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Exchange Rate and Indonesia-China Bilateral Industry Trade Flows: J-Curve and Asymmetric Effects

Alfira Cahyaning Rifami[a], Unggul Heriqbaldi[b,*]

a. Mandiri Bank, Surabaya, Indonesia
b. Department of Economics, Universitas Airlangga, Surabaya, Indonesia
* Corresponding Author, E-mail: u.heriqbaldi@feb.unair.ac.id

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ABSTRACT

This paper examines whether there is a J-curve phenomenon and an asymmetric effect of the exchange rate on the Indonesia-China bilateral industry trade balance. An asymmetric response occurs when the exchange rate affects trade balance differently during periods of currency depreciation or appreciation. An Autoregressive Distributed-Lag (ARDL) and Nonlinear Autoregressive Distributed-Lag (NARDL) models were applied using data from 50 Indonesian export industries between 1Q 1993 and 4Q 2019. We found that in the short run, there are 14 industries impacted by the real exchange rate changes (under the ARDL model), while the NARDL comes with more cases (22 industries). In the long run, the ARDL model reveals 13 industries with a significant impact on exchange rate changes. With a NARDL model, in the case of exchange rate depreciation, there are 15 industries, which experience significant influence on their trade balance, while in the case of exchange rate appreciation, the effect was found in 17 industries. From the perspective of J-Curve, the ARDL model came out with two industries, while with the NARDL model, a J-Curve effect occurs in nine industries. We also found empirical evidence for short-run asymmetric effects in 15 industries. The policy implication of this finding is the importance of maintaining exchange rate stability through monetary policy to reduce the adverse effect of sharp changes in exchange rates on the trade balance.

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1. Introduction

Despite investigated in many recent studies (Ari et al., 2019; Bahmani-Oskooee and Harvey, 2017; Durmaz, 2015; Harvey, 2018; Heriqbaldi et al., 2020; Rasoulinezhad and Kang, 2016), the link between exchange rate and trade balance remains controversial; and there has not been a clear conclusion yet. Theoretically, Krugman et al. (2018: 490) states that the exchange rate depreciation event has two effects, namely the value effect and the volume effect. In the short-run, the depreciation of the exchange rate causes the value effect to be more dominant than the volume effect, where the price of imported goods becomes more expensive which will erode the domestic trade balance because the costs incurred to buy imported products are higher. In the long-run, the volume effect is more predominant, where trade contracts have begun to be renewed and have an impact on increasing the volume of domestic exports and reducing imports. Furthermore, Krugman (2018: 531) states that exchange rate depreciation can improve the trade balance if the Marshall-Lerner Condition is met, where the sum of the elasticity of exports and imports is more than one. The condition of worsening trade balance in the short-run followed by improvement in the long-run is called the J-Curve phenomenon (Bahmani-Oskooee and Hajilee, 2009; Bahmani-Oskooee and Harvey, 2017; Durmaz, 2015).

In the context of international trade, China is one of Indonesia's largest trading partners for more than ten years. In 2018, China's exports to Indonesia amounted to USD 45.5 billion and at the same time, China imported Indonesian products of USD 27.1 billion. The trade deficit experienced by Indonesia continues to increase from year to year. From the perspective of study, several previous studies have shown varying results. Bahmani-Oskooee and Harvey (2009) and Husman (2005) found no long-run effect of changes in Indonesian Rupiah (IDR) exchange rate on bilateral trade balance at an aggregate level. Bahmani-Oskooee and Harvey (2009) used the Autoregressive Distributed-Lag (ARDL) model to identify the effect of the exchange rate on the trade balance between Indonesia and 13 major trading partner countries. The estimation results of the Indonesian and Chinese equations show that the depreciation of the Indonesian rupiah (IDR) against the Chinese Yuan (CNY) has a significant positive effect in the short-run but did not have a significant effect on the long-run. Therefore, they concluded that there was no J-curve phenomenon in the case of Indonesia-China trade. The findings of Bahmani-Oskooee and Harvey (2009) are different from findings from Adiningsih et al. (2013). Adiningsih et al. (2013) used the VECM approach to analyze the effect of the exchange rate on Indonesia's bilateral trade with three main partners, The US, China, and Japan. Using the 1996-2011 period, Adiningsih et al. (2013) found that IDR depreciation toward CNY had a positive effect on the trade balance, both in the short and long-run. Furthermore, Adiningsih et al. (2013) also found a J-Curve phenomenon in Indonesia-China trade balance. Therefore, it can be reiterated that there are no conclusive results regarding the effect of the exchange rate on the trade balance in the case of Indonesia-China.

In the context of Indonesia's trade with other countries, several studies also show mixed findings (Onafowora, 2003; Liew et al., 2003; Hastiadi and Nurunnisa, 2017). Onafowora (2003) analyzed the short and long-run effects of exchange rate changes on the trade balance of 3 ASEAN countries (Indonesia, Malaysia, and

Thailand) in bilateral trade with the US and Japan within cointegrating vector error correction model (VECM). In all cases, the results show a significant positive effect of the exchange rate on the trade balance, in line with theoretical expectations. The main contribution of Onafowora (2003) is its ability to prove that although the 1997 Asian financial crisis affected the trade balance, the existence of cointegration evidence in all models shows that there is a long-run stability of the trade balance in the three country cases. In another study, Liew et al. (2003) investigated whether changes in exchange rates have an effect on the trade balance in ASEAN-5 countries (Indonesia, Malaysia, the Philippines, Singapore, and Thailand). The main contribution of Liew et al. (2003) is the use of real money as a factor that determines the trade balance based on the Purchasing Power Parity (PPP) hypothesis. This approach is different from other studies which are based on the elasticity model (see Baharumshah, 2001; Lal and Lowinger, 2002b; Singh, 2002). The results show that the trade balance proposition is influenced by changes in real money, supported by empirical data of ASEAN-5 economies.

Bahmani-Oskooee and Harvey (2019) continues their study in the case of Indonesia and China. Their study was motivated by criticism of the previous approach used by Rose and Yellen (1989) and other studies, namely in the aspect of application of linear models. This linear model assumes that changes in exchange rates have a symmetrical effect on the trade balance. M. Bahmani-Oskooee and Harvey (2019) states that traders will react differently to depreciation and appreciation events. Therefore, changes in exchange rates can have an asymmetric effect on the trade balance. Bahmani-Oskooee and Harvey (2019) uses the Nonlinear ARDL (NARDL) approach introduced by Shin et al., (2014a) to analyze the effect of asymmetric exchange rates on the trade balance. Bahmani-Oskooee and Harvey (2019) found through the linear ARDL model that income and the real exchange rate had a significant effect on the trade balance. However, with the same model, in the long-run, the significant effect only occurs on income. In the NARDL model, Bahmani-Oskooee and Harvey (2019) also did not find a long-run asymmetric effect of exchange rate. However, the short-run equation estimation results show the existence of asymmetric effects, which is supported by the Wald test, applied to equality of sum of the short-run coefficient estimates. Through their research, Bahmani-Oskooee and Harvey (2019) contributed in providing the evidence of asymmetric effects in the relationship between exchange rates and trade balances in the Indonesia-China case.

At an industry level analysis, Bahmani-Oskooee and Harvey (2015) investigated the relationship between exchange rate and trade balance in the case of the US and Indonesia by using the ARDL model. Bahmani-Oskooee and Harvey (2015) found that almost all industries were affected by changes in exchange rates. They also found a J-Curve phenomenon in 9 out of 23 industries. In terms of Indonesia-China trade relations, various studies have focused only on the aggregate level or total trade balance. So far, there have been no studies analyzing it at the industry or commodity level. Therefore, this study aims to fill this gap by focusing on Indonesia's 50 main exporting industries. Specifically, this study aims to identify whether there is J-curve phenomenon and asymmetric effect in the relationship between IDR-CNY exchange rate and the Indonesia-China trade balance. We contribute to the empirical literature in two lines. First, our analysis focuses on the industry level. This makes our analysis consider the response of specific industries to changes in the exchange rate. Second, to achieve this goal, we use ARDL and NARDL, which not only enable us to provide evidence of a J-Curve phenomenon but also identify whether there are any asymmetric effects from exchange rate on trade balance.

2. Literature Review

There have been extensive studies that investigate the link between exchange rate and trade balance. Studies in this area can be divided into three groups. The first group discusses the effect of exchange rate on trade balance between a country and the rest of the world. In the second group, the study was carried out at a bilateral level to avoid convolutions due to aggregation such as the results of studies in the first group. The last group discusses the effect of exchange rate on trade balance at an industry level.

In the first group, several studies showed mixed findings. Bahmani-Oskooee (1985) found a J-Curve phenomenon in the context of India, Korea and Greece. The study conducted by Noland (1989) in Japan also came to the same conclusion. However, further research conducted by (Rose, 1990) did not find a J-Curve phenomenon in the 30 countries being studied. Meanwhile in Indonesia, the first study in a multilateral setting was conducted by Bahmani-Oskooee and Alse (1994) and continued by Lal and Lowinger (2002), which found that there was a J-Curve phenomenon in several Asian countries, including Indonesia. Similar studies such as Duasa (2007), Rehman and Afzal (2003), Reis Gomes and Senne Paz (2005) found evidence of the J-curve phenomena in Malaysia, Pakistan, and Brazil.

In the second group, Rose and Yellen (1989) introduced a new approach, i.e., a bilateral analysis. This is to avoid an aggregation bias that might occur in previous studies. In their study, Rose and Yellen (1989) found no J-Curve phenomenon in American trade with six partners, i.e. the UK, Italy, Japan, Germany, Canada and France between 1Q of 1960 and 4Q of 1985. Since then, several other studies on bilateral settings were developed and applied in other cases (Bahmani-Oskooee and Brooks, 1999; Bahmani-Oskooee and Goswami, 2003; Halicioglu, 2007; Husman, 2005; Iqbal et al., 2015; Nhung et al., 2018; Panda and Reddy, 2016).

