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Depreciation and Trade Balance: An Exploration of the J-Curve Phenomenon in Indonesia

Mashilal[1*], Rakhmat Dwi Pambudi[2]
[1,2]Faculty of Islamic Economics And Business, UIN Walisongo, Indonesia
E-mail: [1]hilal@walisongo.ac.id, [2]rakhmatdp@walisongo.ac.id
[*]**Corresponding author**

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ABSTRACT

Research Originality: Global economic uncertainty has increased in recent years, leading to an appreciation of the US dollar relative to most global currencies, including the Indonesian rupiah. The novelty of this study is the inclusion of natural resource commodity price index variables, given the importance of these commodities in Indonesia's balance of trade.

Research Objectives: This study aims to examine the effect of rupiah exchange rate depreciation on Indonesia's trade balance.

Research Methods: This study uses a Vector Error Correction Model (VECM) to analyze Indonesia's balance of trade from January 2015 to December 2023, examining the potential J-Curve phenomenon resulting from the depreciation of the Indonesian rupiah.

Empirical Result: Findings from the impulse response analysis suggest that the J-Curve phenomenon is present in Indonesia's balance of trade as a result of the rupiah's depreciation. The results of this study also confirm the positive effect of increasing natural resource commodity prices on Indonesia's trade balance.

Implications: The implication of these findings is that exchange rate depreciation can improve Indonesia's trade balance only when natural resource commodity prices are rising. Conversely, if commodity prices decline, maintaining the stability of the rupiah exchange rate becomes crucial.

Keywords:

depreciation; j-curve; natural resource commodities; trade balance

How to Cite:

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INTRODUCTION

A series of significant events in recent years starting from the United States-China trade war(Sukar & Ahmed, 2019; Li et al., 2020; Nong, 2021), which was followed by the cold war in technology (Chen et al., 2023; Zhang & Zhu, 2023), the COVID-19 pandemic (Hayakawa & Mukunoki, 2021; McKibbin & Fernando, 2023; Egger et al., 2023), the Russia-Ukraine war (Mariotti, 2022; Steinbach, 2023; Izzeldin et al., 2023), the Israel-Palestine conflict (Cui & Maghyereh, 2024; Lin et al., 2024) have an impact on increasing global uncertainty. A series of these events have caused international trade policies taken by major countries to tend to be inward-looking. The tariff increase implemented by the United States during the 2018 trade war with China and the UK's exit from the European Union (Brexit) has fueled momentum against globalization. This momentum has sparked concerns about the impact of increasing trade protectionism (Jiang et al., 2023). As a result, the trend of deglobalization in international trade is increasing. The effects of this deglobalization can reduce the volume of world trade, which then has an impact on reducing global economic growth.

Global economic uncertainty impacts exchange rate depreciation in many countries, especially emerging markets (Abid, 2020). Increasing global uncertainty accompanied by rising prices of food, energy, and natural resource commodities has increased inflation in various parts of the world. With high inflation, many central banks in developed countries have raised their benchmark interest rates, including the United States' central bank and the Federal Reserve. The policy taken by the Federal Reserve has an impact on strengthening the US dollar against other countries' currencies. Caballero et al. (2017) explained that the strengthening of the US dollar occurred due to global economic uncertainty and limited safe-haven assets. Thus, the discourse on de-dollarization in recent years as an effort to reduce dependence on the US dollar has yet to make significant progress, especially amidst China's slowing economic growth.

The exchange rate is an essential determinant of a country's trade balance (Truong & Van Vo, 2023). The exchange rate can be used as an economic policy tool to manage and improve the trade balance deficit(Dogru et al., 2019). Exchange rate depreciation can increase international competitiveness in international trade (Bahmani-Oskooee & Kanitpong, 2018). The domestic currency exchange rate depreciation against trading partners' currencies or foreign currencies causes export goods to become cheaper. This condition may ultimately result in heightened demand for the country's exports.

