of five countries. As a consequence of the fluctuation in value of the Chinese Yuan, they diescovery of the J-curve for their example of five states, including the USA.

Suwanhirunkul & Masih (2018) examine the present inquiry concerns the correlation between the currency rate of Thailand and its trade ratio. They apply an asymmetric ARDL approach, which could give more robust results than previous techniques they used to estimate quarterly data from 1994.I to 2017.IV. They find that the depreciation of Thai Baht enhances the whole net export of Thailand in the long run. Applying the partial sum framework of nonlinear ARDL produces a mixed finding for different elasticity of export and import. However, the discovery of the J-curve cannot be proven in the short run, and concluded that a tradeoff appears between Thailand's export and import sectors.

Bahmani-Oskooee & Baek (2019) investigate the J-curve paradox of Korea and its 14 partners in international trade. They used the comparison of symmetric and aymmetric ARDL models to provide the research based on quarterly data from 1989.1 to 2015.I. They reveal that the industrial movement between Korea and China impact their next export in the short run. The changing method to the asymmetric manner significantly supports Won's depreciation toward the net export between Korea and China in the short and long run. However, the appreciation has a reverse effect for both the short-run and long-run. They conclude that the asymmetric adjustment of the currency rate has relatively more enhances in the discovery of a J-curve than the symmetric model.

Overall, the previous studies show that the depreciation of currency between two countries leads to in the near term, there is a decline seen in the net export, however in the long term, there is an observed rise (Bahmani-Oskooee & Baek, 2019b; Bahmani-Oskooee & Fariditavana, 2016a; Jamilov, 2013; Nusair, 2013) with various manner. It indicates that most of the previous shows the presence of a J-curve. Therefore, our study provides a hypothesis as follows:

H_1: Ceteris paribus, the depreciation (appreciation) of Indonesian Rupiah vis-à-vis Chinese Yuan deteriorates (improves) Indonesia-China bilateral trade balance in the short-run

H_2: Ceteris paribus, the depreciation (appreciation) of the Indonesian Rupiah vis-à-vis Chinese Yuan improves (deteriorates) the Indonesia-China bilateral trade balance in the long run.

3. Method

3.1. Data

The study used quarterly data ranging from 2002: I to 2017: IV, since this was the period during which the data was accessible. The primary source of the original dataset consists of data collected from reputable institutions such as the Indonesian Statistical Bureau, the International Monetary Fund (IMF), and the Organization for Economic Co-operation and Development (OECD). The parameter of interest in this study is the reciprocal trade ratio between Indonesia and China. The data is calculated by dividing imports from China to Indonesia and exports from Indonesia to China in Million US dollars. The independent variables in this study consist of the value of the currency between Indonesia and China, namely the Indonesian Rupiah (IDR) in relation to the Chinese Yuan (CNY), as well as the entire gross domestic product (GDP) of the two nations Indonesia and China. The total GDP is used as a benchmark to represent the rate of development in each respective country. In order to maintain the stationarity of the data, a logarithmic transformation was performed on all the macroeconomic indicators, with the exception of the international trade account.

3.2. Framework Setting

The essential objective of this research is to investigate the correlation between the price of a currency and the global trade account and prove the presence of the J-curve paradox of bilateral trading of Indonesia and China. The original framework of the macroeconomy was modified so that it better fits the findings of Bahmani-Oskooee & Fariditavana (2015). The approach was enhanced by including the two-way trade account parameter, which was a suggestion made by them as well to avoid the bias of using the aggregate trade balance variable. The initial model that was used for this investigation may be summarized using equation (1) as follows:

$$TB_t = \propto + \beta_1 logER_t + \beta_2 logYIDN_t + \beta_3 logYCHN_t + \varepsilon_t, \quad (1)$$

TB_t represents the bilateral trade balance, and the $logER_t$ represents the rate of IDR vis-à-vis CNY. The $logYIDN_t$ represents the economy's growth rate in Indonesia, $logYCHN_t$ represents the growth rate of the economy in China and following commercial fellows' countries, and ε_t is the error term.