In the third study group, a pioneer at the industrial level was Bahmani-Oskooee and Wang (2008), who analyzed the effect of real exchange rate on trade balance between the US and China using 88 industries during the period of 1978-2002. They found a positive effect of depreciation on the trade balance in 34 industries; as well as a J-Curve phenomenon in 22 industries. In other study, Gobbi and Lucarelli (2022) investigated the effect of the depreciation of the Pound Sterling between May 2014 and April 2017 on the British industries' trade balance with The US using monthly data. Gobbi and Lucarelli (2022) uses the ARDL model to analyze both the short-run and long-run effects of changes in Pound Sterling on the US Dollar. The analysis was performed on the 30 most representative industries, and they found a worsening of bilateral trade balance in 8 industries (20.66 % of trade between the UK and the US) and improvement of trade balance in 5 industries (12.43% of trade between the UK and the US). In terms of J-curve, Gobbi & Lucarelli (2022) only found evidence in one industry and two industries with an inverted J-Curve.

In contrast to Gobbi and Lucarelli (2022), Bahmani-Oskooee and Nasir (2020) revisits the trade balance between the UK and the US and analyzes the asymmetric response of the trade balance of each of the 68 industries to changes in the real US dollar-Pound Sterling rate using NARDL model. Bahmani-Oskooee and Nasir (2020) finds that in the short term, exchange rate coefficients, in both appreciation and depreciation, are statistically significant across 48 industries. Furthermore, they also found that when comparing the magnitude of the specific lag coefficient for the depreciation and appreciation variables, they both showed different magnitudes, thus confirming the existence of short-run asymmetric effects in 25 industries. In the long term, asymmetric effects were also found in 27 industries. Other studies conducted in different countries and industries (see Bahmani-Oskooee et al., 2020; Bahmani-Oskooee and Karamelikli, 2021) show mixed results.

Other studies that support the use of industry-level data include M. Bahmani-Oskooee and Hajilee (2009) who found a J-Curve phenomenon in 23 out of 87 industries' trades between Sweden and the US. Bahmani-Oskooee and Mitra (2009) found the same phenomenon in 8 out of 38 industries' trades between India and the US. In another context, Bahmani-Oskooee and Aftab (2018) found a J-Curve phenomenon in 15 of the 59 industries' trades between Malaysia and China. Different levels of impact of exchange rates on each industry shows that some industries can meet the Marshall-Lerner Condition. In a long term, exchange rate depreciation improves the trade balance at an industrial level due to the relatively high elasticity of exports and imports (Bahmani-Oskooee and Baek, 2015;

Bahmani-Oskooee and Harvey, 2015; Guo, 2020). Therefore, the dynamics effect of exchange rate on trade balance at an industry level is strongly influenced by the elasticity of the industry (Bahmani-Oskooee and Aftab, 2018; Bahmani-Oskooee and Hajilee, 2009; Bahmani-Oskooee and Karamelikli, 2018; Cao-Alvira, 2014; Durmaz, 2015).

In terms of methodology, there are various estimation techniques used to analyze the effect of changes in exchange rate on trade balance and to prove a J-Curve phenomenon. The classic Bahmani-Oskooee (1985) research used the Almond Lag Structure method, while Noland (1989) chose the Gamma Distributed Lag method, and Rose (1990) and Rose and Yellen (1989) used non-structural techniques, OLS and 3SLS, respectively. Meanwhile, other studies employ the Error Correction Model (ECM) and Vector Autoregressive (VAR) approaches (Bahmani-Oskooee and Wang, 2008; Hapsari and Kurnia, 2018; Lal and Lowinger, 2002a; Nhung et al., 2018; Rasoulinezhad and Popova, 2017; Sulaimon et al., 2017).

The Autoregressive Distributed Lag (ARDL) method in the context of exchange rate and trade balance was introduced by Bahmani-Oskooee and Brooks (1999). This approach was then used in other studies, including Bahmani-Oskooee and Baek (2015); Bahmani-Oskooee and Harvey (2009); M. M. Bahmani-Oskooee and Goswami (2003); Cao-Alvira (2014); Durmaz (2015); Guo (2020); Panda and Reddy (2016). One of the advantages of this approach is that one does not need to do a unit root test because this model can use both stationary and non-stationary series (Pesaran et al., 2001).

Bahmani-Oskooee and Fariditavana (2016) used a new method of Nonlinear Autoregressive Distributed Lag (NARDL) to analyze the effect of exchange rate on trade balance. The NARDL approach assumes that the dependent variable's response to the increase and decrease of each independent variable is asymmetric (Shin et al., 2014). To identify the asymmetry effect, the NARDL model separates one independent variable into two conditions. As an illustration, the effect of exchange rate on trade balance can be analyzed from the appreciation and depreciation perspective (Bahmani-Oskooee et al., 2016; Bahmani-Oskooee and Aftab, 2018; and Bahmani-Oskooee and Harvey, 2017). By employing the NARDL model, Bahmani-Oskooee and Fariditavana (2016) found a J-Curve phenomenon in trade between the US and the UK, Italy, Germany, Canada and France. Different results were shown when the ARDL model were used. Subsequently, the NARDL method is used in other studies, including Ari et al., (2019); Bahmani-Oskooee et al. (2016); Bahmani-Oskooee and Karamelikli (2018); Harvey (2018).

Meanwhile, research-involving Indonesia has identified several findings. Husman (2005) found that the Marshall-Lerner condition exists in trade between Indonesia and Japan, Germany and South Korea and does not occur in the context of the US, China, the UK, Singapore and Taiwan. Research using the VECM method was also conducted by Adiningsih et al. (2013), which proved a J-Curve phenomenon between Indonesia and China, and Indonesia and Japan. Bahmani-Oskooee and Harvey (2017) apply the ARDL and NARDL approaches. With the ARDL model, Bahmani-Oskooee and Harvey (2017) shows that a J-Curve only occurs between Indonesia and the US, the Philippines, the UK and Singapore. Meanwhile, with the NARDL model, a J-Curve phenomenon can be identified in trade between Indonesia and Australia, the UK, Japan, South Korea and Singapore. In another study, Bahmani-Oskooee and Harvey (2015) used industry-level trade balance data to analyze a J-Curve phenomenon between Indonesia and the US. With the ARDL method, a J-Curve phenomenon was found in nine out of 23 industries.

So far, the study of the effect of exchange rate on trade balance at an industrial level in the case of Indonesia-China has not been conducted. Therefore, this paper aims to fill that gap. This paper employs the ARDL and NARDL models to identify the existence of a J-Curve phenomenon in 50 main industries in Indonesia and to determine whether there is asymmetric effect of exchange rate on trade balance.

Table 1. Summary of the Studies on Exchange Rate Effect

Author (year)	Method	Dependent variable	Independent variables	Countries	Time span	Results/Remarks
Studies with aggregate study setting						
Bahmani-Oskooee (1985)	Almon lag structures	Trade balance	Real exchange rate and GDP	Greece, Korea, India and Thailand	Quarterly: 1970-1980	J-curve found in all countries, except for Thailand
Noland (1989)	Gamma distributed lags	Export and import in two equations	Real exchange rate and GDP	Japan	Monthly: 1970-1985	Found J-curve for the case of Japan
Rose (1990)	3SLS	Trade balance	Real exchange rate and GDP	30 developing countries	Annual: 1970-1988 Quarterly: 1977-1987	The real exchange rate has no significant effects on the trade balance in 30 countries case.
Bahmani-Oskooee and Alse (1994)	Error-Correction Model	Trade balance	Real exchange rate and GDP	19 developed countries and 22 developing countries.	Quarterly: 1971-1990	Only 6 from 20 countries that show cointegrated relation between real exchange rate and trade balance
Lal and Lowinger (2002)	Error-Correction Model	Trade balance	Real effective exchange rate and GDP	7 east Asian countries with 15 largest export markets	Monthly: 1980-1988	6 East Asian countries of 7 experienced J-curve phenomena
Studies with bilateral study setting						
Rose and Yellen (1989)	IV estimation, OLS, polynomial distributed lags	Trade balance	Real exchange rate and GDP	The US and 6 trade partners	Quarterly: 1960-1985	No stable J-curve found.
Bahmani-Oskooee and Brooks (1999)	ARDL	Trade balance	Real exchange rate and GDP	The US and 6 largest trading partners	Quarterly: 1973-1996	Found no J-curve pattern in the short-run, but found depreciation of the US dollar has a favorable long-run effect.
Bahmani-Oskooee and Goswani (2003)	ARDL	Trade balance	Real exchange rate and GDP	Japan and 9 trading partners	Quarterly: 1973-1998	Found evidence of J-curve in the context of Japan-German and Japan-Italy trade relations.

Author (year)	Method	Dependent variable	Independent variables	Countries	Time span	Results/Remarks
Halicioglu (2007)	VECM	Trade balance	Real exchange rate and GDP	Turkey and 9 trading partners	Yearly: 1960-2000	Found no evidence of J-curve phenomena in all bilateral trade cases.
Husman (2005)	VECM	Trade balance	Real exchange rate and GDP	Indonesia and 8 trading partners	Monthly: 1993-2004	J-curve phenomenon found only in the Indonesian bilateral trade with Japan, South Korea and German.
Adiningsih et al. (2013)	VECM	Trade balance	Real exchange rate and GDP	Indonesia and 3 trading partners	Quarterly: 1996-2011	J-curve phenomenon found only in the Indonesian bilateral trade with Japan and China.
Iqbal et al. (2015)	VECM	Trade balance	Real exchange rate and GDP	Pakistan and 10 trading partners	Annually: 1980-2013	Found evidence of the long-run relationship between the real exchange rate and the trade balance in all bilateral cases.
Panda and Reddy (2016)	ARDL Bounds Testing Approach	Trade balance	Real exchange rate and GDP	India and China bilateral trade	Annually: 1987-2014	There is no J-curve effect for the case of India-China bilateral trade
Studies with industry study setting						
Bahmani-Oskooee and Wang (2008)	ARDL Bounds Testing Approach	Ratio of US imports of commodity *i* from China and US exports of commodity *i* to China	GDP_{US}, GDP_{CHINA}, Real exchange rate	The US and China 88 industries	Annually: 1978-2002	J-curve found in 22 industries.
Bahmani-Oskooee and Hajilee (2009)	ARDL Bounds Testing Approach	Ratio of Sweden export of commodity *i* to the US over Sweden imports of commodity *i* from the US	GDP_{SWEDEN}, GDP_{US}, Real exchange rate	Sweden and the US 87 industries	Annually: 1962-2004	J-curve found in 23 industries.
Bahmani-Oskooee and Mitra (2009)	ARDL Bounds Testing Approach	Ratio of India export of commodity *i* to the US over India imports of commodity *i* from the US	GDP_{INDIA}, GDP_{US}, Real exchange rate	India and the US 38 industries	Annually: 1962-2006	J-curve found in 8 industries.
Cao-Alvira (2014)	ARDL Bounds Testing Approach	Ratio of Colombian export of commodity *i* to each partner country over	GDP_{COL}, GDP_{J}, Real exchange rate	Colombia and 16 partners 13 industries	Monthly: 1998-2009	Found no evidence of J-curve.