Conversely, imported goods will become expensive for domestic consumers, which is expected to reduce demand for imported goods (Kamugisha & Assoua, 2020). A country's trade balance is expected to improve after depreciation. This condition is because export and import orders or purchase contracts were negotiated before the depreciation occurred (Arize et al., 2017).

The traditional approach to investigating the impact of depreciation on a country's trade balance is based on the Marshall-Lerner condition. It is called Marshall-Lerner because it is based on the theory of price elasticity of demand proposed by Alfred

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Marshall and Abba P. Lerner. This theory proposes that a nation can strengthen its trade balance in the long run by depreciating its currency(Bahmani-Oskooee, 1985). The Marshall-Lerner condition suggests that a country's trade balance will likely improve when its currency depreciates. This condition occurs when the combined elasticity of demand for exports and imports exceeds one (Bahmani et al., 2013). However, many economists argue that the conditions outlined by the Marshall-Lerner theory are usually only met in the long run, not in the short run. This conditio is because demand tends to be more elastic in the long run(Truong & Van Vo, 2023). As a result, although a depreciation of the domestic currency may cause a worsening of the trade balance in the short run, it is expected to improve in the long run. This phenomenon is referred to as the J-curve effect in international trade theory (Magee, 1973; Bahmani-Oskooee, 1985; Bahmani-Oskooee & Fariditavana, 2016; Ari et al., 2019; Mwito et al., 2021; Madura, 2021; Xu et al., 2022; Truong & Van Vo, 2023).

Figure 1. The Rupiah Exchange Rate Against the US Dollar

Source: Bank Indonesia

Based on Figure 1, the movement of the Indonesian rupiah rate against the US dollar has experienced a downward trend. This data raises the question: Can the depreciation of the Indonesian rupiah improve Indonesia's trade balance? Several empirical studies provide evidence that currency depreciation leads to an enhancement in the trade balance. Bosupeng et al. (2024) found that a depreciation in the exchange rate positively influences the trade balance of developing countries but is ineffective on the trade balance of developed countries. Likewise, Truong and Van Vo (2023) discovered that the depreciation of the exchange rate contributes to the long-term improvement of Vietnam's trade balance. However, such depreciation negatively impacts Vietnam's trade balance in the short term. his implies that the depreciation of the Vietnamese dong results in a J-curve effect on the country's trade balance. Bahmani-Oskooee and Kanitpong (2018) used the ARDL method to examine the influence of exchange rates on Thailand's trade balance with fifteen trading partners. Their findings indicate that the baht depreciation will likely enhance Thailand's trade balance with countries such as Canada, Germany, Indonesia,

South Korea, Malaysia, Singapore, and the United States. However, the impact of exchange rate fluctuations is inconsistent across Thailand's two largest trading partners, China and Japan. In particular, while the baht's depreciation adversely affects the trade balance with China in the long run, it has little to no significant effect on Japan.

Several studies indicate that exchange rate depreciation does not positively impact the trade balance. Bao et al. (2023) examined India's trade balance with the European Union using the Nonlinear Autoregressive Distributed Lag (NARDL) approach. The results indicated that rupee depreciation did not affect India's trade balance, suggesting that devaluation is an ineffective strategy for improving India's trade balance with the European Union. Using the Time Series Multivariate Forecasting technique, Dzanan and Masih (2017) investigated the impact of exchange rate depreciation on the trade balance of developed countries, including Norway. The results showed that exchange rate depreciation did not affect Norway's trade balance in the long term. Likewise, Gobbi & Lucarelli (2022) found empirical evidence that the Pound Sterling's depreciation only positively affected four of the thirty primary British industries in the long run. The depreciation of the Pound Sterling negatively affected science-based industries in the UK in the long run.

The primary aim of this study is to assess the impact of the rupiah's depreciation on Indonesia's trade balance. This study's novelty lies in using natural resource commodity price index variables. In previous studies, the natural resource commodity price index variable was not involved in the relationship between exchange rate depreciation and the trade balance. In the context of the Indonesian economy, natural resource commodities have contributed significantly to Indonesia's export performance. The price of natural resource commodities has increased in recent years, which can help improve Indonesia's trade balance. Therefore, the natural resource commodity index variable is included in the research model. In addition, the research period is a period of increasing global economic uncertainty. High global economic uncertainty causes inward-looking trade policies to be implemented by various countries, especially large countries. Therefore, the trade policy uncertainty index is used as a proxy for international trade policy uncertainty.