3.2.1. The Framework Autoregressive Distributed Lag (ARDL) Model

To determine how currency exchange rates, the ratio of commerce across the two countries, and overall economic development are related to one another of Indonesia and China, we improved equation (1) into Autoregressive Distributed Lag (ARDL) approach. This approach applies to provide original stationary parameter, linked processes, or their mixture. This estimation tests the relationship among macroeconomic variables estimates improved by Pesaran et al. (2001). According to the findings of the particular investigation, the ARDL framework was applied in order to conduct an investigation into whether or not a J-curve exists in terms of the connection that exists between the currency value and the net export. Accordingly, to infer the short-run effect, we turn the equation (1) to the ARDL framework as follows:

$$\Delta TB_t = \alpha + \sum_{k=1}^{n_1} \emptyset_k \Delta TB_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta logYIDN_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta logYCHN_{t-k} + \sum_{k=0}^{n_4} \gamma_k \Delta logER_{t-k} + \delta_1 TB_{t-1} + \delta_2 logYIDN_{t-1} + \delta_3 logYCHN_{t-1} + \delta_4 logER_{t-1} + \varepsilon_t, \quad (2)$$

Once equation (2) is estimated, the projections of coefficients that are associated with each of the first-differenced indicators may be used to establish the short-run influence that the external factor will have on the trade surplus or deficit. The long-run impact is provided by estimates $\delta_1 - \delta_4$, normalized by δ_1. Moreover, we employed the F-test to establish a joint significance linear combination of lagged-level variables to support the long-run cointegration. During the stationary experiments, Pesaran et al. (2001) provided two different sets of essential figures, both of which held regardless of whether the factors being tested were I(1) or I(0). When determining a maximal significant value, it is assumed that every parameter has an amount I(1), but when determining the lowest possible critical value, it is assumed that all factors have the value I(0). If the estimated F-statistic is below the upper bound, then all parameters indicate no long-run cointegration (Bahmani-Oskooee & Baek, 2019; Delatte & López-Villavicencio, 2012; Durmaz, 2015). On the other hand, every single one of the parameters points to the existence of a long-run linkage if the lower bound of the estimated F-statistic is the same as the higher constraint.

In the alternative scenario, the conclusion is unsatisfactory if the F-statistic that was determined falls anywhere in between both of these limits. Considering the research that came before us, we may employ an alternate test that involves constructing a delayed error-correcting element of the linear mixture of lagged-level indicators (Aftab et al., 2017; Shahbaz et al., 2012) in equation (2). The framework is subsequently recalculated utilizing the identical amount of optimal lags, as represented by the subsequent formula:

$$\Delta TB_t = \alpha + \sum_{k=1}^{n_1} \emptyset_k \Delta TB_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta logYIDN_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta logYCHN_{t-k} + \sum_{k=0}^{n_4} \gamma_k \Delta logER_{t-k} + \rho ECM_{t-1} + \varepsilon_t \quad (3)$$

In equation (3), the examination of the value and importance of the ECM_{t-1} factor allows us to assess the framework's trajectory and rate of adaptation subsequent to every short-run instability. In the substance of equation (3), a cynical and significant $\hat{\rho_i}$ denotes the process of modifying the value of the currency to restore the long-term balance after experiencing a temporary imbalance. In conclusion, it can be observed that there evidences an affirmative linkage of the magnitude of $\hat{\rho_i}$ and the speed at which the method of adjustment or convergence velocity occurs.

3.2.2. The Framework Nonlinear Autoregressive Distributed Lag (NARDL) Model

The primary assumption in equation (2) is that the currency rate has a symmetric impact on the net export. However, it would be possible that the currency value has the same elasticity concerning an improves and deteriorates of the Indonesian Rupiah. Due to this phenomenon, the exchange rate's nonlienar impact is included in the model. If in the anticipation of measure modifications across time, such a measure may exert an unbalanced influence on the dependent factor dependent (Bahmani-Oskooee & Saha, 2017; Shin et al., 2012). Thus, we modify equation (2) by generating the exchange rate to become two time-series parameters. One is an appreciation, and the remain is the depreciation.