Author (year)	Method	Dependent variable	Independent variables	Countries	Time span	Results/Remarks
		Colombian imports of commodity *i* from each partner country				
Durmaz (2015)	ARDL Bounds Testing Approach	Ratio of Turkey imports of commodity *i* from the rest of the world and Turkey exports of commodity *i* to the rest of the world	Turkey Industry production index, World Industry production index, Real exchange rate	Turkey 58 industries	Monthly: 1990-2012	J-curve found in 13 industries.
Bahmani-Oskooee and Baek (2015)	ARDL Bounds Testing Approach	Volume of US demand for Korean export at commodity level Volume of Korean import from the US at commodity level	GDP_{COL}, GDP_{J}, relative price of Korean and the US	Korea and the US 10 industries	Quarterly: 1991-2012	Marshall-Lerner condition is satisfied in four industries coded SITC1, SITC7, SITC8, and SITC9.
Bahmani-Oskooee and Harvey (2015)	ARDL Bounds Testing Approach	Ratio of the US export of commodity *i* to Indonesia over the US imports of commodity *i* from Indonesia	$GDP_{INDONESIA}$, GDP_{US}, Real exchange rate	Indonesia and the US 23 industries	Annually: 1973-2011	J-curve found in 9 industries.
Nhung et al. (2018)	VAR	Trade balance	Nominal exchange rate, GDP, oil price	Vietnam and Japan	Quarterly: 2001-2017	Found evidence of J-curve in Mineral fuels, mineral oils and products of their distillation

Author (year)	Method	Dependent variable	Independent variables	Countries	Time span	Results/Remarks
Bahmani-Oskooee and Aftab (2018)	ARDL & NARDL Models	Ratio of Malaysian imports from China over its exports to China	Indexes of industrial production of Malaysia and China, Real exchange rate, dummy financial crisis 2008	Malaysia and China 59 industries	Monthly: 2001-2015	For ARDL model, J-curve found in 12 industries. Short-run asymmetric effects found in 30 industries. Long-run asymmetric effects found in 27 industries.
Bahmani-Oskooee and Karamelikli (2018)	ARDL & NARDL Models	Ratio of Japan's imports of commodity *i* from the U.S. over her exports of commodity *i* to the U.S.	GDP_{JAPAN}, GDP_{US}, Real exchange rate	Japan and the US 56 industries	Quarterly: 1994-2017	Short-run asymmetric effects found in 44 industries. Long-run asymmetric effects found in 18 industries.
Bahmani-Oskooee and Nasir (2020)	ARDL & NARDL Models	Ratio of US's imports of commodity *i* from the UK over US exports of commodity *i* to the UK.	GDP_{UK}, GDP_{US}, Real exchange rate	UK and the US 68 industries	Monthly: 1996-2018	Short-run asymmetric effects found in 25 industries. Long-run asymmetric effects found in 27 industries.
Guo (2020)	ARDL Bounds Testing Approach	Export of China to the partner country at commodity level Import of China from the partner country at commodity level	Export, Import, nominal effective exchange rate, China's industrial production index, trade partner's industrial production index	China and the ten trade partners 8 industries	Monthly: 2008-2018	6 industries have the sum of import and export elasticities of demand more than unity.
Gobbi and Lucarelli (2022)	ARDL Bounds Testing Approach	Ratio of the UK export of commodity *i* to the US over the UK imports of commodity *i* from the US	GDP_{UK}, GDP_{US}, Real exchange rate	UK and the US 30 industries	Monthly: 2010-2019	Found one possible J-curve and two possible inverted J-curve

3. Methodology

This paper uses ARDL model to identify the existence a J-Curve phenomenon by involving estimation of short-term and long-term parameters. Meanwhile, the NARDL model is used to investigate whether the response of Indonesia-China trade balance to the appreciation and depreciation of the real IDR-CNY exchange rate is asymmetrical. Following Rose and Yellen (1989), we begin with the following specifications:

$$LnTB_{j,t} = \alpha_0 + \alpha_1 LnY_{C,t} + \alpha_2 LnY_{I,t} + \alpha_3 LnREX_t + \varepsilon_t \quad (1)$$

where $TB_{j,t}$ is a measure of the trade balance of industry *j* where trades between Indonesia and China happen. It is defined as the ratio of Indonesia exports of industry *j* to China over the imports of the same industry from China. $Y_{C,t}$ is a measure of economic activity in China and since increase in economic activity is expected to increase Indonesia's exports of commodity *j*, an estimate of α_1 is expected to be positive. Similarly, if an increase in Indonesia's economic activity that is denoted by $Y_{I,t}$ stimulates Indonesia import of commodity *j* from China, an estimate of α_2 is expected to be negative. Finally, REX_t is the real IDR-CNY rate, an increase reflects a depreciation of IDR or an appreciation of CNY. If real depreciation of IDR is to increase the Indonesian export of commodity j, an estimate of α_3 is expected to be positive.

Table 2. Variables and Definitions

No.	Variables	Definition	Data Source
1	$TB_{j,t}$	TB_j is defined as the Indonesia's trade balance of industry j with China. For sign consistency, we define it as the Indonesian imports of commodity j from China over the Indonesian exports of commodity j to China.	The World Bank
2	$Y_{C,t}$	Y_C is China's real GDP measured in US Dollar	National Bureau of Statistics of China
3	$Y_{I,t}$	Y_I is Indonesia's real GDP measured in US Dollar	Indonesian's statistic
4	REX_t	REXt = $NER\ Rp/Yuan \times \frac{CPI\ China}{CPI\ Indonesia}$ An increase in REX means a depreciation of IDR toward CNY.	IMF-International Financial Statistics

In order to identify a J-Curve effect, we need to accommodate the dynamic adjustment mechanism into (1). Following (Pesaran et al., 2001) bound testing approach, the error-correction model specification can be derived as follow:

$$\Delta LnTB_{j,t} = \beta_0 + \sum_{i=1}^{n1} \beta_{1,i} \Delta LnTB_{j,t-i} + \sum_{i=0}^{n2} \beta_{2,i} \Delta LnY_{C,t-i} + \sum_{i=0}^{n3} \beta_{3,i} \Delta LnY_{I,t-i} + \sum_{i=0}^{n4} \beta_{4,i} \Delta LnREX_{t-i} + \lambda_0 LnTB_{j,t-1} + \lambda_1 LnY_{C,t-1} + \lambda_2 LnY_{I,t-1} + \lambda_3 LnREX_{,t-1} + \xi_t \quad (2)$$

The above equation is an error-correction model. Instead of including the lagged error term from (1) in (2), Pesaran et al. (2001) recommend to include a linear combination of lagged level variables. They demonstrate that if lagged level variables are jointly significant by applying the F-test, variables in (1) are cointegrated. However, they also show that in this context the F-test has new critical values. Once (2) is estimated by OLS and cointegration is established, estimates of $\lambda_1 - \lambda_3$ normalized on λ_0 constitute long-run estimates. Short-run estimates are reflected in the coefficients attached to first-differenced variables.

Assumption in (1) or (2) is that exchange rate elasticity is the same for depreciation and appreciation. M. Bahmani-Oskooee and Fariditavana (2016) argued that this need not be the case because traders' expectation and reaction could be different. Shin et al. (2014) introduced the concept of asymmetric cointegration by decomposing the variable of concern into its positive and negative changes. In our case, we decompose $\Delta LnREX$, which includes positive changes (IDR depreciations) and negative changes (IDR appreciation). From this series we generate two new variables as follows:

$$POSt = \sum_{j=1}^{t} \Delta LnREX_j^{+} = \sum_{j=1}^{t} max(\Delta LnREXj,0),$$
$$NEGt = \sum_{j=1}^{t} \Delta LnREX_j^{-} = \sum_{j=1}^{t} min(\Delta LnREXj,0). \quad (3)$$

In (3) the *POS* variable is the partial sum of positive changes in $\Delta LnREX$ and represents only IDR depreciation toward CNY, and the *NEG* variable is the partial sum of negative changes and represents only IDR appreciation toward CNY. The next step is to go back to (2) and replace the *LnREX* variable by *POS* and *NEG* to derive the NARDL as follow:

$$\Delta LnTB_{j,t} = \beta_0 + \sum_{i=1}^{n1} \beta_{1,i} \Delta LnTB_{j,t-i} + \sum_{i=0}^{n2} \beta_{2,i} \Delta LnY_{C,t-i} + \sum_{i=0}^{n3} \beta_{3,i} \Delta LnY_{I,t-i} + \sum_{i=0}^{n4} \beta_{4,i} \Delta POS_{t-i} + \sum_{i=0}^{n5} \beta_{5,i} \Delta NEG_{t-I} + \gamma_0 LnTB_{j,t-1} + \gamma_1 LnY_{C,t-1} + \gamma_2 LnY_{I,t-1} + \gamma_3 POS_{t-1} + \gamma_4 NEG_{t-1} + \xi_t \quad (4)$$

4. Results and Discussion

This section estimates both the linear model (2) and the nonlinear model (4) for each of the 50 industries with trades between Indonesia and China. This paper used quarterly data over the period between 1Q of 1993 and 4Q of 2019 (108 observations). A maximum of four lags is imposed on each first-differenced variable, and Akaike's information criterion (AIC) is used to select an optimum model for each industry. Since there are different critical values for different estimates or diagnostic statistics, they are all collected in the notes to the tables and used to identify significant estimates at the 5% level with ** and at the 10% level with *.