METHODS

The study examines monthly time series data from January 2015 to December 2023. The research variables include Indonesia's trade balance, rupiah exchange rate, global trade policy uncertainty index, Indonesian industrial production index, and natural resource commodity price index.

This study uses the Vector Error Correction Model (VECM). This model analyzes the dynamic relationship between cointegrated non-stationary time series data (Khurshid, 2023). This study uses VECM to analyze the short-term dynamics and long-term relationship between exchange rate depreciation and the trade balance. VECM is formed through various stages (Ren et al., 2020; Shao et al., 2021). The first step involves conducting a unit root test to assess the stationarity of each variable's data. The Augmented Dickey-Fuller (ADF) method is used in the data stationarity test. The results of the

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ADF t-statistic value indicated by the unit root test are compared with the MacKinnon critical value to see the stationarity of the data studied. If the ADF t-statistic exceeds the MacKinnon critical value, it can be concluded that the data is stationary, signifying the absence of a unit root.

Second, determining the optimal lag length. One of the conditions that must be considered in estimation using VECM is the condition for determining the lag length to be used. Determining the optimal lag length in this study uses information criteria that refer to the Schwarz Information Criterion (SIC) value. Determining this lag length is important for use in cointegration tests. The Johansen maximum likelihood method is the most widely used method in cointegration tests.

Table 1. Research Variables

Variable	Definition	source
Indonesia Trade Balance	The ratio between the value of exports and the value of imports of Indonesia	www.bps.go.id
Rupiah Exchange Rate	Nominal exchange rate of Indonesian rupiah	www.bi.go.id
Global Trade Policy Uncertainty	a monthly index that measures the combined frequency of occurrence of the terms trade policy and uncertainty in major newspapers.	www.policyuncertainty.com
Indonesian Industrial Production Index	a measure of the monthly change, in real terms, in total output of large and medium-sized non-oil manufacturing firms.	www.bi.go.id
Natural Resource Commodity Price Index	Index of all commodity prices except gold	www.imf.org

Source: processed from various sources

Third, based on the previous tests, the model is then developed to examine both short-term and long-term relationships among the variables, using the VECM as follows:

$$LnTB_t = a_0 + \sum_{j=1}^{k} \alpha_1 \, DLnTB_{t-j} + \sum_{j=1}^{k} \alpha_2 \, DLnER_{t-j} + \sum_{j=1}^{k} \alpha_3 \, DLnTPU_{t-j} + \sum_{j=1}^{k} \alpha_4 \, DLnIPI_{t-j} + \sum_{j=1}^{k} \alpha_5 \, DLnCOM_{t-j} + \mu_{1t} \quad (1)$$

Where based on the equation above, LnTB represents the natural logarithm of Indonesia's trade balance, LnER denotes the natural logarithm of the nominal rupiah exchange rate, LnTPU refers to the natural logarithm of global trade policy uncertainty, LnIPI signifies the natural logarithm of the Indonesian Industrial Production Index, and LnCOM indicates the natural logarithm of the natural resource commodity price index. Additionally, D represents the first difference of the data, k denotes the maximum lag length, j refers to the lag, α represents the regression coefficient, and μ denotes the error term.

Fourth, the impulse response function is built to see the influence of endogenous variables' responses to shocks on other endogenous variables in the model. The impulse response function analysis can monitor how endogenous variables respond within the

VAR model. The impulse response function illustrates the direction of the relationship and the extent of influence among endogenous variables. Consequently, a shock to a variable incorporating new information will impact both that variable and others within the VAR system. Additionally, impulse response function analysis allows tracking the effects of a variable's shock over multiple future periods. The analysis then uses variance decomposition to describe the relative importance of each variable in the VECM due to the shock or how strong the composition of the role of a particular variable is to other variables. Thus, variance decomposition seeks to estimate the percentage contribution of each variable's variance attributed to fluctuations in a specific variable.