We follow Shin et al. (2011), who provided asymmetric framework of autoregressive distributed lag (NARDL). According to the case of the nonlinear effect of currency rate utilizing the NARDL framework, some previous studies developed the framework of (Shin et al., 2011; Bahmani-Oskooee et al., 2018; Bahmani-Oskooee & Baek, 2019; Nusair, 2013; Suwanhirunkul & Masih, 2018). They find an asymmetric effect of the currency rate on the trade balance dynamics. To address this issue, we represent the differences of logER variable as ΔlogER. The ΔlogER variable included positive and negative changes following the research of Bahmani-Oskooee & Fariditavana (2015). The positive changes represent the appreciation of IDR vis-à-vis CNY, and the negative changes represent the depreciation of it. We present the affirmative differences by $\Delta logER_t^+$ and negative changes by $\Delta logER_t^-$. The parameters that have been indicated are next utilized to construct the idea of partial sums in order to develop the additional parameters:

$$logERPos_t = \sum_{k=1}^{n} \Delta logER_t^+ = \sum_{k=1}^{n} \max\left(logER_t, 0\right), \quad (4)$$

$$logERNeg_t = \sum_{k=1}^{n} \Delta logER_t^- = \sum_{k=1}^{n} \min(logER_t, 0). \quad (5)$$

The logERPos represents the currency's appreciation, and the logERNeg represents the currency's depreciation. Then we rewrite the logER paramter of equation (2) with logERPos and logERNeg to provide the new formula:

$$\begin{aligned}\Delta TB_t = \alpha &+ \sum_{k=1}^{n_1} \emptyset_k \Delta TB_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta logYIDN_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta logYCHN_{t-k} \\ &+ \sum_{k=0}^{n_4} \mu_k \Delta logERPos_{t-k} + \sum_{k=0}^{n_5} \sigma_k \Delta logERNeg_{t-k} + \delta_1 TB_{t-1} + \delta_2 logYIDN_{t-1} \\ &+ \delta_3 logYCHN_{t-1} + \delta_4 logERPos_{t-1} + \delta_5 logERNeg_{t-1} + \varepsilon_t\end{aligned} \quad (6)$$

The parameter denoted as the partial sum in formula (6) is a nonlinearity referred to as the nonlinear autoregressive distributed lag (NARDL). The equation (2) is a symmetric ARDL famework by Pesaran et al. (2001). According to Shin et al. (2011), The linear autoregressive distributed lag (ARDL) model estimation approach is consistently applied. The result of coefficients and signs of ΔlogERPos and ΔlogERNeg will define the symmetry and asymmetry relationship of the exchange rate. Moreover, we employed an original Wald test, distributed as χ^2 with one degree of freedom, to estimate the short-run linear impact of the exchange rate with the null hypothesis H_0: $\sum \mu = \sum \sigma$. The exchange rate has a short-run nonlinear effect on the trade balance if $\sum \mu \neq \sum \sigma$. The exchange rate has a long-run symmetry impact toward net export if the null hypothesis is H_0: $-\delta_6/\delta_1 = -\delta_7/\delta_1$ rejected in favor of inequality.

Finally, for further check of cointegration exists, we also employed the error correction parameter for the asymmetric framework of equation (6) and re-estimated employing the similar number of optimum lags as follows:

$$\Delta TB_t = \alpha + \sum_{k=1}^{n_1} \emptyset_k \Delta TB_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta logYIDN_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta logYCHN_{t-k} \quad (7)$$

$$+\sum_{k=0}^{n_4} \mu_k \Delta logERPos_{t-k} + \sum_{k=0}^{n_5} \sigma_k \Delta logERNeg_{t-k} + \rho ECM_{t-1} + \varepsilon_t.$$

The utilization of the error correction component serves as an alternate examination that employs standardized long-run estimations of the formula (6). The significant and negative estimation of ECM_{t-1} indicates the support of the cointegration. In the following part, In this study, we outline the methodology employed for estimating the frameworks and proceed to analyze the outcomes for both symmetric and asymmetric Autoregressive Distributed Lag (ARDL) variables.

4. Result and Discussion

The analysis begins by ensuring that the data analyzed are stationary in the level or differences. The result then showed that parameters are either *I(0)* or *I(1)* to know that no presence regarding that consideration (Pesaran et al., 2001). The unit root tests used in this study Augmented Dickey-Fuller (ADF) developed by Dickey & Fuller (1979), Kwiatkowski-Phillips Schmidt-Shin (KPSS) developed by Kwiatkowski et al. (1992).

