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COULD INDONESIA BE AT RISK OF DUTCH DISEASE? AN EXAMINATION OF PALM OIL

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ABSTRACT

The surge in palm oil production owes to its cost-effectiveness and lack of trans-fatty acids, mirroring a global uptick in consumption across various sectors, including food, non-food industries, and biofuels. Indonesia, as the foremost exporter of this commodity, wields considerable influence over the global palm oil market. However, this dominance raises concerns about the Dutch Disease, a phenomenon explored in economic literature. This study aims to investigate whether palm oil production in Indonesia, through changes in the real exchange rate, has led to the Dutch Disease in the Indonesian economy. The study adopts a model framework originally developed by Kuralbayeva et. al. (2001), which is designed to empirically investigate the Balassa-Samuelson effect. The analysis utilizes monthly data from the period 2009:M01 to 2022:M12, including Indonesia's real effective exchange rate, terms of trade, palm oil prices, and real wages. By constructing a general VAR model, the study explores the short- and long-term effects of terms of trade, palm oil prices, and real wages on the real effective exchange rate. According to the findings, there is a long-run cointegration among variables. There is Granger causality from real wages to real exchange rate and other variables, and its relationship with terms of trade is not statistically significant. The real exchange rate is less influenced by terms of trade than expected, and although real wages impact it, the evidence is insufficient to confirm Dutch Disease, suggesting balanced sectoral competitiveness and limited effects of palm oil exports.

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ENDONEZYA HOLLANDA HASTALIĞI RİSKİ ALTINDA OLABİLİR Mİ? PALM YAĞI ÜZERİNE BİR İNCELEME

MAKALE BİLGİSİ
Araştırma Makalesi

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Anahtar Kelimeler:
Endonezya,
Hollanda Hastalığı,
Palm Yağı,
Var Modeli

ÖZ

Palm yağı üretiminin artışı, maliyet etkinliği ve trans yağ asitleri içermemesinden kaynaklanmaktadır. Bu durum, gıda, gıda dışı endüstriler ve biyoyakıtlar dahil olmak üzere çeşitli sektörlerde küresel tüketim artışını yansıtmaktadır. Endonezya, bu emtianın en büyük ihracatçısı olarak küresel palm yağı piyasası üzerinde önemli bir etkiye sahiptir. Ancak bu hakimiyet, ekonomi literatüründe incelenen bir fenomen olan Hollanda Hastalığı ile ilgili endişeleri gündeme getirmektedir. Bu çalışma, Endonezya'daki palmiye yağı üretiminin, reel döviz kurundaki değişiklikler yoluyla Endonezya ekonomisinde Hollanda Hastalığına yol açıp açmadığını araştırmayı amaçlamaktadır. Çalışma, Balassa-Samuelson etkisini ampirik olarak araştırmak için tasarlanan, Kuralbayeva, Kutan ve Wyzan (2001) tarafından geliştirilen bir model çerçevesini benimsemektedir. Analiz, 2009:M01 ile 2022:M12 arasındaki döneme ait aylık verileri kullanmaktadır. Bu veriler arasında Endonezya'nın reel efektif döviz kuru, ticaret hadleri, palmiye yağı fiyatları ve reel ücretler bulunmaktadır. Genel bir VAR modeli oluşturarak, çalışma ticaret hadleri, palmiye yağı fiyatları ve reel ücretlerin reel efektif döviz kuru üzerindeki kısa ve uzun vadeli etkilerini incelemektedir. Bulgulara göre, değişkenler arasında uzun vadeli bir eşbütünleşme vardır. Reel ücretlerden reel döviz kuru ve diğer değişkenlere Granger nedenselliği vardır ve ticaret hadleriyle ilişkisi istatistiksel olarak anlamlı değildir. Reel döviz kuru, ticaret hadlerinden beklendiğinden daha az etkilenmektedir ve reel ücretler onu etkilese de, Hollanda Hastalığını doğrulamak için kanıtlar yetersizdir, bu da dengeli sektörel rekabet gücü ve palmiye yağı ihracatının sınırlı etkilerini göstermektedir.

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1. INTRODUCTION

Natural resources are necessary for countries economic growth since they provide essential raw materials and energy sources. However, abundant natural resources can be both a boon and a burden. Many countries rich in natural resources often face what Sachs and Warner (2001) described as the “resource curse”.Inadequate use of natural resources can lead to economic overreliance, resulting in a number of serious issues. This reliance causes economic instability because of the volatility of resource prices, which is impacted by global market circumstances, geopolitical events, and environmental issues. It also hinders diversification, leaving other economic areas underdeveloped. This scenario can eventually lead to Dutch Disease, in which an economy becomes unduly reliant on income from natural resource exports, harming other sectors.

The term Dutch Disease was initially coined in 1977 by Journal of The Economist to illustrate the consequences of discovering a natural gas field in 1959 on the Dutch economy. The journal stated that the discovery of natural gas negatively affected the manufacturing sector following the appreciation of the exchange rate, which ultimately harmed the economy (Corden and Neary, 1982; Corden, 1984).This increase in income strengthens the domestic currency, making non-resource sectors—particularly the manufacturing sector (Automobile Manufacturing, Chemical Manufacturing, Electronics Technology, Textile, Machinery, etc.) less competitive in global markets (Corden and Neary, 1982).

Dutch disease hastens deindustrialization by shifting the economic structure favoring resource-based industries, reducing industrial competitiveness. A resource boom, such as in oil, gas, or commodities like palm oil, results in an infusion of foreign currency, which causes the local currency to appreciate. As a result, manufactured exports lose competitiveness in international markets, while lower-cost imports progressively degrade domestic industrial production. Furthermore, increased revenue from resource exports raises wages and demand in the service sector, resulting in a shift of labor and capital away from manufacturing. This shift leads to increasing production expenses, diminishing profits, and lower investment in industrial operations. Additionally, decreased investment in manufacturing hampers technological progress and innovation, worsening industrial stagnation. Eventually, an overdependence on resource exports increases economic susceptibility to volatility in commodity prices. Without a robust manufacturing foundation, the long-term economic stability is threatened, accelerating the trend of deindustrialization. (Gylfason et al., 1984 ; Frankel, 2012; Zubikova, 2018).