RESULTS AND DISCUSSION

The unit root test is an important step in the formation of VECM. This test prevents the use of non-stationary data in the model. The findings of the unit root test, performed using the Augmented Dickey-Fuller (ADF) test, are shown in Table 2. In the level data, the variables LnTB, LnTPU, and LnCOM are not stationary, so they must continue the data stationarity test on the first difference. All variables on the first difference indicate that the data is stationary.

Table 2. Unit Root Test

Variable	Level			First Difference		
	ADF tatistic	Critical Value	Prob.	ADF Statistic	Critical Value	Prob.
LnTB	-2.830614	-3.453179	0.1899	-12.16292	-3.453179	0.0000
LnER	-4.698920	-3.452358	0.0012	-9.307110	-3.453179	0.0000
LnTPU	-3.292240	-3.452358	0.0731	-13.83928	-3.452764	0.0000
LnIPI	-5.963733	-3.452358	0.0000	-10.49396	-3.453179	0.0000
LnCOM	-2.320083	-3.452764	0.4193	-7.036473	-3.452764	0.0000

Source: data processed

Determining the right lag length is the next step before conducting cointegration tests and estimation in VECM. The criteria for determining lag length include the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Criterion (HQ). In this study, the Schwarz Information Criterion (SC) was utilized, with lag 1 being chosen as indicated in Table 3.

Once the optimal lag is established, the data is tested for cointegration to verify the number of cointegration relationships present. The results of the cointegration test are shown in Table 4. Table 4 shows that there is one cointegration relationship, as indicated by the trace statistic of 84.94881, which exceeds the critical value of 76.97277 at the 95% confidence level. Overall, the results of the Johansen Cointegration Test indicate a long-term relationship among the five variables included in the model.

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Table 3. Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	335.0498	NA	9.35e-10	-6.600996	-6.470737	-6.548278
1	645.1174	582.9272	3.13e-12	-12.30235	-11.52080*	-11.98604*
2	672.9288	49.50425*	2.97e-12*	-12.35858*	-10.92573	-11.77868
3	685.6194	21.32025	3.83e-12	-12.11239	-10.02825	-11.26890
4	698.3298	20.08244	4.99e-12	-11.86660	-9.131168	-10.75952
5	710.7747	18.41842	6.60e-12	-11.61549	-8.228773	-10.24483
6	725.0549	19.70669	8.55e-12	-11.40110	-7.363085	-9.766842
7	736.6970	14.90186	1.19e-11	-11.13394	-6.444634	-9.236093
8	752.7991	19.00044	1.55e-11	-10.95598	-5.615383	-8.794545

Source: data processed

Table 4. Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None *	0.270041	84.94881	76.97277	0.0108
At most 1	0.232405	51.58353	54.07904	0.0820
At most 2	0.138176	23.54730	35.19275	0.4922
At most 3	0.061161	7.784655	20.26184	0.8415
At most 4	0.010275	1.094812	9.164546	0.9388

Source: Data processed

Based on Table 5, in the long term, the DlnER variable has a negative effect on the DLnTB variable. Likewise, the DLnTPU variable has a positive and significant effect. However, the DLnIPI and DlnCom variables do not significantly affect DLnTB in the long term. Thus, the depreciation of the rupiah exchange rate in the long term can improve Indonesia's trade balance.

Table 5. Estimates of Trade Balance Equation (Long Run)

Variable	Coefficient	Standard Error	t-statistics
DLnER	-1.167334	0.31452	-3.71146*
DLnTPU	0.112882	0.02626	4.29888*
DLnIPI	0.036988	0.27345	0.13527
DLnCOM	-0.012111	0.06854	-0.17669

Significance Level: * 0.05

Meanwhile, based on Table 6, all variables, namely DLnER, DLnTPU, DLnIPI, and DLnCOM, do not significantly affect the DLnTB variable in the short term. This means that the short-term depreciation of the rupiah exchange rate does not improve Indonesia's balance of trade.