Table 1. Unit Root Testing Result

Variable	ADF	PP	KPSS
TB_t	-1.966206 [5]	-1.231140 [4]	0.861270*** [6]
$logYIDN_t$	-2.145720 [1]	-2.414194 [5]	0.197965*** [5]
$logYCHN_t$	-1.538563 [1]	-1.197503 [5]	0.643530* [6]
$logER_t$	-0.329487** [0]	-0.329487** [0]	0.925701 [6]
ΔTB_t	-1.910958* [5]	-3.900343*** [4]	0.103568*** [4]
$\Delta logYIDN_t$	-2.350605* [8]	-4.832522*** [5]	0.127688*** [3]
$\Delta logYCHN_t$	-4.794703*** [3]	-4.205702*** [5]	0.167559*** [4]
$\Delta logER_t$	-6.928626*** [0]	-6.911587*** [3]	0.093784*** [3]

***< 1%, **< 5%, and *< 10%.

The outcome of the unit root analysis is displayed in Table 1. We used the comparative result with 1%, 5%, and 10% significance levels. According to the rule of the stationary test, the probability test should be lower than the significance level. Thus, the finding of ADF and PP tests, all variables do not pass the stationary test except the exchange rate ($logER_t$). However, in the first point of divergence, every factor exhibit stationarity as the null hypothesis is refuted at a significance level of 10%. The examination was completed utilizing , leading us to infer that there are no unit roots in the first difference. Consequently, every factor must fit into either the I(0) or I(1) category. It would be a significant finding concern because we employ one of the simplified approaches to cointegration analysis developed by Granger, (1988); Johansen (1991); Phillips & Hansen (1990); Phillips & Loretan (1991); Stock & Watson (1993), which requires all of the parameters to be I(1) progresses in level. However, The autoregressive distributed lag (ARDL) technique to cointegration, which was pioneered by Pesaran et al. (2001), is a widely used methodology in econometric analysis is used to effectively manage a set of factors that exhibit an amalgam of I(0) and I(1) characteristics in their ranges. Testing for cointegration is considered an optimal methodology.

4.1.1. The Result of Linear ARDL Model Estimation

The empirical analysis began by estimating the symmetric impact of ARDL model outlined in formula (2) to examine the determinants of the net export between Indonesia and China. We follow the previous studies (Bahmani-Oskooee et al., 2018; Delatte & López-Villavicencio, 2012; Durmaz, 2015) who estimate the model by imposing the Akaike Info Criterion (AIC) model selection method. Each short-run parameter is subject to an upper limit of four delays. The null hypothesis under consideration posits that existing unfavorable link between the dependent and independent parameter. It may be the case that insignificant fundamental variables accompany the finding of each estimation. Thus, we estimate the bivariate equation for each independent variable separately to find which primary variable significantly affects the bilateral trade.

Table 2. Results of the Short-run and Long-run ARDL Model Estimation

Variable	**Multivariate**	**$logYIDN_t$**	**$logYCHN_t$**	**$logER_t$**
Panel (A) ARDL Estimates				
C	-2.579993*** (0.731944)	-0.041422 (0.056271)	0.103086 (0.079302)	-2.975338*** (0.917185)
TB_{t-1}	1.051113*** (0.132467)	1.608326*** (0.089052)	1.554520*** (0.098954)	1.260836*** (0.131255)
TB_{t-2}	-0.176359 (0.114829)	-0.634674*** (0.087664)	-0.604438*** (0.098897)	-0.228741** (0.115457)
TB_{t-3}	-0.001474 (0.073508)			-0.348944*** (0.086365)
TB_{t-4}	-0.204959*** (0.064996)			
$logYIDN_t$	0.150153*** (0.018591)	0.099550*** (0.035883)		
$logYIDN_{t-1}$	-0.165226*** (0.018045)	-0.175370*** (0.051499)		
$logYIDN_{t-2}$		0.089983*** (0.021274)		
$logYCHN_t$	-0.083883*** (0.011073)		-0.072669*** (0.021996)	
$logYCHN_{t-1}$	0.078345*** (0.011470)		0.111729*** (0.036747)	
$logYCHN_{t-2}$			-0.043240** (0.018247)	
$logER_t$	-0.091359 (0.132439)			-0.097717 (0.140707)
$logER_{t-1}$	-0.337717* (0.168895)			-0.000878 (0.222233)
$logER_{t-2}$				-0.357652 (0.267600)
$logER_{t-3}$				0.296519* (0.174452)
$logER_{t-4}$				-0.303974** (0.113750)
ECM_{t-1}	-0.331680 (0.042413)	-0.026348** (0.012557)	-0.049918** (0.024163)	-0.316849*** (0.073906)
F-statistic	11.30796***	1.417035	1.373586	5.895531***
Adjusted R^2	0.992867	0.980133	0.983174	0.980642
Serial Correlation	1.524950*** [0.2282]	0.736516*** [0.4835]	0.717321*** [0.4926]	0.729970*** [0.4871]
Normality	13.54604	35.83996	22.03831	6.584108*