Oomes and Kalcheva (2007) identified the primary symptoms of Dutch disease as an overvalued exchange rate, sluggish growth in the manufacturing sector, rapid expansion of the services sector, elevated average wages, and unemployment. The capital-intensive nature of the resource sector may not create enough jobs, and reliance on volatile commodity markets can lead to employment instability. An appreciated currency can reduce the competitiveness of non-resource sectors globally, potentially resulting in unemployment in export-oriented industries (Botta, 2015).

The occurrence of Dutch disease notably affects trade openness, especially in nations abundant in resources. This situation emerges when a rise in natural resource wealth causes a decrease in the manufacturing and agricultural industries, ultimately leading to a reduction in trade openness (Boussalem & Benterki, 2015). When palm oil prices and export demand increase, the sector becomes markedly more lucrative than several other industries, potentially instigating what economists refer to as the resource-movement effect. In this context, laborers abandon employment in industry or other agricultural sectors—such as rice, maize, or vegetable cultivation—to pursue more lucrative opportunities on palm oil plantations. Similarly, land once utilized for food crops or other forms of commercial agriculture is repurposed for palm oil cultivation, as landowners perceive higher returns from this practice. The transition of labor and land to the palm oil industry diminishes resources for other sectors, frequently resulting in decreased productivity, diminished competitiveness, and, over time, a more constrained economic foundation reliant on a singular commodity (Siregar & Sihaloho, 2021). Indonesia accounts for 59% of global palm oil production. This percentage places Indonesia at the top of the list of palm oil producing countries worldwide. Indonesia, which produced 43 million Metric Tons of palm oil in 2023-2024, increased its production to 46 million Metric Tons in 2024-2025 with a 7% growth rate (USDA, 2025). The relevant information is as shown in Figure 1 and Table 1.

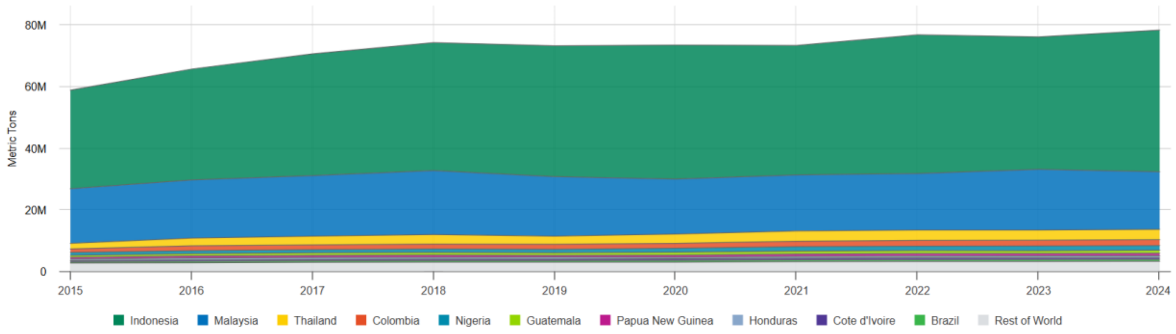

Figure 1. Global Palm Oil Production 2015-2024
Source: https://www.fas.usda.gov/data/production/commodity/4243000

Table 1- Top Palm Oil Producing Countries
Source: https://www.fas.usda.gov/data/production/commodity/4243000

Market	**% of Global Production**	**Total Production (2024/2025, Metric Tons)**
Indonesia	59%	46 Million
Malaysia	24%	18.7 Million
Thailand	4%	3.33 Million
Colombia	2%	1.9 Million
Nigeria	2%	1.5 Million
Guatemala	1%	990,000

Papua New Guinea	1%	830,000
Brazil	0,77%	600,000
Cote d'Ivorie	0,77%	600,000
Honduras	0,76%	595,000

In the last two decades, palm oil production has surged due to its cost-effectiveness and absence of trans-fatty acids. This rise aligns with a significant global increase in consumption, driven by its versatile use in food, non-food sectors, and the biofuel industry (Jafari et al.,2017). Nowadays most of the packaged food and personal hygiene products found in a regular supermarket contain palm oil (Dauvergne, 2018). Several countries rely on palm oil exports for foreign currency, contributing heavily to their economies. Yet, the palm oil industry faces controversy due to its association with widespread environmental degradation. (Teng et al., 2020). Indonesia, the top exporter in the world, plays an essential role in the international palm oil market. Between 2008 and 2022, production fluctuated from 20,500 MT to 46,500 MT, showing a positive trend, contributing 4.5% to the GDP and supporting 3 million jobs. Indonesia is responsible for about 52% of the world's palm oil supply, reinforcing its export supremacy. Nonetheless, this significant dependence on palm oil raises concerns regarding Dutch Disease, which could affect the country's economic framework. (UNDP, 2022; IMF, 2022; BPS, 2021). The study is organized as follows: Section 2 reviews the relevant literature, Section 3 details the dataset and methodology, Section 4 presents the findings, and Section 5 provides an evaluation of the results.

2. THEORETICAL FRAMEWORK

Dutch Disease refers to the negative consequences resulting from a sudden increase in a country's currency value, particularly linked to the discovery or exploitation of a valuable natural resource. It encompasses the unanticipated repercussions that such a discovery can bring to the nation's entire economy. Corden & Neary, (1982), pioneers in defining and exploring the impacts of Dutch Disease, identified three key sectors pertinent to this phenomenon:

- Sectors based on natural resources (mining, natural gas, oil, etc.)
- Tradable sectors (agriculture and manufacturing industry that can be subject to international trade and have outputs of goods and services) and
- Non-tradable sectors are the service sectors, which include healthcare, education, retail, construction, etc.