An essential next step in VECM is the model stability test, which is crucial to validate the results of the impulse response and variance decomposition analyses. Based on

Table 7, the VECM model that has been formed has been stable, as seen from the AR root value below one, so it is valid enough to carry out the following analysis process, namely impulse response and variance decomposition.

Table 6. Estimates of Trade Balance Equation (Short Run)

Variable	Coefficient	Standard Error	t-statistics
DLnER	0.006841	0.03174	0.21554
DLnTPU	0.760791	0.41286	1.84274
DLnIPI	-0.042322	0.07215	-0.58662
DLnCOM	-0.032142	0.06596	-0.48726

Significance Level: * 0.05

Figure 2 shows the impulse response of Indonesia's balance of trade to shocks from the depreciation of the Indonesian rupiah, global trade policy uncertainty, Indonesia's industrial production index, and the natural resource commodity price index. The depreciation of the Indonesian rupiah in the initial period had a negative impact on Indonesia's balance of trade. In the subsequent period, Indonesia's trade balance fell by 0.0069% due to the effects of the rupiah's depreciation. In the third period, Indonesia's balance of trade responded positively to the depreciation of the Indonesian rupiah, increasing by 0.0061%. By the sixth period, the positive response of Indonesia's balance of trade had risen to 0.011%. Overall, the impulse response analysis results indicate that the depreciation of the Indonesian rupiah has a positive impact on the balance of trade in the long term. The depreciation negatively affected Indonesia's balance of trade, but this effect improved over time, leading to a positive impact in subsequent periods. Consequently, the relationship between the depreciation of the Indonesian rupiah and Indonesia's trade balance follows a J-curve pattern.

Table 7. Modulus

Root		Modulus
0.983316		0.983316
0.866154		0.866154
0.799666		0.799666
0.673273		0.673273
0.423461	- 0.253659i	0.493621
0.423461	+ 0.253659i	0.493621
-0.442139		0.442139
-0.241039	- 0.209961i	0.319662
-0.241039	+ 0.209961i	0.319662
-0.096027		0.096027

Source: data processed

The shock in the industrial production index and natural resource commodity prices positively impacted Indonesia's trade balance. In the sixth period, Indonesia's trade balance

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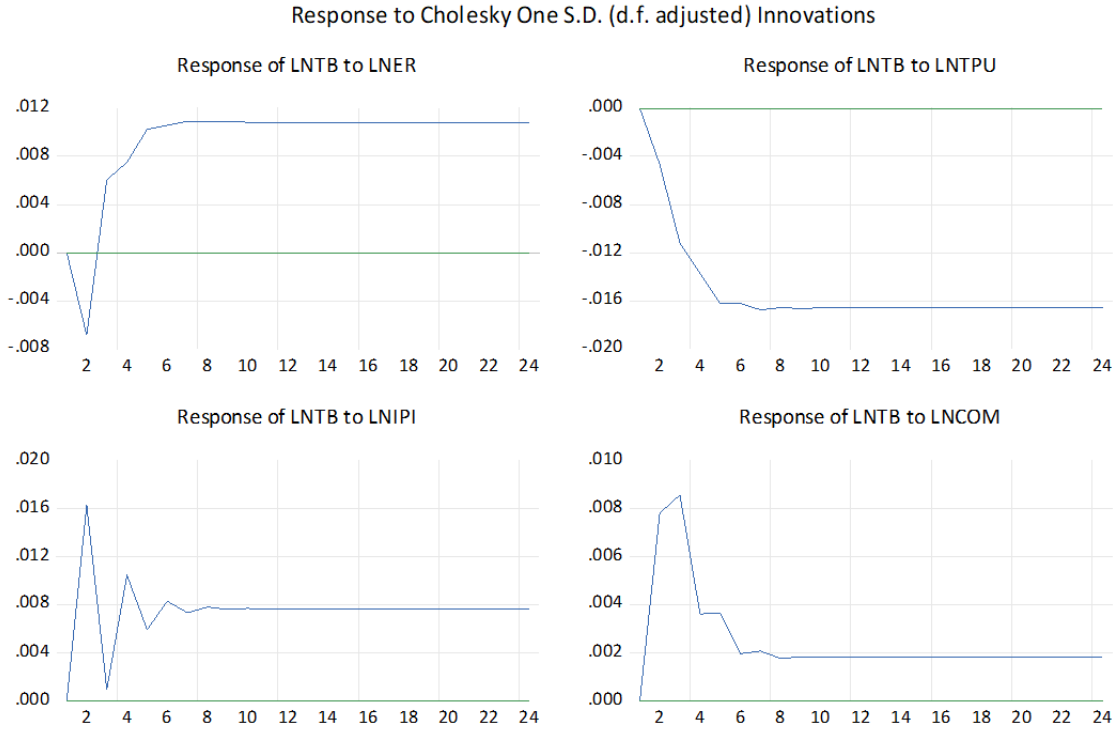
responded positively to the industrial production index and natural resource commodity price shocks by 0.0083% and 0.0019%, respectively. In contrast, the increase in global trade policy uncertainty negatively affected Indonesia's trade balance by 0.016% in the sixth period.