Variable	Multivariate	$logYIDN_t$	$logYCHN_t$	$logER_t$
	[0.001144]	[0.000000]	[0.000016]	[0.037177]
Heteroskedasticity	2.609367*	2.091961**	0.108465***	0.715456***
	[0.0126]	[0.0799]	[0.9900]	[0.6768]
Functional Form	0.495441	0.142803***	0.159114***	0.005507***
	[0.4849]	[0.7070]	[0.6915]	[0.9411]
Panel (B) Long-run Coefficient Estimates				
C	-7.778572***	-1.572112	0.076401	-9.390386***
	(0.637130)	(0.438331)	(0.747419)	(0.088787)
$logYIDN_t$	-0.045444	0.537539		
	(0.040780)	(2.277061)		
$logYCHN_t$	-0.016698		-0.083741	
	(0.012524)		(2.065121)	
$logER_t$	-1.293645***			-1.463482***
	(0.087606)			(0.646521)

***< 1%, **< 5%, *< 10%.

Table 2 displays the outcome of the limit evaluation method for the linear autoregressive distributed lag (ARDL) model. In Panel (A), the study presents the short-run estimates and diagnostic tests, including assessments for sequential correlation, heteroskedasticity, normalcy, and the Ramsey-RESET test for functional form. Additionally, the F-statistic is employed to test the null hypothesis of no cointegration. The equation can be found as well specified except for the normality test for bivariate specification for the growth rate of Indonesia and China failed the test, and the multivariate equation fails the tests for normality and the Ramsey-RESET test for functional form at a 10 % significance level. The corrected R^2 values indicate that all models exhibit a high level of goodness of fit, with the multivariate equation demonstrating the strongest fit, exceeding 99 %. The F-statistic, when applied to both multidimensional and bidirectional calculations, provides evidence of a sustained equilibrium link regarding the bilateral commerce of Indonesia and China, as well as the currency exchange rate of Indonesian Rupiah (IDR) with respect to the Chinese Yuan (CNY), by contradicting the null hypothesis.

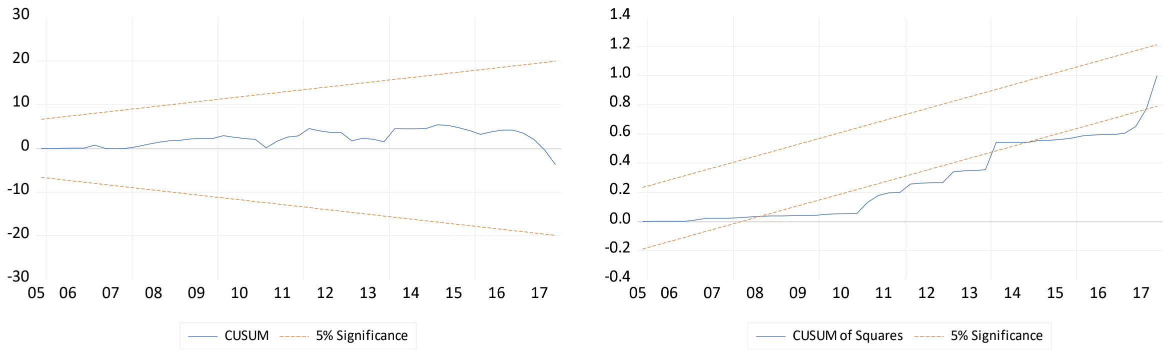


Figure 2. The CUSUM and CUSUMQ tests for Linear ARDL Model.

The result of the error correction term, estimated from equation (3), explains that the long-term of the system reverts to the equilibrium for each multivariate and bivariate equation, are unfavorable and significant at 1 percent. The findings suggest that each model exhibits a divergence of less than 33.16 % in the short-term balance, which is rectified within a one-year timeframe. According to some previous studies (Bahmani-Oskooee et al., 2018;

Bahmani-Oskooee & Baek, 2019), the negative coefficient estimates of ECM_{t-1} indicates that the model support for cointegration, especially for replacing the insignificant of F-statistic for the bivariate equation of the growth rate in Indonesia and China. Finally, the recursive stability explains that the linear ARDL model for the multivariate equation is stable, passing the CUSUM test. However, it fails the test for CUSUM of Square.