The Dutch Disease begins with substantial inflows of income or foreign currency resulting from a thriving sector, often triggered by the discovery of extensive natural resource reserves. This leads to increased demand for goods, raising domestic prices or the nominal exchange rate depending on fixed or flexible exchange rates. This causes a real exchange rate appreciation, making traditional exports pricier and leading to less competitiveness. Local producers face competition from cheaper imports, causing a shift of labor and production from traditional exports to booming sectors (direct de-industrialization) and domestically produced non-traded goods (indirect de-industrialization). This movement raises non-traded goods' prices, while traded goods' prices remain stable, resulting in cheaper imports and job shifts to lower-cost countries and imports rises. Ultimately, overvalued exchange rates harm economic growth and macroeconomic stability (Barder, 2006 ; Brinčíková, 2016)

In the literature, various theories have been proposed to explain real exchange rate movements during economic transitions. A prominent explanation is the Balassa–Samuelson effect, which attributes real exchange rate appreciation to productivity growth in the tradables sector, leading to higher real wages and, consequently, increased prices in the non-tradables sector (Halpern & Wyplosz, 1997; De Broeck & Sløk, 2001). Orlowski (1997) emphasizes the influence of high inflation, rising labor costs, and nominal exchange rate trends. Additionally, Dibooglu and Kutan (2001) provide empirical support for Brada’s (1998) hypothesis that real exchange rate dynamics in transition economies are shaped by both real and monetary shocks.

Norway is often considered an example model for how to manage natural resource wealth. Norway established the Government Pension Fund Global, commonly known as the Norwegian Oil Fund, to manage its oil revenue for the long-term benefit of future generations. This sovereign wealth fund is designed to diversify global investments and reduce dependence on the oil sector (Udemba, 2022; Øvald, 2023).

Botswana is often seen as a rare example of a country that has avoided the resource curse, achieving strong economic growth. However, despite its success in resource-based development, the country has faced significant challenges in diversifying its economy beyond diamonds. The country has effectively managed its diamond revenues by investing in education, healthcare, and infrastructure development. The country established the Pula Fund to save excess diamond revenues for future generations, promoting economic diversification and sustainable growth (Barczikay, 2020).

3. LITERATURE REVIEW

In the literature, it has been seen that most of the studies investigated the natural resources gifted countries to find out the validity of Dutch Disease. While some of them examined the manufacturing and service related sectors. The studies conducted on this subject are summarized below, beginning with those affirming the validity of Dutch Disease, followed by those disputing it, arranged in below.

Koitsiwea et al., (2015) analyzed Australia's mining sector (1975–2013) using a VAR model and found that mining influences exchange rates while GDP impacts services. To mitigate the resource curse, the study recommends strengthening manufacturing and tourism competitiveness.

Gasmi et al., (2017) examined the Algerian economy over the period from 1960 to 2016 by utilizing the Autoregressive Distributed Lag (ARDL) model to investigate the connections between the real effective exchange rate, productivity differences, terms of trade, real oil prices, government spending, inflation, net foreign assets, and output in the manufacturing sector. The results did not show definitive proof that Algeria faced Dutch disease during this timeframe, indicating that the economy might have demonstrated resilience against the negative impacts often linked with reliance on resources.

Taguchi et al., (2018) investigated the effects of resource production on the economies of ASEAN countries from 1970 to 2015 utilizing a Vector Autoregression (VAR) model. The study focused on mining and utility production, the ratio of manufacturing to services, and real GDP per capita. The results revealed that Laos and Myanmar, having industrialized later, encountered Dutch disease, with resource production impeding the growth of manufacturing. Furthermore, Indonesia faced similar obstacles between 1970 and 1996, emphasizing the negative impacts of reliance on resources for industrial advancement.

Barczikay et al., (2020) conducted an analysis of Botswana, Namibia, and South Africa in 2018 utilizing a NARDL model to study growth, unemployment, sectoral contributions to GDP, diamond exports, and economic complexity. The results indicated a partial Dutch disease effect impacted by Botswana’s trading relationships with Namibia and South Africa.

Ibrahim (2021) examined the impact of extractive industries, specifically oil and gas, on Azerbaijan's economy from 2000 to 2018 through the lens of the Dutch Disease theory. The results indicate that Dutch Disease effects are indeed present, emphasizing indirect de-industrialization and spending impacts. Nevertheless, there are no observed direct adverse effects on manufacturing, agriculture, or non-tradable sectors.

Pelzl et al., (2021) found mixed evidence of Dutch disease in Indonesia, highlighting that while mining booms that rely heavily on capital do not elevate wages in manufacturing, booms in labor-intensive sectors do increase wages but lead to a decline in employment within traded goods sectors. In contrast, Siregar et al., (2021) found no evidence of Dutch disease from 2011 to 2015, as the growth of palm oil production was associated with positive effects on both spending and job creation without displacing other sectors.

Shahvari (2022) investigated the effects of migrant remittances on Indonesia's economy over the period of 1984 to 2020, utilizing an Autoregressive Distributed Lag (ARDL) model. The research identified signs of Dutch disease, indicating that considerable remittance inflows contributed to the appreciation of the rupiah, which in turn encouraged heightened imports and dissuaded exports. These results highlight the substantial impact of remittances on the real exchange rate.

Udemba et al., (2022) analyzed the existence of Dutch disease in Algeria and Norway by employing an Autoregressive Distributed Lag (ARDL) model for the timeframes 1999Q1–2018Q4 and 1999Q1–2019Q4, respectively. By analyzing variables such as government consumption spending, real exchange rates, foreign direct investment, GDP per capita, and crude oil prices, the study identified long-term cointegration, suggesting evidence of Dutch disease in both countries.

Biedermann et al., (2023) used a nonlinear autoregressive distributed lag (NARDL) model to investigate the occurrence of Dutch disease in Angola, paying particular attention to the cointegration between oil prices and the real effective exchange rate of the kwanza, thereby validating the existence of this phenomenon.

Şanlısoy et al., (2023) examined the connection between palm oil prices and the real effective exchange rate in Indonesia, analyzing data from the first quarter of 2000 to the fourth quarter of 2021 through a Nonlinear Autoregressive Distributed Lag (NARDL) model. The results demonstrated that long-term positive shocks in palm oil prices result in an appreciation of the real effective exchange rate, showing evidence of Dutch disease affecting the Indonesian economy.