The variance decomposition of the research model is shown in Table 8. Variance decomposition seeks to estimate the percentage contribution of each variable's variance due to changes in specific variables. Typically, the most significant shock influencing the variance of each variable originates from the variable itself. As shown in Table 8, the contribution of variance to the Indonesian trade balance variable continues to decline until the end of the research period (period 24) but remains the most dominant. In the 12th period, the contribution of variance to the Indonesian trade balance variable decreased to 72.96% from 92.09% in the third period. By the end of the period, the contribution of variance to the Indonesian trade balance variable is 65.63%.

Figure 2. Impulse Response of Trade Balance



Source: data processed

The shock effect that contributes the most to Indonesia's balance of trade is the variation in the global trade policy uncertainty variable. In the 12th period, the contribution of this variable was 14.82%, a significant increase from 1.85% in the third period. By the end of the 24th period, the contribution of global trade policy uncertainty to Indonesia's balance of trade rose to 19.91%. The second, third, and fourth largest shock effects were attributed to the Indonesian rupiah variable, the Indonesian industrial production index, and the price of natural resource commodities, with contributions at the end of the period of 8.47%, 5.22%, and 0.77%, respectively.

The increasing global economic uncertainty in recent years has caused most world currencies to depreciate (Abid, 2020). The increasing demand for US dollars amid global uncertainty has caused the US dollar to strengthen against almost all world currencies (Kido, 2018). The Indonesian rupiah at the end of March 2024 depreciated by 5.25% (year on year). The same thing happened to currencies in various Asian countries. The Malaysian Ringgit exchange rate was recorded to have depreciated by 7.24%, the Thailand Bath depreciated by 6.93%, the Singapore Dollar depreciated by 1.55%, the Indian Rupee depreciated by 1.41%, the Chinese Renminbi depreciated by 5.18%, the Japanese Yen depreciated by 13.31%, and the South Korean Won depreciated by 3.29% (International Financial Statistics, 2024).

Table 8. Variance Decomposition of LnTB

Period	LnTB	LnER	LnTPU	LnIPI	LnCOM
3	92.09448	1.049444	1.849139	3.326848	1.680092
6	82.89730	3.283340	7.918694	4.392484	1.508186
9	76.81755	5.118459	12.15138	4.658444	1.254166
12	72.96462	6.273392	14.82159	4.853755	1.086644
15	70.29301	7.073296	16.67529	4.987512	0.970887
18	68.32774	7.661669	18.03877	5.086064	0.885757
21	66.82138	8.112661	19.08387	5.161587	0.820506
24	65.63001	8.469347	19.91043	5.221318	0.768899

Source: data processed

Based on Figure 2, the results of the impulse response analysis indicate that the depreciation of the Indonesian rupiah had a negative impact on Indonesia's balance of trade in the early periods, followed by a positive impact in subsequent periods. Thus, in the short term, the rupiah depreciation negatively affects Indonesia's trade balance. However, in the long term, the depreciation of the rupiah positively impacts the balance of trade. Consequently, the relationship between the depreciation of the rupiah and Indonesia's trade balance formed a J-curve pattern. The results of this study are in line with (Bahmani-Oskooee & Kanitpong, 2018; Doojav, 2018; Bao & Le, 2021; Truong & Van Vo, 2023; Bosupeng et al., 2024).