According to the panel (A) of Short-run estimates, the result explains that the exchange rate coefficient is negative and significant at 1 percent for both multivariate and bivariate equations. Since we apply the exchange rate as a value of Chinese Yuan in terms of Indonesian Rupiahs, the depreciation is spilled by an enhance in the value of the currency value between them. The result represents a depreciation between Indonesian Rupiahs vis-à-vis the Chinese Yuan, which would also decrease the net export of Indonesia in the short run. This result does not support the previous result of Suwanhirunkul & Masih (2018) that there is no cointegration between Thai Baht and its bilateral net export in the short run. It implies they cannot present the J-curve phenomenon in their short-run analysis. Following "the new interpretation of J-curve" provided by Rose & Yellen (1989), which extended by Bahmani-Oskooee et al. (2018) and Bahmani-Oskooee & Fariditavana (2016), our short-run accept our hypothesis (H_1) of the depreciation (appreciation) of Indonesian Rupiah vis-à-vis Chinese Yuan deteriorates (improves) Indonesia-China bilateral trade balance in the short-run, ceteris paribus. We confirm that our estimation supports the presence of a J-curve in the short run.

Panel (B) presents the long-term examination of the occurrence of the J-curve. The estimated coefficients of the exchange rate variable in the multidimensional formula exhibit an unfavorable and statistically significant relationship. This suggests that a long-term depreciation of the Indonesian Rupiah (IDR) against the Chinese Yuan (CNY) is associated with a decline in the ratio of trade. This finding differs from the explanation of Bahmani-Oskooee et al. (2018) and Bahmani-Oskooee & Fariditavana (2016) that in the presence of J-curve is represented by the depreciation followed by an increase in net export in the long-run. Nevertheless, our result rejects the hypothesis (H_2) of the depreciation (appreciation) of the Indonesian Rupiah vis-à-vis Chinese Yuan improves (deteriorates) the Indonesia-China bilateral trade balance in the long run, ceteris paribus. In general, the findings from our analysis using the linear ARDL framework lack evidence for the existence of the J-curve consequence in the bilateral trade linkage of Indonesia and China.

4.1.2. The result of Nonlinear ARDL Model Estimation

In the development discussion of the discovery of a J-curve, we turn to the nonlinear manner of the ARDL model. We estimate equation (6) of the nonlinear ARDL model after modifying the currency rate parameter to appreciation and depreciation. This estimation regards the previous study of Shin et al. (2011) by utilizing the identical methodology employed in the symmetric model of ARDL framework.

The assessment results for the short-run and long-run nonlinear ARDL model are presented in Table 3. Panel (A) in Table 3 presents the short-term predictions, along with the evaluations, including the Breusch-Godfrey Serial Correlation LM test, the Jacque-Bera normality test, the Breusch-Pagan-Godfrey test for Heteroskedasticity, and the Ramsey-RESET test for stability. The result indicates that the model is relatively stable, which is the null hypothesis of serial correlation, heteroskedasticity, and functional form. However, the bivariate equation of the growth rate variables of Indonesia and China does not pass the test for normality.