The literature on Dutch Disease shows mixed results across different contexts and methods. Koitsiwea et al. (2015) and Taguchi et al. (2018) revealed sectoral crowding-out in mining-dependent and late-industrializing economies, while Gasmi et al. (2017) and Siregar et al. (2021) saw resilience in Algeria and Indonesia. Various research, including those by Barczikay et al. (2020), Ibrahim (2021), Pelzl et al. (2021), Shahvari (2022), Udemba et al. (2022), and Biedermann et al. (2023), validate the presence of differing intensities of Dutch Disease impacts across regions such as Southern Africa, Azerbaijan, Norway, and Angola. Şanlısoy et al. (2023) utilized a nonlinear ARDL (NARDL) model for Indonesia, revealing that positive shocks in palm oil prices lead to an appreciation of the real exchange rate, agreeing with the concept of Dutch Disease. Our study differs in that it employs the VAR framework of Kuralbayeva et al. (2001), which is designed to test the Balassa–Samuelson effect by linking real exchange rate fluctuations to productivity and sectoral shifts. Using monthly data from 2009-2022 on palm oil prices, real wages, terms of trade, and the real effective exchange rate, we investigated dynamic interdependence and causality. While VAR captures rich short- and long-run feedbacks, its symmetry assumption may overlook asymmetric adjustments found in NARDL research, explaining our limited evidence of Dutch Disease. By employing this framework, our study seeks to enrich the existing literature by providing fresh evidence on the potential presence of Dutch Disease within Indonesia's economy.

4. DATA AND MODEL

This study aims to investigate the potential presence of Dutch Disease within the Indonesian economy. Specifically, it examines any effects of fluctuations in terms of trade, palm oil prices, and real wages on Indonesia's real effective exchange rate over the period from 2009:M01 - 2022:M12. All quarterly data are sourced from the Federal Reserve Economic Data (FRED) and BPS-Statistics Indonesia. Detailed information on the variables used in this analysis is provided in Table 2.

Table 2: Variables list

Variables Name	Time Period	Source
LREER (Real Effective Exchange Rate)	2009:M01 - 2022:M12	Federal Reserve

LTOT (Terms of Trade)	2009:M01 - 2022:M12	Economic Data (FRED)
LPALM (Palm Oil Price)	2009:M01 - 2022:M12	
LRWI (Real Wages)	2009:M01 - 2022:M12	BPS-Statistics Indonesia

Our models follow the specification model developed by Kuralbayeva et al., (2001). The model used in the study is shown in Equation (1):

$$REER=f\ (TOT, P, RW) \tag{1}$$

Where RER, TOT, P, and RW denote the real exchange rate, terms of trade, price level, and real wages, respectively.

In empirical analysis, first, whether there is a correlation between the Variables was tested. Based on the results, the Augmented Dickey-Fuller (1981) and Phillips-Perron (1988) linear unit root tests and finally with a general VAR framework, the study investigates the long- and short-term effects of terms of trade, palm oil prices, and real wages on the real effective exchange rate.

4.1. Methodology

4.1.1. Augmented Dickey-Fuller (1981) and Phillips-Perron (1988) Tests

It is necessary to determine the stationarity of the series for the analyses. Ensuring that there is no unit root in the series, in other words, determining their stationary levels, is crucial to avoid misleading results from possible shocks in the series. Augmented Dickey-Fuller (1981) and Phillips-Perron (1988) unit root tests will be conducted to determine the levels of stationarity.

$$\Delta y_t = \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \, \Delta y_{t-i+1} + \varepsilon_t \tag{2}$$

$$\Delta y_t = c + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \, \Delta y_{t-i+1} + \varepsilon_t \tag{3}$$

$$\Delta y_t = c + \gamma y_{t-1} + \delta_2 t + \sum_{i=2}^{p} \beta_i \, \Delta y_{t-i+1} + \varepsilon_t \tag{4}$$

According to the Augmented Dickey-Fuller (1981) unit root test, the regression can be represented by three equations:
Equation (2) presents the regression without a constant term and trend variable.
Equation (3) presents the regression with a constant term but no trend variable.
Equation (4) represents an equation where both the constant term and trend variable are present simultaneously, as suggested by Dickey and Fuller (1979).

The Phillips-Perron (1988) test, compared to the Extended Dickey-Fuller test, is a more flexible test that does not consider restrictions on error terms. Additionally, the main difference between the two tests is that lag values of the dependent variable are not found in alternative forms (Aktaş and Yılmaz, 2008, p. 96). The Phillips-Perron test, in its simplest form, is presented in equation (5).

$$\begin{aligned} y_t &= \mu + \alpha y_{t-1} + \varepsilon_t \\ (1 - \alpha L) y_t &= \mu + \varepsilon_t \end{aligned} \tag{5}$$

4.1.2. Vector Autoregression Test (VAR)

The model developed by Sims (1980) is based on the Granger causality test model. In the model, if there are two endogenous variables, each of them is associated with its own lagged values as well as the lagged values of the other endogenous variable up to a certain period. Sims criticizes the endogenous-exogenous distinction in structural models, stating that this separation is artificial. Considering the Y_t and X_t series, the VAR model is defined as follows (Ertek, 2000: 404):

$$\boldsymbol{Y_t = \alpha + \sum_{j=1}^{m} \beta_j Y_{t-j} + \sum_{j=1}^{m} \delta_j X_{t-j} + \varepsilon_{1t}} \tag{6}$$

$$\boldsymbol{X_t = \alpha + \sum_{j=1}^{m} \theta_j Y_{t-j} + \sum_{j=1}^{m} \vartheta_j X_{t-j} + \varepsilon_{2t}} \tag{7}$$

Here, ε_1t and ε_2t are error terms. The lagged values of Y affect the X variable, and the lagged values of X affect the Y variable. Since only lagged variables appear on the right-hand side of the equations in this model, the values to be obtained using the least squares method will be consistent.