Let us consider the estimates of the linear model (2) first. Due to the volume of the results, they are reported in Tables 5 to 7. While Table 5 reports only short-run coefficient estimates attached to the exchange rate (to save space), Table 6 reports long-run estimates for all exogenous variables. The diagnostic statistics are reported in Table 7.

Table 7 shows the short-term ARDL estimation results for the real exchange rate variable. The estimation results show that there are 14 industries, where the real exchange rate has a significant effect on the trade balance in the short term, namely industries 057, 251, 513, 523, 598, 652, 653, 657, 675, 744, 759, 771, 773, and 785. A significant positive effect was shown by industry 653, 744, and 759. A significant negative effect was demonstrated by industries 057, 251, 513, 598, 652, 657, 675, 771, 773, and 785, while significant positive and negative effects were shown by industry 523.

Table 6 shows the results of the long-term ARDL estimation of all dependent and independent variables. With respect to China's real GDP (YC), 13 industries show a significant positive, namely industries 251, 285, 333, 422, 511, 515, 522, 523, 598, 671, 682, 743, and 772. Meanwhile, 22 industries showed a significant negative, namely 054, 057, 334, 431, 634, 641, 651, 652, 653, 655, 657, 676, 684, 711, 716, 728, 741, 744, 752, 759, 773, and 793. The negative effect of China's real GDP shows that in line with the increase in economic activity, more Chinese producers are producing imported substitute goods in the industry; hence, they need less imported goods from Indonesia. This conclusion is in line with Adiningsih et al. (2013), Bahmani-Oskooee and Harvey (2015), and Bahmani-Oskooee and Mitra (2009).

With respect to Indonesia's real GDP (YI), nine industries show a significant positive effect, namely industries 057, 333, 334, 431, 562, 634, 684, 773, and 793. Meanwhile, 13 industries show a significant negative effect (231, 251, 285, 511, 512, 653, 657, 682, 716, 728, 743, 771, and 772). In the real exchange rate (RER), we find that seven industries show a significant positive effect, namely industry 057, 321, 333, 431, 651, 764, and 773, while six industries show a significant negative (285, 512, 655, 682, 728, and 772).

Table 5 shows the results of the ARDL diagnostic test. In terms of cointegration condition, we use the bound test introduced by Pesaran et al. (1996). Based on the F test, we find that 13 industries are not cointegrated, and 38 industries are cointegrated in the long run. The results of the *ECMt-1* test showed that all models are significantly negative and less than one. The Lagrange Multiplier test indicates that only two models have autocorrelation (rejecting the null hypothesis) problem (657 and 851). The results of the *Ramsey RESET* test show that 15 models are not well specified (rejecting the null hypothesis), namely industry 283, 431, 515, 634, 651, 652, 671, 672, 679, 728, 741, 743, 772, 778, 793, while 35 other industries have suitable specification.

The results of the *CUSUM* stability test show that there are three industries with unstable models, while the other 47 industries have stable models. The *CUSUMSQ* test indicates 11 industries with stable models, while 39 other models are declared unstable.

Table 2. Short-run Estimates of the Linear ARDL Model

Code	Industry	Short-run Estimates				
		ΔlnRERt	**ΔlnRERt-1**	**ΔlnRERt-2**	**ΔlnRERt-3**	**ΔlnRERt-4**
054	Vegetables, frsh/chld/frz	-	-	-	-	-
057	Fruit/nuts, fresh/dried	-4.00 (-2.03)*	-3.87 (-1.79)*	-6.81 (-3.32)**	-4.47 (-3.71)	-
231	Natural rubber/latex/etc	-	-	-	-	-
251	Pulp and waste paper	1.97 (0.99)	-5.10 (-3.08)**	-1.93 (-2.10)**	-	-
283	Copper ores/concentrates	-	-	-	-	-
285	Aluminium ores/concs/etc	-	-	-	-	-
321	Coal non-agglomerated	-1.34 (-0.46)	-	-	-	-
333	Petrol/bitum. oil, crude	-	-	-	-	-
334	Heavy petrol/bitum oils	-	-	-	-	-
422	Fixed veg oils not soft	-	-	-	-	-
431	Animal/veg oils procesd	-	-	-	-	-
511	Hydrocarbons/derivatives	-	-	-	-	-
512	Alcohols/phenols/derivs	-	-	-	-	-
513	Carboxylic acid compound	0.32 (0.30)	-2.20 (-2.09)**	-	-	-
515	Organo-inorganic compnds	-	-	-	-	-
522	Elements/oxides/hal salt	-	-	-	-	-
523	Metal salts of inorg acd	0.45 (0.26)	-0.07 (-0.05)	3.73 (2.46)**	-3.81 (-2.60)**	-
562	Manufactured fertilizers	-	-	-	-	-
598	Misc chemical prods nes	-2.99 (-1.92)*	-	-	-	-
634	Veneer/plywood/etc	-	-	-	-	-
641	Paper/paperboard	-	-	-	-	-
651	Textile yarn	-	-	-	-	-
652	Cotton fabrics, woven	-3.08 (-2.61)**	-	-	-	-
653	Man-made woven fabrics	2.04 (2.32)**	-0.80 (-1.90)	-0.62 (1.43)	-	-
655	Knit/crochet fabrics	-	-	-	-	-
657	Special yarns/fabrics	-1.59 (-1.30)	-0.69 (-1.40)	-1.08 (-2.18)**	-	-
671	Pig iron etc ferro alloy	-	-	-	-	-
672	Primary/prods iron/steel	-	-	-	-	-
675	Flat rolled alloy steel	-0.63 (-0.68)	-2.25 (-2.38)**	-	-	-

Code	Industry	Short-run Estimates				
		ΔlnRERt	**ΔlnRERt-1**	**ΔlnRERt-2**	**ΔlnRERt-3**	**ΔlnRERt-4**
676	Iron/steel bars/rods/etc	-	-	-	-	-
679	Iron/steel pipe/tube/etc	-	-	-	-	-
682	Copper	-	-	-	-	-
684	Aluminium	-	-	-	-	-
711	Steam generating boilers	-	-	-	-	-
716	Rotating electr plant	-	-	-	-	-
723	Civil engineering plant	-	-	-	-	-
728	Special indust machn nes	-	-	-	-	-
741	Indust heat/cool equipmt	-	-	-	-	-
743	Fans/filters/gas pumps	-	-	-	-	-
744	Mechanical handling equi	1.72 (2.68)**	1.12 (1.78)*	-0.82 (-1.29)	1.60 (2.52)	-
752	Computer equipment	-1.13 (-0.99)	-	-	-	-
759	Office equip parts/accs.	0.61 (0.28)	-0.08 (-0.04)	5.10 (2.92)**	2.89 (1.67)*	-
764	Telecomms equipment nes	-	-	-	-	-
771	Elect power transm equip	-1.26 (-1.70)*	-0.38 (-0.54)**	-1.98 (-2.91)**	-0.98 (-1.35)	-
772	Electric circuit equipmt	-	-	-	-	-
773	Electrical distrib equip	0.42 (0.48)	-1.97 (-2.26)**	-1.22 (-1.38)	-	-
778	Electrical equipment nes	-	-	-	-	-
785	Motorcycles/cycles/etc	-3.33 (-1.97)**	-2.17 (-1.39)	-1.53 (-1.01)	-3.68 (-2.57)**	-
793	Ships/boats/etc	-	-	-	-	-
851	Footwear	-	-	-	-	-

Source: Research finding.

Note: a. (**) significance at 5%; (*) significance at 10%. b. The parentheses represents the value of t-statistic. c. Critical values of t-test at 5% (1.96); 10% (1.64).

Table 3. Long-run Estimates of the Linear ARDL Model

Code	Industry	Long-run Estimates			
		C	**lnYC**	**lnYI**	**lnRER**
054	Vegetables,frsh/chld/frz	1.98 (0.50)	-0.42 (-2.70)**	-0.35 (-0.71)	-0.45 (-0.48)
057	Fruit/nuts, fresh/dried	-53.59 (-4.85)**	-1.31 (-4.42)**	8.27 (8.00)**	9.86 (5.13)**