Table 3. Results of the Short-run and Long-run Nonlinear ARDL Model Estimation

Variable	**Multivariate**	**$logYIDN_t$**	**$logYCHN_t$**	**$logERPos_t$**	**$logERNeg_t$**
Panel (A) ARDL Estimates					
C	0.307323** (0.122449)	-0.041422 (0.056271)	0.103086 (0.079302)	0.074113*** (0.027202)	0.152764*** (0.047582)
TB_{t-1}	1.089561*** (0.157671)	1.608326*** (0.089052)	1.554520*** (0.098954)	1.455431*** (0.076412)	1.317025*** (0.102118)
TB_{t-2}	-0.096534 (0.157684)	-0.634674*** (0.087664)	-0.604438*** (0.098897)	-0.333232*** (0.074486)	-0.238620*** (0.065960)
TB_{t-3}	-0.262892*** (0.075590)			-0.254056*** (0.063641)	-0.287731*** (0.063824)
$logYIDN_t$	0.139552*** (0.025914)	0.099550*** (0.035883)			
$logYIDN_{t-1}$	-0.130912*** (0.026046)	-0.175370*** (0.051499)			
$logYIDN_{t-2}$		0.089983*** (0.021274)			
$logYCHN_t$	-0.092063*** (0.011311)		-0.072669*** (0.021996)		
$logYCHN_{t-1}$	0.103222*** (0.016225)		0.111729*** (0.036747)		
$logYCHN_{t-2}$	-0.020946* (0.012172)		-0.043240** (0.018247)		
$logERPos_t$	-0.193223 (0.312218)			0.562722 (0.382219)	
$logERPos_{t-1}$	-0.100886 (0.397880)			-0.389361 (0.330612)	
$logERPos_{t-2}$	0.245115 (0.304796)				
$logERPos_{t-3}$	-0.002594 (0.208982)				
$logERPos_{t-4}$	-0.404245** (0.188785)				
$logERNeg_t$	-0.383511*** (0.141345)				-0.150739** (0.058761)
$logERNeg_{t-1}$	0.107177 (0.200431)				
$logERNeg_{t-2}$	-0.599300* (0.328492)				
$logERNeg_{t-3}$	0.495053 (0.294620)				
ECM_{t-1}	-0.269865*** (0.040985)	-0.026348** (0.012557)	-0.049918** (0.024163)	-0.131857*** (0.042493)	-0.209327*** (0.055809)
F-statistic	6.440363***	1.417035	1.373586	3.096942*	4.527782**
Adjusted R^2	0.991804	0.980133	0.983174	0.978969	0.980242
Serial Correlation	0.877041*** [0.4241]	0.736516*** [0.4835]	0.717321*** [0.4926]	0.335502*** [0.7165]	4.917521* [0.0109]
Normality	0.626912*** [0.730916]	35.83996 [0.000000]	22.03831 [0.000016]	8.713111* [0.012822]	7.784944* [0.020395]
Heteroskedasticity	1.815947** [0.0597]	2.091961** [0.0799]	0.108465*** [0.9900]	0.834442*** [0.5309]	0.806359*** [0.5264]

Variable	Multivariate	$logYIDN_t$	$logYCHN_t$	$logERPos_t$	$logERNeg_t$
Functional Form	5.360221*	0.142803***	0.159114***	1.475684***	2.205634***
	[0.0258]	[0.7070]	[0.6915]	[0.2297]	[0.1432]
Wald S	0.241306***				
	[0.6233]				
Wald L	0.160067***				
	[0.6891]				
Panel (B) Long-run Coefficient Estimates					
C	1.138803***	-1.572112	0.076401	0.562071***	0.729788***
	(0.248374)	(0.438331)	(0.747419)	(0.103826)	(0.056224)
$logYIDN_t$	0.032016	0.537539			
	(0.076755)	(2.277061)			
$logYCHN_t$	-0.036267***		-0.083741		
	(0.020090)		(2.065121)		
$logERPos_t$	-1.689109***			1.314764***	
	(0.602741)			(0.215363)	
$logERNeg_t$	-1.410263***				-0.720110***
	(0.249372)				(0.080319)

***< 1%, **< 5%, *< 10%.

The result of adjusted R^2 explains that all of the equation has a goodness of fit above 98.01 %. The F-statistic confirms the cointegration of the currency value and net export between Indonesia and China by refuting the null hypothesis of no cointegration. Panel (A) also reports the ECT parameters, which is negative and significant at 1 percent. We estimate equation (3) for the ECM to replace the insignificant F-statistic, especially for the bivariate growth rate equation in both Indonesia and China. The results suggest that every framework exhibits a divergence of less than 2.64 % in the short-run point of equilibrium, which is subsequently rectified within a one-year timeframe. Moreover, the Wald test refutes the null hypothesis of H_0: $\sum \mu = \sum \sigma$. It implied that in the short-run, the sum of the parameter of ΔlogERPos essentially differs from that of ΔlogERNeg.

In this study, we introduce the Wald-L analysis as empirical support for the presence of a long-term asymmetry impact of the currency rate on bilateral commerce dynamics across Indonesia and China. The estimates of equation (6) of the nonlinear ARDL model exist in the long-run asymmetry impact to the bilateral trade since we find that the coefficient of appreciation and depreciation of currency exchange in the $\delta_4 \neq \delta_5$ requirement being met, and it supports the result of long-run Wald test. Finally, figure 2 shows the recursive stability, which explains that the asymmetric ARDL framework for the multivariate fromula is stable, passing the CUSUM test. However, it fails the test for CUSUM of Square.