4.1.3. Johansen (1988) Cointegrating Test

The long-term and short-term relationships among the variables were examined using the Johansen (1988) cointegration test, which includes both the trace and maximum eigenvalue statistics tests. Cointegration indicates that, although individual series may exhibit stochastic trends, they can still be linked through a long-run equilibrium relationship.

4.1.4. Vector Error Correction Model (VECM)

When cointegration is found among the series, it indicates a long-term equilibrium relationship exists. In these instances, the Vector Error Correction Model (VECM) is used to examine the short-run dynamics of the cointegrated variables. If cointegration does not exist, there is no need for VECM, and the analysis can move directly to Granger causality tests to explore causal relationships between the variables. The regression format of the VECM is defined as follows:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\alpha_1} + \boldsymbol{p_1 e_1} + \sum_{i=0}^{n} \boldsymbol{\beta_i \Delta Y_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\delta_i \Delta X_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\gamma_i \Delta Z_{t-i}} \tag{8}$$

$$\Delta \boldsymbol{X_t} = \boldsymbol{\alpha_2} + \boldsymbol{p_2 e_{i-1}} + \sum_{i=0}^{n} \boldsymbol{\beta_i Y_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\delta_i \Delta X_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\gamma_i \Delta Z_{t-i}} \tag{9}$$

In VECM, the cointegration rank represents the number of cointegrating links. For example, a rank of two indicates that the non-stationary variables are stationary in two linearly independent ways. A negative and statistically significant coefficient of the error correction term (i.e., et-1 in the equations above) indicates that short-term deviations in the independent variables from the long-term equilibrium will be corrected over time, thereby restoring a stable long-run relationship between the variables.

4.1.5. Granger Causality Test

To determine if alterations in one variable lead to changes in another, we utilized the Granger Causality test. According to Granger (1969), a variable can be considered to cause another if its past and present values help forecast the future values of the latter variable. In this research, we applied the VAR-based Granger Causality test to investigate the causal relationships among the relevant variables.

5. EMPIRICAL RESULTS

The initial phase of the analysis involved examining the descriptive statistics of the variables, including the mean, minimum-maximum range, standard deviation, skewness, kurtosis, and Jarque-Bera values. To improve the reliability of the results, the natural logarithms of the variables were applied. The descriptive statistics and normality test results for the variables are presented in Table 3.

Table 3: Descriptive Statistics of Variables

	Observation	**Mean**	**Maxiumum**	**Minimum**	**Standard Deviation**	**Skewness**	**Kurtosis**	**Jarque-Bera (P.v)**
LREER	168	4,623	4,730	4,476	0,051	0,046	2,614	1,101 (0,61)
LTOT	168	4,682	4,941	4,465	0,103	0,128	2,230	4,603 (0,09)
LP	168	6,613	7,410	6,096	0,284	0,528	2,795	8,114 (0,01)
LRW	168	10,518	10,875	10,200	0,219	0,331	1,983	10,246 (0,00)

Before proceeding with the unit root test, it's useful to assess the correlation between the variables. Table 4 shows the correlation analysis test results between variables. Looking at the descriptive statistics, it can be seen that the standard deviation is lowest in the LREER variable and highest in the LP variable. Looking at the distribution of the variables, it can be seen that all of them are skewed to the right, with the most skewed distribution in the LP variable and the least skewed distribution in the LREER variable. When examining the dispersion of the variables, it is observed that all variables are flatly distributed. The Jarque-Bera value at the 5% significance level indicates that LREER and LTOT follow a normal distribution, while LP and LRW do not follow a normal distribution.

Table 4: Correlations Between Variables

	LREER	**LTOT**	**LP**	**LRW**
LREER	1			
LTOT	0,103	1		
LP	0,354	0,431	1	
LRW	-0,438	0,280	0,058	1

Table 4 shows the correlation between variables. The LREER variable has a positive but weak correlation with the LTOT variable at a rate of 0.103, while it has a relatively stronger and positive correlation with the LP variable at a rate of 0.354. Additionally, it was found that the LREER variable has a negative correlation with the LRW variable at a rate of 0.348. Furthermore, there is a relatively moderate positive correlation between the LP variable and the LTOT variable at a rate of 0.431. Finally, a relatively weak but positive correlation was found between the LRW variable and the LTOT variable at a rate of 0.280, and between the LP variable and the LTOT variable at a rate of 0.058.

In time series analysis, the first step is to determine whether the variables contain unit roots. To achieve this, linear unit root tests that do not account for structural breaks, developed by Dickey-Fuller (1981, ADF) and Phillips-Perron (1988, PP), will be performed.

Table 5: ADF (1981) and PP (1988) Unit Root Test Results

		Variables	**ADF**	**PP**			**Variables**	**ADF**	**PP**
Level	**Constant**	LREER	-2,918 (0,04) **	-2,989 (0,03) **	**First Difference**	**Constant**	LREER	-11,081 (0,00)***	-10,514 (0,00)***
		LTOT	-2,434 (0,13)	-5,628 (0,00)***			LTOT	-15,269 (0,00)***	-32,776 (0,00)***
		LP	-2,402 (0,14)	-2,173 (0,21)			LP	-9,912 (0,00)***	-9,830 (0,00)***
		LRW	-0,763 (0,82)	-0,792 (0,81)			LRW	-12,373 (0,00)***	-12,373 (0,00)***
	Constant+Trend	LREER	-3,818 (0,01)**	-3,454 (0,04)**		**Constant+Trend**	LREER	-11,156 (0,00)***	-10,586 (0,00)***
		LTOT	-2,470 (0,34)	-5,620 (0,00)***			LTOT	-15,299 (0,00)***	-37,499 (0,00)***
		LP	-2,405 (0,37)	-2,175 (0,49)			LP	-9,885 (0,00)***	-9,803 (0,00)***

		LRW	-2,632 (0,26)	-2,744 (0,22)			LRW	-12,350 (0,00)***	-12,350 (0,00)***

Note: ***, **, and * denote the stationarity of the series at the 1%, 5%, and 10% significance levels, respectively. The values parentheses indicate the probability values.