Code	Industry	Long-run Estimates			
		C	lnYC	lnYI	lnRER
231	Natural rubber/latex/etc	13.14 (1.62)	0.14 (0.20)	-6.65 (-3.22)**	-4.36 (-0.10)
251	Pulp and waste paper	13.95 (1.82)*	1.06 (3.31)**	-3.45 (-3.52)**	-3.04 (-1.47)
283	Copper ores/concentrates	0.70 (0.10)	0.32 (0.27)	0.15 (0.04)	0.19 (0.03)
285	Aluminium ores/concs/etc	6.87 (1.30)	1.80 (5.15)**	-1.89 (-1.75)*	-3.33 (-1.78)*
321	Coal non-agglomerated	-17.70 (-1.60)	0.10 (0.07)	1.92 (0.45)	15.97 (1.72)*
333	Petrol./bitum. oil, crude	-13.46 (-2.17)**	1.32 (2.95)**	5.02 (3.72)**	4.88 (1.99)**
334	Heavy petrol/bitum oils	-9.92 (-1.69)*	-1.45 (-2.42)**	5.03 (2.56)**	5.79 (1.61)
422	Fixed veg oils not soft	2.13 (0.41)	2.03 (4.16)**	-0.38 (-0.25)	-2.11 (-0.82)
431	Animal/veg oils procesd	-13.48 (-2.23)**	-1.84 (-6.16)**	2.49 (2.61)**	5.05 (3.26)**
511	Hydrocarbons/derivatives	10.93 (1.02)	1.98 (4.67)**	-5.78 (-4.57)**	-1.28 (-0.47)
512	Alcohols/phenols/derivs	13.90 (2.58)**	0.33 (1.13)	-2.91 (-3.26)**	-3.33 (-2.13)**
513	Carboxylic acid compound	-6.36 (-0.83)	-1.01 (-1.34)	1.07 (0.41)	4.53 (0.99)
515	Organo-inorganic compnds	8.36 (1.10)	1.27 (1.72)*	-3.71 (-1.59)	-5.31 (-1.32)
522	Elements/oxides/hal salt	0.03 (0.01)	1.34 (3.36)**	-1.92 (-1.56)	-0.52 (-0.25)
523	Metal salts of inorg acd	8.92 (1.22)	1.79 (1.68)*	-5.19 (-1.50)	-9.10 (-1.27)
562	Manufactured fertilizers	-7.85 (-0.62)	-1.15 (-0.67)	7.32 (1.66)*	3.25 (0.33)
598	Misc chemical prods nes	0.08 (0.02)	1.05 (2.80)**	-0.87 (-0.76)	-0.75 (-0.32)
634	Veneer/plywood/etc	-9.57 (-1.51)	-1.87 (-2.69)**	4.77 (2.20)**	6.02 (1.61)
641	Paper/paperboard	-5.12 (-1.00)	-2.32 (-3.50)**	3.39 (1.51)	5.31 (1.25)
651	Textile yarn	-4.63 (-0.82)	-0.90 (-4.22)**	-0.65 (-0.99)	2.47 (1.78)*
652	Cotton fabrics, woven	5.30 (1.29)	-0.10 (-3.50)**	-1.14 (-1.30)	-1.69 (-0.94)
653	Man-made woven fabrics	8.91 (2.50)**	-1.85 (-14.91)**	-0.95 (-2.48)**	-0.58 (-0.75)
655	Knit/crochet fabrics	7.72 (2.36)**	-1.49 (-9.42)**	-0.69 (-1.41)	-1.43 (-1.70)**
657	Special yarns/fabrics	1.31 (0.35)	-0.68 (-2.64)**	-1.98 (-2.40)**	0.83 (0.51)
671	Pig iron etc ferro alloy	-6.52 (-0.81)	3.08 (3.38)**	-0.60 (-0.21)	2.34 (0.45)
672	Primary/prods iron/steel	-10.02 (-1.32)	1.78 (0.86)	4.43 (0.75)	11.57 (1.05)
675	Flat rolled alloy steel	-4.36 (-0.62)	-1.23 (-1.04)	1.38 (0.33)	5.57 (0.66)
676	Iron/steel bars/rods/etc	10.99 (1.23)	-3.82 (-8.60)**	-1.33 (-0.98)	-1.02 (-0.35)
679	Iron/steel pipe/tube/etc	0.41 (0.09)	0.04 (0.13)	-1.30 (-1.42)	-0.08 (-0.05)
682	Copper	21.87 (5.01)**	0.46 (2.82)**	-4.66 (-9.19)**	-6.90 (-6.61)**
684	Aluminium	-8.87 (-1.15)	-2.05 (-8.46)**	1.67 (2.41)**	2.39 (1.50)

Code	Industry	Long-run Estimates			
		C	lnYC	lnYI	lnRER
711	Steam generating boilers	11.81 (1.61)	-2.66 (-5.90)**	-2.25 (-1.63)	-2.31 (-0.98)
716	Rotating electr plant	-0.56 (-0.14)	-0.68 (-2.03)**	-1.82 (-1.74)*	1.67 (0.93)
723	Civil engineering plant	-0.86 (-0.13)	-0.56 (-1.11)	-2.48 (-1.55)	2.03 (0.75)
728	Special indust machn nes	24.59 (3.44)**	-0.83 (-4.73)**	-2.58 (-4.78)**	-3.16 (-3.43)**
741	Indust heat/cool equipmt	-6.58 (-0.95)	-1.03 (-1.65)*	0.66 (0.35)	3.80 (1.14)
743	Fans/filters/gas pumps	17.51 (3.56)**	0.41 (1.93)*	-3.62 (-5.53)**	-4.66 (-4.37)
744	Mechanical handling equi	2.01 (0.41)	-1.03 (-3.33)**	-1.47 (-1.41)	0.08 (0.04)
752	Computer equipment	-4.61 (-0.56)	-1.89 (-3.90)**	1.70 (1.06)	1.72 (0.65)
759	Office equip parts/accs.	-4.81 (-0.58)	-2.39 (-2.05)**	2.75 (0.93)	3.87 (0.63)
764	Telecomms equipment nes	-5.65 (-1.64)*	-1.52 (-3.31)	0.12 (0.08)	5.17 (2.21)**
771	Elect power transm equip	9.07 (1.26)*	0.36 (1.15)	-4.53 (-4.39)**	-1.50 (-0.69)
772	Electric circuit equipmt	14.73 (2.11)**	0.71 (2.33)**	-4.42 (-4.80)**	-3.03 (-1.95)*
773	Electrical distrib equip	-19.27 (-2.71)**	-1.59 (-4.91)**	1.96 (1.75)*	6.45 (3.25)**
778	Electrical equipment nes	-0.05 (-0.01)	-0.10 (-0.39)	-1.10 (-1.37)	0.39 (0.28)
785	Motorcycles/cycles/etc	-2.09 (-0.30)	-0.34 (-1.14)	0.52 (0.62)	-0.18 (-0.10)
793	Ships/boats/etc	-11.76 (-1.44)	-1.70 (-2.13)**	5.57 (2.31)**	5.40 (1.28)
851	Footwear	-7.87 (-1.36)	0.47 (1.02)	2.13 (1.46)	3.15 (1.07)

Source: Research finding. **Note**: a. (**) significance at 5%; (*) significance at 10% b. The parentheses represents the value of t-statistic c. Critical values of t-test at 5% (1.96); 10% (1.64).

Table 4. Linear ARDL Model Diagnostic Statistics

Code	Industry	F	ECM_{t-1}	LM	RESET	Adj. R^2	CUSUM	CUSUMSQ
054	Vegetables,frsh/chld/frz	9.59**	-0.46 (-6.29)**	1.15	0.13	0.36	S	US
057	Fruit/nuts, fresh/dried	13.05**	-0.48 (-7.35)**	0.98	1.28	0.43	S	US
231	Natural rubber/latex/etc	4.01*	-0.18 (-4.07)**	0.48	0.02	0.21	S	US
251	Pulp and waste paper	8.09**	-0.39 (-5.78)**	0.79	1.74	0.32	US	S
283	Copper ores/concentrates	1.80	-0.12 (-2.72)**	1.29	9.33**	0.06	S	US
285	Aluminium ores/concs/etc	5.66**	-0.30 (-4.83)**	1.51	1.55	0.31	S	US
321	Coal non-agglomerated	3.65	-0.14 (-3.88)**	0.03	2.40	0.23	S	S
333	Petrol./bitum. oil,crude	4.98*	-0.20 (-4.53)**	0.11	0.13	0.22	S	US
334	Heavy petrol/bitum oils	3.54	-0.17 (-3.82)**	0.51	2.40	0.18	S	US

Code	Industry	F	ECM_{t-1}	LM	RESET	Adj. R^2	CUSUM	CUSUMSQ
422	Fixed veg oils not soft	5.90**	-0.22 (-4.93)**	1.74	0.99	0.26	S	S
431	Animal/veg oils procesd	6.96**	-0.40 (-5.36)**	1.07	7.42**	0.23	S	US
511	Hydrocarbons/derivatives	8.70**	-0.44 (-5.99)**	0.82	0.02	0.30	S	US
512	Alcohols/phenols/derivs	8.86**	-0.37 (-6.05)**	0.98	1.67	0.29	S	US
513	Carboxylic acid compound	3.72**	-0.19 (-3.92)**	1.78	2.95	0.16	S	US
515	Organo-inorganic compnds	2.89	-0.19 (-3.45)**	0.96	7.77**	0.09	S	US
522	Elements/oxides/hal salt	5.06**	-0.23 (-4.57)**	0.19	0.79	0.27	US	US
523	Metal salts of inorg acd	1.96	-0.12 (-2.85)**	0.79	0.55	0.21	S	US
562	Manufactured fertilizers	1.71	-0.13 (-2.65)**	0.41	0.66	0.19	S	S
598	Misc chemical prods nes	5.19**	-0.26 (-4.63)**	0.28	0.18	0.26	S	US
634	Veneer/plywood/etc	2.93	-0.17 (-3.48)**	0.58	5.23**	0.09	S	US
641	Paper/paperboard	3.97**	-0.13 (-4.05)**	0.71	0.69	0.27	S	US
651	Textile yarn	10.27**	-0.47 (-6.51)**	0.54	3.80**	0.29	S	US
652	Cotton fabrics, woven	4.06**	-0.25 (-4.10)**	2.56	6.63**	0.25	S	US
653	Man-made woven fabrics	12.11**	-0.47 (-7.07)**	1.11	0.09	0.37	S	US
655	Knit/crochet fabrics	9.09**	-0.40 (-6.12)**	0.39	0.16	0.29	S	US
657	Special yarns/fabrics	4.62**	-0.26 (-4.37)**	4.37**	0.60	0.38	S	US
671	Pig iron etc ferro alloy	3.67	-0.18 (-3.89)**	0.32	4.36**	0.12	S	US
672	Primary/prods iron/steel	1.86	-0.08 (-2.77)**	1.86	4.14**	0.12	S	US
675	Flat rolled alloy steel	1.98	-0.10 (-2.85)**	0.14	0.90	0.12	S	S
676	Iron/steel bars/rods/etc	5.66**	-0.33 (-4.83)**	0.83	0.13	0.29	S	S
679	Iron/steel pipe/tube/etc	5.68**	-0.31 (-4.84)**	1.07	3.99**	0.19	S	US
682	Copper	14.39**	-0.31 (-7.70)**	2.21	0.00	0.50	S	US
684	Aluminium	11.13**	-0.54 (-6.78)**	1.21	0.00	0.33	S	S
711	Steam generating boilers	3.81*	-0.29 (-3.97)**	0.15	0.55	0.12	S	US
716	Rotating electr plant	5.62**	-0.24 (-4.81)**	0.10	1.75	0.22	S	US
723	Civil engineering plant	4.07*	-0.28 (-4.09)**	0.16	0.32	0.13	US	US
728	Special indust machn nes	9.97**	-0.67 (-6.41)**	0.41	6.74**	0.31	S	US
741	Indust heat/cool equipmt	3.67	-0.22 (-3.89)**	0.53	7.99**	0.12	S	US
743	Fans/filters/gas pumps	8.81**	-0.39 (-6.03)**	0.36	8.62**	0.29	S	US
744	Mechanical handling equi	6.11**	-0.27 (-5.02)**	0.04	0.16	0.37	S	S
752	Computer equipment	8.36**	-0.33 (-5.88)**	2.77	1.84	0.26	S	S