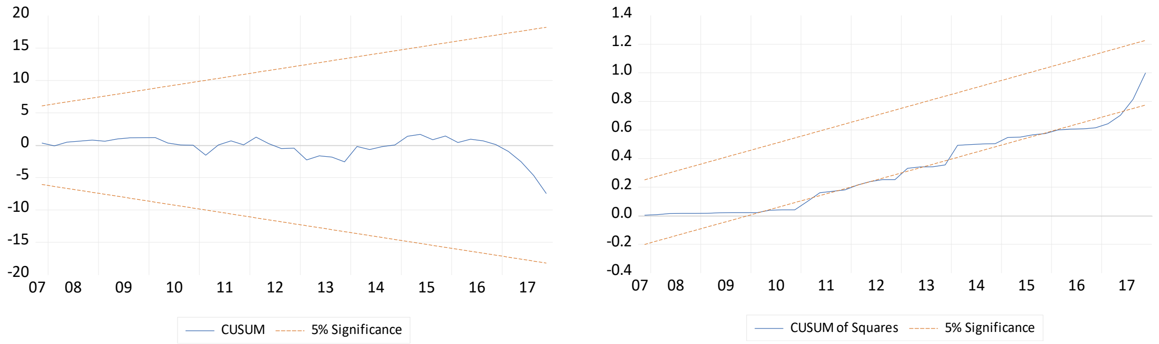


Figure 3. The CUSUM and CUSUMQ tests for the Nonlinear ARDL Model.

The short-run estimation of the nonlinear ARDL model in panel (A) shows that both exchange rate appreciation ($logERPos_t$) and deprecation ($logERNeg_t$) of multivariate equations are significant for all negative coefficients. However, the positive coefficients of the multivariate equation are not significant, as well as the bivariate equation of the $logERPos_t$. According to Bahmani-Oskooee & Saha (2017) and Nusair (2013), positive and significant appreciation and depreciation variables indicate the presence of a J-curve. However, our estimation provides the negative significance of these two variables. This finding supports the previous result of Suwanhirunkul and Masih (2018) that they cannot present the J-curve paradox in their short-run analysis. The findings of our study indicate that the outcomes contradict our initial hypothesis (H_1) on the impact of the depreciation (appreciation) of the Indonesian Rupiah in relation to the Chinese Yuan on the short-term Indonesia-China bilateral trade balance, assuming all other factors remain constant. Therefore, it can be concluded that the NARDL model is unable to identify the existence of the J-curve phenomenon in the immediate term.

The long-run parameter estimates presented in panel (B) remain the same. The $logERPos_t$ and $logERNeg_t$ variables of the multivariate equation are statistically significant at 1 percent with negative signs. An appreciation (depreciation) of IDR vis-à-vis CNY deteriorates (improves) the trade balance. This discovery confirms the explanation of Bahmani-Oskooee et al. (2018b) and Bahmani-Oskooee & Fariditavana (2016) that in the existence of J-curve is represented by the depreciation between the countries' exchange rate is followed by an increase in net export in the long-run. It implies that our result accepts the hypothesis (H_2) of the depreciation (appreciation) of the Indonesian Rupiah vis-à-vis Chinese Yuan improves (deteriorates) the Indonesia-China bilateral net export in the long run, ceteris paribus. Although our study reveals evidence of the negative effect of the IDR vis-à-vis CNY on the bilateral trade between Indonesia and China in the long run, we cannot conclude the presence of J-curve since we reject our hypothesis of H_1.

5. Conclusion

The consensus of symmetry and asymmetry methodology, as proposed by Shin et al. (2011), needs a reduced-form net export framework between Indonesia and China after the liberalization of trading in Southeast Asia and China. We improve the study of Bahmani-Oskooee & Fariditavana (2015), who analyze the aggregate trade balance into bilateral trade with symmetric and asymmetric models. The result of linear analysis suggests a support of J-curve evidence in the short-run. Nonetheless, it does not support it in the long-run. Compared to the achievement of the linear model, our nonlinear model offers inverse evidence that the short-run result does not support. However, the long-run analysis supports the presence of a J-curve. Overall, we cannot present J-curve evidence in linear or nonlinear analysis. This study is limited to only bilateral trade between two economies and employs fewer control variables. Therefore, for the further study of J-curve analysis, we suggest a more comparison study of an economy and other bilateral trading partners.

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