In ADF (1981) and PP (1988) unit root tests, the null hypothesis states that there is a unit root in the variables, while the alternative hypothesis suggests no unit root in the variables. Probability values are taken into account in the decision phase. Accordingly, in both the model with constant and the model with constant and trend, the variables have unit roots at their first difference level values. It seems that there are consistent results in both unit root tests.

Prior to conducting the Vector Autoregression (VAR) analysis, it is essential to determine the optimal lag length for the variables. To this end, preliminary diagnostic checks were performed to assess whether the inverse roots lie within the unit circle, and to examine the presence of autocorrelation and heteroskedasticity. Based on the lag length selection criteria, the optimal lag length for the VAR model was identified as four. Subsequent analyses were carried out using the VAR (1–4) specification. As illustrated in Figure 2, all inverse roots are located within the unit circle, confirming the stability of the model.

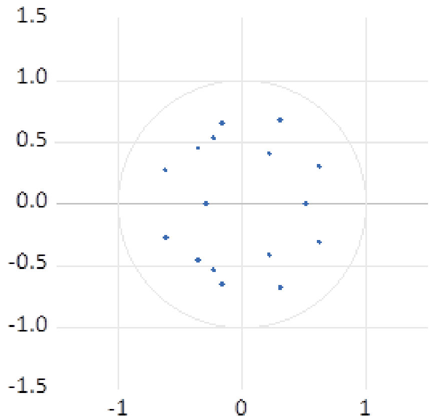

Figure 2: The Position of Inverse Roots within The Unit Circle

Following the verification that the inverse roots lie within the unit circle, the VAR (1–4) model was examined for the presence of autocorrelation. To assess this, the Lagrange Multiplier (LM) test for autocorrelation was employed. In this test, the null hypothesis (H_0) posits the absence of autocorrelation, while the alternative hypothesis (H_1) indicates its presence. The results of the LM test revealed that the null hypothesis could not be rejected at all four lag levels, suggesting that the model does not suffer from autocorrelation issues.

Table 6: VAR Residual Serial Correlation LM Test

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.50775	16	0.1008	1.486189	(16, 407.0)	0.1009

2	22.20714	16	0.1366	1.401739	(16, 407.0)	0.1367
3	22.67691	16	0.1226	1.432211	(16, 407.0)	0.1227
4	14.92133	16	0.5304	0.933537	(16, 407.0)	0.5305
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	23.50775	16	0.1008	1.486189	(16, 407.0)	0.1009
2	33.97439	32	0.3726	1.065700	(32, 477.3)	0.3732
3	49.07226	48	0.4299	1.024755	(48, 483.6)	0.4313
4	62.69370	64	0.5228	0.978974	(64, 476.0)	0.5257
*Edgeworth expansion corrected likelihood ratio statistic.						

Following the Autocorrelation LM test, it is necessary to examine whether the VAR (1–4) model exhibits a heteroskedasticity problem. In this context, the null hypothesis (H_0) suggests the absence of heteroskedasticity, while the alternative hypothesis (H_1) indicates its presence. Based on the results of the heteroskedasticity test, the null hypothesis was not rejected, indicating that the model does not suffer from heteroskedasticity.

Table 7: VAR Residual Heteroskedasticity Test Result (Includes Cross Terms)

Chi-sq	**df**	**Prob.**
1545.216	1520	0.3203

Based on the determination of the optimal lag length as four for the variables, the VAR (1–4) model was selected for further analysis. As a next step, it is necessary to perform the variance decomposition of the variables.

Table 1: Johansen Cointegration Test Result

H0	**Eigenvalue**	**Trace Sta.**	**%5 Critical Value**	**Prob.(*)**
r=0	0.316909	145.7749	63.87610	0.00
r≤1	0.202384	86.70028	42.91525	0.00
r≤2	0.182958	51.65053	25.87211	0.00
r≤3	0.122926	20.33047	12.51798	0.00

H0	**Eigenvalue**	**Max-Eigen Sta.**	**%5 Critical Value**	**Prob.(*)**
r=0	0.316909	59.07466	32.11832	0.00
r≤1	0.202384	35.04974	25.82321	0.00
r≤2	0.182958	31.32007	19.38704	0.00
r≤3	0.122926	20.33047	12.51798	0.00

*MacKinnon-Haug-Michelis (1999) p-values

The Trace Test indicates the presence of four cointegrating equations at the 0.05 significance level. Similarly, the Maximum Eigenvalue Test also confirms the existence of four cointegrating equations at the 0.05 level. The results of the trace statistics suggest the presence of at least four cointegrating vectors. Therefore, the null hypothesis of no cointegration among the variables is rejected. This finding implies the existence of a long-term relationship among the real effective exchange rate, terms of trade, palm oil prices, and real wages. Furthermore, the results of the Maximum Eigenvalue Test support this conclusion at the 0.05 significance level. Consequently, the Vector Error Correction Model (VECM) is employed. The VECM approach allows for the identification of long-term relationships among the relevant variables and links them to short-term deviations (Lorde et al., 2009).

Table 2: Vector Error Correction Estimates

Variable	Coefficient	Std. Error	T-Statistic	P. Value
Cointeq1	-0.077711	0.067836	-1.145564	0.25
(DLREER(-1))	-0.534121	0.106695	-5.006072	0.00***
(DLREER(-2))	-0.660504	0.111561	-5.920556	0.00***
(DLREER(-3))	-0.436574	0.115910	-3.766484	0.00***
(DLREER(-4))	-0.329926	0.098435	-3.351714	0.00***
(DLREER(-5))	-0.058224	0.088332	-0.659143	0.51
D(DLTOT(-1))	-0.082882	0.083043	-0.998054	0.31
D(DLTOT(-2))	-0.059096	0.072507	-0.815047	0.41
D(DLTOT(-3))	-0.036998	0.059953	-0.617117	0.53
D(DLTOT(-4))	-0.019465	0.042618	-0.456736	0.64
D(DLTOT(-5))	-0.006434	0.022600	-0.284712	0.77
D(DLP(-1))	0.023061	0.019790	1.165261	0.24
D(DLP(-2))	-0.007312	0.022674	-0.322462	0.74
D(DLP(-3))	-0.033825	0.025092	-1.348072	0.17
D(DLP(-4))	-0.032048	0.023106	-1.386971	0.16
D(DLP(-5))	0.013687	0.021639	0.632522	0.52
D(DLRW(-1))	0.124177	0.061449	2.020806	0.04**
D(DLRW(-2))	0.068308	0.058996	1.157826	0.24
D(DLRW(-3))	0.032750	0.054553	0.600331	0.54
D(DLRW(-4))	0.095788	0.049864	1.920963	0.05*
D(DLRW(-5))	0.037084	0.039161	0.946963	0.34
C	-0.000753	0.001511	-0.498127	0.61