Code	Industry	F	ECM_{t-1}	LM	RESET	Adj. R^2	CUSUM	CUSUMSQ
759	Office equip parts/accs.	5.01**	-0.16 (-4.55)**	0.69	0.57	0.33	S	S
764	Telecomms equipment nes	5.14**	-0.18 (-5.03)**	0.67	0.17	0.22	S	US
771	Elect power transm equip	8.26**	-0.31 (-5.84)**	0.63	1.55	0.26	S	US
772	Electric circuit equipmt	6.41**	-0.41 (-5.14)**	0.94	3.96**	0.18	S	S
773	Electrical distrib equip	9.04**	-0.37 (-6.11)**	1.10	1.06	0.30	S	US
778	Electrical equipment nes	7.25**	-0.42 (-5.47)**	1.90	5.93**	0.21	S	US
785	Motorcycles/cycles/etc	9.19**	-0.42 (-6.16)**	0.37	3.06	0.30	S	US
793	Ships/boats/etc	3.13	-0.19 (-3.59)**	0.42	4.49**	0.12	S	US
851	Footwear	4.20	-0.20 (-4.17)**	3.14**	1.83	0.25	S	US

Source: Research finding.
Note: a. (**) significance at 5%; (*) significance at 10% b. For F, 5% = upper bound (4.35); lower bound (3.23) and 10%= upper bound (3.77); lower bound (2.72) c. The number inside the parentheses next to ECMt-1 is the absolute value of the t-ratio d. Critical value of t-test at 5% (1.96); 10% (1.64)
e. For LM and RESET, significance if Prob < 0.05

Next, we consider the estimates of the NARDL model. Again, due to the volume of the results, they are reported in four tables. While Table6 reports short-run estimates associated with IDR appreciation and depreciation. Long-run estimates appear in Table 7 and the associated diagnostics in Table 8.

Table 5. Short-run Estimates (Depreciation & Appreciation) From the NARDL Model

Code	Short-run Estimates									
	ΔPOSt	ΔPOSt-1	ΔPOSt-2	ΔPOSt-3	ΔPOSt-4	ΔNEGt	ΔNEGt-1	ΔNEGt-2	ΔNEGt-3	ΔNEGt-4
054	-5.70** (-3.17)	6.33** (4.84)	-3.25** (-3.43)	-	-	0.38 (0.22)	-0.08 (-0.09)	1.95** (2.65)	1.29* 1.81)	-
057	-2.81 (-0.83)	-	-	-	-	-1.78 (-0.50)	-5.31** (-3.36)	-5.41** (-3.27)	-3.96** (-2.33)	-
231	-	-	-	-	-	-	-	-	-	-
251	-	-	-	-	-	-	-	-	-	-
283	-	-	-	-	-	-	-	-	-	-
285	-	-	-	-	-	-	-	-	-	-
321	-1.72 (-0.49)	10.45** (2.91)	-	-	-	-0.90 (-0.30)	-6.13** (-2.46)	-	-	-
333	-	-	-	-	-	-	-	-	-	-
334	-2.07* (-1.74)	-	-	-	-	-	-	-	-	-
422	-	-	-	-	-					
431	-	-	-	-	-	-1.09 (-0.52)	-	-	-	-

Code	Short-run Estimates									
	ΔPOSt	**ΔPOSt-1**	**ΔPOSt-2**	**ΔPOSt-3**	**ΔPOSt-4**	**ΔNEGt**	**ΔNEGt-1**	**ΔNEGt-2**	**ΔNEGt-3**	**ΔNEGt-4**
511	5.96** (2.83)	-6.83** (-3.46)	-	-	-		-	-	-	-
512	-	-	-	-	-		-	-	-	-
513	-	-	-	-	-	0.31 (0.18)	-4.62** (-2.78)	-3.39** -(1.99)	-	-
515	-0.86 (-0.50)	-	-	-	-	-	-	-	-	-
522	-	-	-	-	-	0.50 (0.34)	0.30 (0.25)	1.21 (0.39)	0.46** (2.80)	-
523	1.87 (0.57)	-0.90 (-0.36)	5.77** (2.22)	-	-	2.15 (0.62)	0.10 (0.06)	3.12* (1.93)	-4.99** (-3.08)	-
562	-	-	-	-	-	-	-	-	-	-
598	-	-	-	-	-	-4.61** (-3.14)	-	-	-	-
634	-	-	-	-	-	-	-	-	-	-
641	-	-	-	-	-	-0.69 (-0.50)	1.97** (2.09)	-	-	-
651	-	-	-	-	-	-	-	-	-	-
652	-	-	-	-	-	-	-	-	-	-
653	-	-	-	-	-	-	-	-	-	-
655	-	-	-	-	-	-	-	-	-	-
657	-1.19 (-0.91)	-3.12** (-2.58)	-2.72** (-3.15)	-	-	-	-	-	-	-
671	-	-	-	-	-	-	-	-	-	-
672	-	-	-	-	-	-	-	-	-	-
675	-4.18 (-1.41)	-4.90* (-1.83)	-8.11** (-2.92)	-7.14** (-2.46)	-	-	-	-	-	-
676	-7.50** (-4.18)	3.17* (1.95)	-3.88** (-2.12)	-	-	-	-	-	-	-
679	-	-	-	-	-	-	-	-	-	-
682	-1.21 (-1.25)	-1.85** (-3.34)	-	-	-	-	-	-	-	-
684	-	-	-	-	-	-	-	-	-	-
711	-	-	-	-	-	-	-	-	-	-
716	-	-	-	-	-	-	-	-	-	-
723	-	-	-	-	-	-	-	-	-	-
728	-6.66** (-3.09)	-2.53** (-1.69)	-3.25* (-1.93)	-3.17** (-2.22)	-	-	-	-	-	-
741	-	-	-	-	-	-	-	-	-	-
743	-1.69 (-0.99)	-	-	-	-	-	-	-	-	-
744	0.13 (0.14)	-	-	-	-	-0.46 (-0.31)	2.29 (1.53)	-1.63* (-1.64)	-	-
752	-	-	-	-	-	-1.80 (-0.89)	-	-	-	-
759	-5.34 (-1.60)	-5.58** (-2.15)	4.91* (1.82)	5.06* (1.84)	-	-4.31 (-1.13)	3.73** (2.10)	3.95 (2.26)	-	-
764	3.44** (3.71)	-	-	-	-	-	-	-	-	-
771	-2.72** (-2.22)	-0.34 (-0.32)	-4.32** (-3.70)	-1.42** (-1.34)	-	-	-	-	-	-
772	-	-	-	-	-	-	-	-	-	-
773	1.11 (0.70)	-2.60* (-1.85)	-	-	-	-	-	-	-	-

Code	Short-run Estimates									
	ΔPOSt	**ΔPOSt-1**	**ΔPOSt-2**	**ΔPOSt-3**	**ΔPOSt-4**	**ΔNEGt**	**ΔNEGt-1**	**ΔNEGt-2**	**ΔNEGt-3**	**ΔNEGt-4**
778	-	-	-	-	-	-	-	-	-	-
785	-0.28 (-0.13)	-	-	-	-	-3.94* (-1.96)	-	-	-	-
793	-	-	-	-	-	-	-	-	-	-
851	-2.46 (-1.48)	2.59* (1.64)	-	-	-	-	-	-	-	-

Source: Research finding.

Note: a. (**) significance at 5%; (*) significance at 10%. b. The parentheses represents the value of t-statistic. c. Critical values of t-test at 5% (1.96); 10% (1.64).

Table 6 shows the results of the short-term NARDL estimation for the real exchange rate variable, which is specified into positive (depreciation) and negative (appreciation) effects. On the depreciation variable (ΔPOS), a significant positive effect is shown by industry 321, 523, 764, and 851, a significant negative effect is demonstrated by industry 334, 657, 675, 682, 728, 771, and 773, while significant positive and negative effects are shown by industry 054, 511, 676, and 759. In the appreciation variable (ΔNEG), a significant positive effect is demonstrated by industry 054, 522, 641, and 759; a significant negative effect is shown by industry 057, 321, 513, 598, 744, and 785, while significant positive and negative effects are shown by industry 523.

Table 7 shows the long-term NARDL estimates of all variables. In China's real GDP variable (lnYC), eight industries show a significant positive, namely 054, 283, 285, 515, 562, 651, 671, and 728. Meanwhile, five industries show a significant negative (598, 741, 743, 764, and 773). In Indonesia's real GDP variable (lnYI), four industries show a significant positive (057, 598, 764, and 773). Meanwhile, 14 industries show a significant negative effect, namely 054, 251, 283, 285, 512, 515, 651, 652, 655, 676, 682, 716, 728, and 771.