Our study regarding the impact of exchange rate depreciation on the trade balance contradicts the study conducted by Bao et al. (2023), which shows that rupee depreciation does not affect India's trade balance with the European Union. Likewise, the findings of Gobbi & Lucarelli (2022) show that the weakening of the Pound sterling in general has no significant effect on the UK's trade balance from the industrial sector. The findings of Ali et al. (2018) show the same thing: there is no J-Curve pattern in the relationship between exchange rate depreciation and Pakistan's trade balance. This condition is because the need for imported goods in Pakistan is very high.

Indonesia's trade balance performance in recent years has experienced a surplus. Indonesia's trade balance has experienced a consecutive surplus trend for 50 consecutive months from May 2020 to June 2024 (BPS-Statistics Indonesia, 2024). Indonesia's trade

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balance surplus in June 2024 was USD 2.39 billion. This surplus was lower than the previous year's period, which was USD 3.45 billion. The decline in the value of Indonesia's balance of trade surplus cannot be separated from export performance. For example, Indonesia's export performance in 2023 was recorded at USD 258.82 billion, or below the previous year's export performance of USD 291.90 billion. The slowdown in export value aligns with the moderation in the prices of Indonesia's leading natural resource commodities, such as palm oil and coal. In addition, the economic slowdown in major trading partner countries also contributed to the decline in Indonesia's export performance. Natural resource commodities play a crucial role in enhancing Indonesia's export performance. When key natural resource commodities prices increase, Indonesia's export performance improves, and vice versa. This result aligns with research findings indicating that the prices of natural resource commodities positively impact Indonesia's balance of trade.

CONCLUSION

Impulse response analysis is utilized to demonstrate the existence of the J-curve phenomenon in the trade balance. The study results indicate that, in the long term, the depreciation of the Indonesian rupiah can enhance Indonesia's trade balance. This finding aligns with the theories of Alfred Marshall and Abba P. Lerner regarding the relationship between exchange rate depreciation and a country's trade balance. Based on the impulse response analysis, a J-curve phenomenon is evident in Indonesia's trade balance due to the rupiah depreciation. However, it is essential to emphasize that the improvement in Indonesia's balance of trade is not solely attributable to the rupiah's depreciation but also the rise in the prices of natural resource commodities. During the study period, leading natural resource commodities in Indonesia, such as coal and crude palm oil, experienced significant price increases. This fact is supported by the study's findings that the prices of natural resource commodities positively affect Indonesia's trade balance. Additionally, other research indicates that Indonesia's industrial production index positively affects the balance of trade, while global trade policy uncertainty negatively impacts it.

Although the results of the study indicate that the depreciation of the Indonesian rupiah has a positive impact on the balance of trade, the stability of the rupiah remains paramount. One of the critical points of this study is to reaffirm the significant role of natural resource commodities in Indonesia's balance of trade. Exchange rate depreciation positively affects the trade balance, provided an increase in the prices of natural resource commodities accompanies it. Therefore, the rise in the prices of these commodities in recent years has contributed to Indonesia's consistent surplus balance of trade. However, Indonesia's reliance on natural resource commodities for exports is concerning due to the price fluctuations in the global market.

Additionally, the added value generated from the export of natural resource commodities is relatively low. A viable policy response would accelerate natural resource-based industrialization to create added value and reduce vulnerability to price fluctuations. Furthermore, there must be a prompt and effective response to the trade policies of other countries that exhibit an inward-looking trend, which increases global trade uncertainty.

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