According to Table 9, the elimination of imbalances that may occur in the DLREER and DLRW variables has yielded statistically significant results. Any imbalance in the real exchange rate variable decreases by 0.53 (1%) in the first lag, by 0.66 (1%) in the second lag, by 0.43 (1%) in the third lag, and by 0.32 (1%) in the fourth lag, thereby reaching equilibrium. The real worker income variable also increased by 0.12 (5%) in the first lag and by 0.09 (5%) in the fourth lag, indicating that short-term imbalances can be resolved.

Table 3- Error Correction Terms

ECT	CointEq1	Standard Errors	T. Statistics
DLREER(-1)	1.000	-	-
DLTOT(-1)	-1.3422	(0.20591)	[-6.518]***
DLPALM(-1)	0.0425	(0.08709)	[0.488]
DLRW(-1)	0.8997	(0.1970)	[4.565]***
C	-0.0017	-	-

The VECM results also indicate a long-term equilibrium relationship between the DLREER, DLTOT, and DLRW variables. The error correction coefficient required for the real exchange rate to be in equilibrium is specified in Model 10. According to this, a 1% increase in the terms of trade leads to a 1.34% decrease in the real exchange rate, while a 1% increase in real worker income causes a 0.89% increase in the real exchange rate. These effects are statistically significant with t-statistics of -6.518 and 4.565, respectively. Although the palm oil price coefficient is 0.042, the t-statistic is not statistically significant. Additionally, the constant is found to be -0.0017 according to the error correction formula.

$$ect_{t-1} = 1{,}00DLReer_{t-1} - 1{,}3422DLTot_{t-1} + 0{,}0425DLP_{t-1} + 0{,}8997DLRw_{t-1} - 0{,}0017 \quad (10)$$

Variance decomposition investigates what percentage of the variation in a variable is due to itself and what percentage is due to other variables. If a variable explains nearly 100% of the variation in variance on its own, it is considered an external variable. The order of the variables is very important in this analysis. The order is from external to internal. Variance decomposition is the second function targeted in VAR. It investigates what percentage of the variation in the variance of each of the variables under examination is explained by their own lags and what percentage is explained by other variables. It can also be used as a side assessment of whether variables are internal or external (Tarı, 2006: 452-453). Based on this, the variance decomposition analysis results are as shown in Tables 11, 12, 13, and 14.

Table 4: Variance Decomposition of DLREER

Period	S.E.	DLREER	DLTOT	DLP	DLRW
1	0.017459	100.0000	0.000000	0.000000	0.000000
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.018116	99.15985	0.000115	0.569574	0.270466
		(2.15986)	(0.75912)	(1.60197)	(1.19943)
3	0.018548	98.17183	0.315628	0.664824	0.847715
		(3.10224)	(1.80803)	(1.78126)	(1.82292)
4	0.018734	96.88254	0.422161	1.471809	1.223493
		(4.15057)	(2.21245)	(2.17712)	(2.41293)
5	0.018983	94.80646	0.426750	1.663096	3.103695
		(4.15338)	(2.12135)	(2.19007)	(2.90765)
6	0.019043	94.24043	0.499140	1.823638	3.436786
		(4.52069)	(2.36101)	(2.26702)	(3.09746)
7	0.019057	94.11486	0.515159	1.835122	3.534854
		(4.63580)	(2.35398)	(2.27093)	(3.22434)
8	0.019067	94.02059	0.533959	1.849004	3.596445
		(4.79631)	(2.44693)	(2.29259)	(3.27137)
9	0.019078	93.99886	0.560413	1.848046	3.592683
		(4.86801)	(2.45617)	(2.31455)	(3.28508)
10	0.019087	93.99212	0.560728	1.857666	3.589488
		(4.89692)	(2.45698)	(2.33514)	(3.29727)
11	0.019088	93.98942	0.562417	1.857811	3.590349
		(4.92878)	(2.46664)	(2.33039)	(3.30740)
12	0.019091	93.98437	0.562887	1.861821	3.590919
		(4.93753)	(2.46517)	(2.33438)	(3.31395)
13	0.019092	93.98071	0.562901	1.861768	3.594618
		(4.95968)	(2.47785)	(2.33776)	(3.32782)
14	0.019092	93.97636	0.563556	1.862645	3.597434
		(4.97123)	(2.48016)	(2.33856)	(3.33268)