Table 6. Long-run Coefficient Estimates of the Nonlinear ARDL Model

Code	Industry	Long term Estimates				
		Konstanta	**lnYC**	**lnYI**	**POS**	**NEG**
054	Vegetables, frsh/chld/frz	1.96 (1.92)*	4.08 (3.25)**	-4.96 (-3.75)**	-4.75 (-2.80)**	0.77 0.68)
057	Fruit/nuts, fresh/dried	-19.78 (-5.70)**	-2.73 (-0.92)	9.60 (2.93)**	10.11 (2.44)**	8.02 (3.79)**
231	Natural rubber/latex/etc	7.93 (2.97)**	-4.31 (-1.12)	-2.34 (-0.52)	-1.07 (-0.17)	-6.36 (-1.76)*
251	Pulp and waste paper	6.20 (2.71)**	2.72 (1.49)	-5.18 b(2.51)**	-3.69 (-1.36)	-1.60 (-1.03)
283	Copper ores/concentrates	2.93 (1.20)	14.05 (2.09)**	-13.92 (-1.91)*	-16.12 (-1.69)*	-0.28 (-0.06)

Code	Industry	Long term Estimates				
		Konstanta	lnYC	lnYI	POS	NEG
285	Aluminium ores/concs/etc	1.14 (0.67)	7.27 (2.76)**	-7.60 (-2.57)**	-10.13 (-2.67)**	-3.97 (-2.08)**
321	Coal non-agglomerated	-3.09 (-1.08)	5.45 (0.49)	-0.84 (0.07)	9.85 (0.61)	14.21 (1.24)
333	Petrol./bitum. oil,crude	-6.72 (-3.07)**	1.00 (0.25)	5.36 (1.25)	5.27 (0.99)	4.90 (1.97)**
334	Heavy petrol/bitum oils	-3.48 (-2.09)**	-1.10 (-0.36)	4.46 (1.26)	6.30 (1.36)	7.07 (2.48)**
422	Fixed veg oils not soft	-0.78 (-0.44)	3.69 (1.28)	-2.12 (-0.63)	-4.15 (-0.95)	-2.29 (-0.89)
431	Animal/veg oils procesd	1.39 (0.67)	1.43 (0.70)	-0.93 (-0.40)	-0.46 (-0.14)	2.87 (1.35)
511	Hydrocarbons/derivatives	7.26 (2.65)**	-2.60 (-1.10)	-1.43 (-0.54)	3.09 (0.86)	-2.30 (-1.04)
512	Alcohols/phenols/derivs	5.70 (3.04)**	2.47 (1.07)	-5.11 (-2.02)**	-6.04 (-1.80)*	-3.60 (-2.20)**
513	Carboxylic acid compound	-3.04 (-1.23)	-5.68 (-0.74)	9.21 (0.98)	10.20 (0.90)	4.18 (0.71)
515	Organo-inorganic compnds	3.73 (1.56)	9.74 (1.73)*	-13.75 (-1.97)**	-19.11 (-2.19)**	-10.30 (-2.10)**
522	Elements/oxides/hal salt	0.19 (0.10)	0.95 (0.28)	-2.20 (-0.58)	-0.75 (-0.15)	-0.93 (-0.49)
523	Metal salts of inorg acd	0.01 (0.01)	-5.50 (-0.92)	2.65 (0.42)	-1.40 (-0.17)	-10.44 (-1.61)
562	Manufactured fertilizers	-4.87 (-1.38)	15.05 (1.95)**	-8.92 (-1.03)	-10.77 (-0.98)	8.54 (1.37)
598	Misc chemical prods nes	-2.69 (-1.87)*	-4.18 (-2.09)**	4.37 (1.90)*	5.31 (1.83)*	-0.89 (-0.46)
634	Veneer/plywood/etc	-2.46 (-1.20)	-3.44 (-0.79)	6.44 (1.25)	7.99 (1.20)	6.24 (1.63)
641	Paper/paperboard	-0.01 (-0.01)	1.09 (0.25)	-0.11 (-0.02)	1.98 (0.30)	6.08 (1.53)
651	Textile yarn	4.03 (2.42)**	0.81 (0.64)*	-2.41 (-1.68)*	0.44 (0.22)	2.37 (1.68)*
652	Cotton fabrics, woven	3.75 (3.40)**	1.97 (1.09)	-5.10 (-2.37)**	-6.86 (-2.37)**	-3.66 (-2.34)**
653	Man-made woven fabrics	5.81 (4.33)**	-1.50 (-1.59)	-1.10 (-1.08)	-1.03 (-0.78)	-0.71 (-1.07)
655	Knit/crochet fabrics	4.35 (3.50)**	0.09 (0.07)	-2.35 (-1.75)*	-3.42 (-1.99)**	-1.66 (-1.94)*
657	Special yarns/fabrics	5.14 (4.40)**	-0.86 (-0.58)	-2.15 (-1.37)	1.81 (0.92)	2.05 (1.83)*
671	Pig iron etc ferro alloy	-2.68 (-0.97)	9.71 (1.95)*	-7.77 (-1.33)	-6.43 (-0.85)	0.94 (0.20)
672	Primary/prods iron/steel	-3.03 (-1.14)	10.79 (0.63)	-4.50 (-0.26)	1.22 (0.06)	11.35 (0.98)
675	Flat rolled alloy steel	3.50 (1.57)	11.32 (1.26)	-14.88 (-1.56)	-11.83 (-0.99)	4.06 (0.44)
676	Iron/steel bars/rods/etc	10.22 (3.46)**	3.55 (1.12)	-8.55 (-2.52)**	-7.66 (-1.79)*	1.26 (0.41)
679	Iron/steel pipe/tube/etc	0.48 (0.29)	1.40 (0.59)	-2.66 (-1.02)	-0.96 (-0.28)	0.68 (0.29)
682	Copper	6.99 (6.15)**	-0.36 (-0.39)	-3.79 (-3.63)**	-5.81 (-3.93)**	-6.66 (-6.86)**
684	Aluminium	1.07 (0.63)	1.51 (1.16)	-1.78 (-1.26)	-0.78 (-0.43)	3.46 (3.69)**

Code	Industry	Long term Estimates				
		Konstanta	lnYC	lnYI	POS	NEG
711	Steam generating boilers	7.07 (2.46)**	0.22 (0.05)	-5.34 (-1.06)	-5.96 (-0.94)	-2.83 (-1.05)
716	Rotating electr plant	2.72 (1.82)*	1.87 (0.86)	-4.48 (-1.86)*	-1.49 (-0.48)	1.39 (0.77)
723	Civil engineering plant	2.77 (1.06)	-1.82 (-0.60)	-1.15 (-0.32)	3.60 (0.78)	2.19 (0.81)
728	Special indust machn nes	13.80 (4.84)**	4.01 (2.27)**	-7.39 (-3.92)**	-7.32 (-3.14)**	-1.42 (-1.10)
741	Indust heat/cool equipmt	-1.82 (-0.79)	-5.56 (-1.83)*	5.46 (1.52)	9.34 (2.00)**	4.24 (1.49)
743	Fans/filters/gas pumps	4.90 (3.04)**	-6.02 (-3.18)**	2.53 (1.31)	1.37 (0.57)	-6.16 (-4.52)**
744	Mechanical handling equi	1.54 (1.03)	-0.84 (-0.36)	-1.26 (-0.46)	0.52 (0.14)	0.82 (0.38)
752	Computer equipment	-0.91 (-0.33)	-5.57 (-1.31)	5.06 (1.11)	5.27 (0.91)	0.85 (0.36)
759	Office equip parts/accs.	0.51 (0.26)	-1.50 (-0.28)	1.13 (0.20)	-0.69 (-0.09)	-0.15 (-0.03)
764	Telecomms equipment nes	0.61 (0.48)	-6.97 (-3.26)**	5.13 (2.02)**	10.47 (3.10)**	4.04 (2.10)**
771	Elect power transm equip	7.94 (3.95)**	2.01 (1.03)	-6.64 (-3.18)**	-2.70 (-0.99)	-0.42 (-0.20)
772	Electric circuit equipmt	6.34 (2.63)**	-0.92 (-0.43)	-2.46 (-1.09)	-0.89 (-0.31)	-2.63 (-2.18)**
773	Electrical distrib equip	-1.08 (0.56)	-5.38 (-2.31)**	4.73 (1.79)*	10.62 (2.98)**	6.33 (3.08)**
778	Electrical equipment nes	1.60 (0.87)	1.40 (0.81)	-2.66 (-1.36)	-1.48 (-0.58)	0.21 (0.15)
785	Motorcycles/cycles/etc	-1.42 (-0.79)	-2.72 (-0.98)	2.16 (0.73)	3.32 (0.91)	0.71 (0.42)
793	Ships/boats/etc	-3.30 (-1.25)	5.72 (1.23)	-2.50 (-0.47)	-4.18 (-0.60)	3.93 (0.98)
851	Footwear	-3.40 (-2.26)**	0.91 (0.21)	1.83 (0.40)	1.75 (0.33)	2.13 (0.62)

Source: Research finding.

Note: a. (**) significance at 5%; (*) significance at 10%. b. The parentheses represents the value of t-statistic. c. Critical values of t-test at 5% (1.96); 10% (1.64).

Five industries have a significant positive effect on the IDR depreciation variable (POS), namely 057, 598, 741, 764, and 773. Meanwhile, 10 industries have a significant negative effect, namely 054, 283, 285, 512, 515, 652, 655, 676, 682, and 728. Eight industries have a significant positive effect on the IDR appreciation variable (NEG), namely 057, 333, 334, 651, 657, 684, 764, and 773. Meanwhile, nine industries with a significant negative effect are 231, 285, 512, 515, 652, 655, 682, 743, and 772.

The results of the NARDL cointegration test in Table 6 show that there are 15 industries that are not cointegrated in the long run (231, 283, 321, 513, 515, 523, 634, 641, 671, 672, 675, 711, 723, 741, and 793). Then there are 35 long-term cointegrated industries consisting of 31 industries (054, 057, 251, 285, 422, 431, 511, 512, 522, 562, 598, 651, 652, 653, 655, 657, 676, 679, 682, 684, 716, 728, 743, 752, 759, 764, 771, 772, 773, 778, and 785 are cointegrated at the 5% level and four industries (333, 334, 744, and 851) are cointegrated at the 10% level.

Table 8 shows the results of the NARDL diagnostic test. The results of the *ECMt-1* test showed that all models were significantly negative at the 5% level. The Lagrange Multiplier test shows that only five models have autocorrelation. The results of the *Ramsey RESET* test show that 37 industries have the right model.

The results of the *CUSUM* stability test show that there are four industries with unstable models, while 46 other industries have stable models. The *CUSUMSQ* test shows 10 industries with stable models while the other 40 are declared unstable. The Wald S test shows that there are 15 models that are significant at 5% (057, 321, 513, 522, 523, 641, 657, 675, 676, 682, 728, 764, 771, 785) and 10% (598). This proves that the effect of exchange rate on trade balance between Indonesia and China tends to be asymmetric in the short term. Meanwhile, the Wald L test also show that the effect of the exchange rate on the trade balance between Indonesia and China is asymmetrical in the long run in nine industries (283, 285, 562, 598, 676, 684, 728, 743, and 764).

Table 7. Nonlinear Model Diagnostic Statistics

Code	Fstat	ECM_{t-1}	LM	RESET	Adj. R^2	CUSUM	CUSUMSQ	Wald S	Wald L
054	11.82**	-0.41 (-7.86)**	0.80	1.87	0.59	S	US	1.78	1.14
057	10.52**	-0.46 (-7.42)**	0.29	3.74	0.44	S	US	21.71**	0.73
231	3.36	-0.21 (-4.19)**	0.03	0.02	0.22	S	US	0.00	1.44
251	6.08**	-0.40 (-5.62)**	0.43	7.76**	0.24	S	S	0.00	1.07
283	2.52	-0.17 (-3.62)**	3.71**	13.91**	0.11	S	US	0.00	4.64**
285	5.91**	-0.30 (-5.55)**	1.20	1.53	0.35	S	US	0.00	5.90**
321	1.90	-0.11 (-3.14)**	0.35	0.22	0.36	S	US	24.29**	0.05
333	3.95*	-0.20 (-4.54)**	0.10	0.12	0.22	S	US	0.00	0.01
334	3.60*	-0.20 (-4.33)**	0.41	4.27**	0.23	S	US	3.03	0.04
422	4.76**	-0.22 (-4.97)**	1.41	1.21	0.26	S	S	0.00	0.33
431	6.11**	-0.38 (-5.64)**	1.52	6.38**	0.23	S	US	0.00	2.35
511	7.55**	-0.49 (-6.27)**	1.43	0.02	0.35	S	US	0.05	3.13
512	7.27**	-0.36 (-6.16)**	1.22	1.56	0.29	S	US	0.00	0.94
513	2.04	-0.13 (-3.26)**	1.75	0.44	0.17	S	US	10.67**	0.50
515	3.04	-0.18 (-3.97)**	0.33	7.93**	0.13	S	US	0.00	2.99
522	5.71**	-0.28 (-5.46)**	1.02	0.19	0.34	US	US	8.38**	0.01
523	1.88	-0.14 (-3.14)**	2.34**	0.15	0.23	S	US	3.21**	1.65
562	4.32**	-0.17 (-4.74)**	0.40	1.04	0.23	S	S	0.00	13.80**
598	7.67**	-0.31 (-6.32)**	0.61	1.84	0.34	S	US	9.89*	10.53**
634	2.35	-0.17 (-3.50)**	0.64	6.03**	0.09	S	US	0.00	0.14
641	2.22	-0.12 (-3.41)**	0.19	0.24	0.30	S	US	4.52**	0.75
651	8.72**	-0.46 (-6.74)**	0.77	4.01**	0.30	S	US	0.00	1.80
652	5.26**	-0.23 (-5.23)**	0.07	6.77**	0.23	S	US	0.00	3.29
653	7.35**	-0.42 (-6.19)**	5.28**	0.00	0.32	S	US	0.00	0.09
655	7.17**	-0.40 (-6.11)**	0.72	0.06	0.29	S	US	0.00	1.78
657	10.14**	-0.38 (-7.28)**	1.15	0.27	0.50	S	US	7.90**	0.11
671	3.33	-0.19 (-4.16)**	0.37	5.94**	0.13	S	US	0.00	1.83
672	1.55	-0.08 (-2.84)**	1.34	4.04**	0.12	S	US	0.00	0.35
675	1.87	-0.11 (-3.13)**	0.25	0.00	0.18	S	US	12.73**	2.47
676	6.01**	-0.33 (-5.60)**	0.65	0.73	0.34	S	S	7.32**	6.97**
679	4.55**	-0.32 (-4.87)**	0.59	1.69	0.19	S	S	0.00	0.14
682	12.35**	-0.32 (-8.02)**	2.93**	0.47	0.53	US	US	7.46**	0.72
684	9.93**	-0.58 (-7.19)**	0.34	0.36	0.33	S	S	0.00	7.74**
711	2.74	-0.26 (-3.78)**	0.61	0.98	0.11	S	US	0.00	0.39

Code	Fstat	ECM_{t-1}	LM	RESET	Adj. R^2	CUSUM	CUSUMSQ	Wald S	Wald L
716	4.82**	-0.24 (-5.01)**	0.19	1.48	0.24	S	US	0.00	1.51
723	3.26	-0.28 (-4.12)**	0.12	0.31	0.14	S	US	0.00	0.18
728	10.74**	-0.77 (-7.50)**	0.84	2.59	0.37	S	US	15.40**	8.69**
741	3.34	-0.26 (-4.17)**	0.52	5.76**	0.13	S	US	0.00	1.91
743	9.56**	-0.47 (-7.07)**	1.19	3.23	0.35	S	US	0.99	14.66**
744	4.33*	-0.25 (-4.75)**	0.08	0.76	0.34	S	S	2.78	0.03
752	6.91**	-0.34 (-6.00)**	3.25**	2.26	0.26	S	S	0.78	0.82
759	4.14**	-0.17 (-4.66)**	0.19	0.00	0.44	US	S	0.50	0.01
764	4.97**	-0.23 (-5.09)**	0.71	0.59	0.28	S	US	13.75**	5.34**
771	7.78**	-0.36 (-6.37)**	0.76	1.34	0.30	S	US	13.37**	1.05
772	6.46**	-0.53 (-5.81)**	1.04	3.30	0.21	US	S	0.00	0.52
773	6.33**	-0.37 (-5.75)**	2.13	1.26	0.26	S	US	0.72	2.28
778	5.95**	-0.42 (-5.56)**	2.29	5.88**	0.21	S	US	0.00	0.79
785	7.03**	-0.39 (-6.06)**	0.09	0.34	0.29	S	US	4.99**	0.77
793	2.91	-0.20 (-3.89)**	0.13	4.41**	0.12	S	US	0.00	2.58
851	3.77*	-0.19 (-4.44)**	0.47	2.00	0.30	S	US	0.47	0.01

Source: Research finding.

Note: a. (**) significance at 5%; (*) significance at 10% b. For F, 5% = upper bound (4.01); lower bound (2.86) and 10%= upper bound (3.52); lower bound (2.45) c. The number inside the parentheses next to ECMt-1 is the absolute value of the t-ratio d. Critical value of t-test at 5% (1.96); 10% (1.64) e. For LM, RESET, Wald-S, and Wald-L are significance if Prob < 0.05

Under the ARDL model, a J-Curve phenomenon occurs if the real exchange rate coefficient is negative and significant in the short term, followed by a positive and significant coefficient in the long term (Ari et al., 2019; Durmaz, 2015; Harvey, 2018). Based on this definition, the ARDL comes with only two industries, namely 057 (fruit/nuts, fresh/dried) and 773 (electrical distribution equipment). In contrast to ARDL, with the NARDL model we find nine industries (057, 333, 334, 598, 651, 657, 684, 764, and 773). These results are based on the definition stated by Bahmani-Oskooee and Fariditavana (2016) that depreciation (POS) or appreciation (NEG) has a significant positive effect and is cointegrated in the long term, regardless of whether the short-term coefficient is positive or negative and significant or insignificant.

One of possible explanation for industry with a J-Curve phenomenon in the NARDL model is that each industry's import and export prices react differently to changes in exchange rate (Bahmani-Oskooee et al., 2016). In an industry where demand for exports and imports is elastic, changes in exchange rate will have a significant impact on the volume of exports and imports of the industry. This means that although the depreciation of the IDR can worsen the trade balance of an industry in the short term, in the long term, a high level of elasticity of demand will lead to an increase in exports and a decrease in imports of the industry, resulting in a J-Curve phenomenon.

Overall, most of Indonesia's main export industries for the Chinese market tend not to respond to changes in the IDR-CNY exchange rate. This indicates that most of Indonesia's exporting and importing products are price inelastic so that changes in price does not affect the demand for export and import volumes. The depreciation of the IDR cannot be a strategy for the government to promote Indonesian exports because only a few sectors benefited. Therefore, ensuring exchange rate stability through monetary policy with interest rate instruments will be much more effective in encouraging exports of the domestic manufacturing industry.

5. Conclusion

This study aims to analyze the effect of real exchange rate of IDR-CNY on trade balance between Indonesia-China at an industry level. Specifically, this tries to identify the existence of a J-Curve phenomenon and an asymmetric effect of exchange rate on Indonesia-China trade balance. Using the ARDL model, we find a significant short-term effect of the real exchange rate on the trade balance of 14 industries, while the NARDL model comes out with 22 industries. This result explains the effects of exchange rate tend to be following a more asymmetrical pattern especially in the short-term. In the context of identifying a J-Curve phenomenon, we also find that the NARDL model is superior to the ARDL because the NARDL model is able to find more industries experiencing this phenomenon. Our study also shows that the impact of changes in the exchange rates on trade between Indonesia and China is relatively limited. We find that there are less than 50 percent of Indonesia's export industry is significantly impacted when the IDR-CNY exchange rate changes. This is partly due to the characteristics of the demand for exports and imports, which tend to be price inelastic. The policy implication of this finding is that the depreciation of the IDR against foreign currencies may not be suitable as a strategy to promote exports since its impact is limited to only a few industries.

It is important to note that our study covers only 50 industries in which Indonesian and Chinese trade occurs. In 2020, there were 258 industries involved in the two countries' trades. Therefore, further studies can expand the industry coverage and classify the industries based on the level of export-import demand elasticity. Second, our study did not consider structural changes in the model. Hence, further research can accommodate a structural break analysis due to the currency crisis as occurred in the late 1990s.

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