Table 5: Variance Decomposition DLTOT

Period	S.E.	DLREER	DLTOT	DLP	DLRW

1	0.067426	0.005575	99.99442	0.000000	0.000000
		(0.87188)	(0.87188)	(0.00000)	(0.00000)
2	0.082222	0.004875	96.81061	2.196512	0.988007
		(1.15099)	(2.85682)	(2.39750)	(1.38925)
3	0.083122	0.055642	95.34160	2.780661	1.822093
		(1.66091)	(4.29713)	(3.58143)	(2.42738)
4	0.084227	0.748950	93.20864	3.502977	2.539431
		(2.50454)	(4.46429)	(3.41180)	(2.43408)
5	0.086342	0.712725	89.48217	3.850290	5.954816
		(2.57601)	(5.12536)	(3.37048)	(3.47510)
6	0.087026	0.711989	88.62576	3.986804	6.675447
		(2.54007)	(5.38143)	(3.51897)	(3.89353)
7	0.087070	0.714030	88.53911	4.047532	6.699325
		(2.63512)	(5.48049)	(3.58055)	(3.89391)
8	0.087141	0.840776	88.41421	4.054375	6.690635
		(2.63502)	(5.55627)	(3.58448)	(3.89461)
9	0.087276	1.072512	88.14041	4.065422	6.721654
		(2.60830)	(5.64133)	(3.60616)	(3.89320)
10	0.087279	1.072466	88.13493	4.066150	6.726454
		(2.61507)	(5.67434)	(3.62502)	(3.89307)
11	0.087287	1.086490	88.11982	4.065451	6.728236
		(2.61385)	(5.68723)	(3.62658)	(3.88787)
12	0.087290	1.086499	88.11559	4.067444	6.730471
		(2.63101)	(5.69988)	(3.63215)	(3.88723)
13	0.087293	1.086685	88.10952	4.067644	6.736153
		(2.63561)	(5.71098)	(3.63929)	(3.89285)
14	0.087294	1.086765	88.10950	4.067662	6.736069
		(2.64321)	(5.71827)	(3.64133)	(3.89404)

Table 13: Variance Decomposition of DLP

Period	S.E.	DLREER	DLTOT	DLP	DLRW
1	0.075611	0.206384	2.393042	97.40057	0.000000
		(1.02005)	(2.62587)	(2.76214)	(0.00000)
2	0.078199	0.323124	2.518364	96.94007	0.218437
		(1.60790)	(2.52260)	(3.27537)	(1.07326)
3	0.078534	0.422685	2.937544	96.12535	0.514422
		(2.00231)	(2.77792)	(3.77616)	(1.60737)
4	0.079333	1.020181	3.732271	94.28117	0.966375
		(2.51681)	(3.16284)	(4.17707)	(2.11640)
5	0.079516	1.147318	3.733622	93.98531	1.133754
		(2.75419)	(3.11409)	(4.23028)	(2.44214)
6	0.079720	1.457445	3.812405	93.59751	1.132637
		(2.79467)	(3.22115)	(4.43886)	(2.44326)
7	0.079867	1.729125	3.799938	93.28619	1.184750
		(2.89532)	(3.19991)	(4.64483)	(2.44780)
8	0.079916	1.776081	3.797969	93.17956	1.246390
		(2.89486)	(3.19677)	(4.71518)	(2.45745)
9	0.079930	1.778584	3.797875	93.16068	1.262865
		(2.88975)	(3.19241)	(4.75807)	(2.45095)
10	0.079938	1.778980	3.802983	93.14206	1.275976
		(2.89113)	(3.21444)	(4.80002)	(2.45474)
11	0.079941	1.782332	3.803294	93.13551	1.278863
		(2.89840)	(3.21176)	(4.81408)	(2.45236)
12	0.079943	1.783626	3.804873	93.13024	1.281258
		(2.90216)	(3.22040)	(4.83098)	(2.45366)
13	0.079946	1.787400	3.804617	93.12623	1.281753
		(2.90662)	(3.22022)	(4.83930)	(2.45444)
14	0.079947	1.788352	3.804595	93.12514	1.281911
		(2.90850)	(3.21912)	(4.84402)	(2.45594)

Table 14: Variance Decomposition of DLRW

Period	S.E.	DLREER	DLTOT	DLP	DLRW
1	0.037389	0.346957	0.089561	0.192238	99.37124
		(1.30367)	(1.38520)	(1.05569)	(2.27584)
2	0.037722	1.233029	0.865842	0.278103	97.62303
		(2.03330)	(1.98563)	(1.24898)	(3.13776)
3	0.039018	4.964508	0.828767	2.861814	91.34491
		(3.67563)	(1.99696)	(2.67876)	(4.92671)
4	0.039157	4.945592	0.823119	3.419033	90.81226
		(3.59977)	(2.11718)	(2.74314)	(5.00589)
5	0.040092	8.964415	1.046657	3.341634	86.64729
		(4.56996)	(2.24606)	(2.87541)	(5.32371)
6	0.040251	9.584219	1.055980	3.339410	86.02039
		(4.80586)	(2.29594)	(2.88517)	(5.58831)
7	0.040280	9.664612	1.055107	3.345052	85.93523
		(4.78404)	(2.28440)	(2.90215)	(5.64985)
8	0.040334	9.823370	1.054935	3.381070	85.74063
		(4.82121)	(2.26818)	(2.89083)	(5.77731)
9	0.040367	9.809464	1.053575	3.401590	85.73537
		(4.85627)	(2.27161)	(2.88309)	(5.83018)
10	0.040375	9.807183	1.059354	3.417883	85.71558
		(4.88929)	(2.28657)	(2.87996)	(5.86866)
11	0.040380	9.820100	1.059483	3.422005	85.69841
		(4.91538)	(2.28603)	(2.88192)	(5.90313)
12	0.040382	9.819185	1.059777	3.422110	85.69893
		(4.91214)	(2.29121)	(2.88245)	(5.91187)
13	0.040383	9.823174	1.061861	3.421939	85.69303
		(4.91260)	(2.29642)	(2.88599)	(5.93090)
14	0.040384	9.825732	1.061848	3.422192	85.69023
		(4.92300)	(2.30012)	(2.88733)	(5.94373)

Cholesky Ordering: DLREER DLTOT DLP DLRWI
Standard Errors: Monte Carlo (100 repetitions)

Variance decomposition analysis over the 14-year period reveals that in the initial period, the real effective exchange rate (DLREER) is entirely explained by its own shocks. By the 14th period, 93.97% of its variance is still attributed to its own innovations. Additionally, at this stage, 3.59% of the variance in the real effective exchange rate is explained by real worker incomes, 1.86% by palm oil prices, and 0.56% by terms of trade.

In the case of terms of trade (DLTOT), the initial period shows that 99.99% of the variance is due to its own shocks, with only 0.005% influenced by the real effective exchange rate. By the 14th period, 88.10% of the variance in terms of trade remains explained by its own shocks, while 6.73% is attributed to real worker incomes, 4.06% to palm oil prices, and 1.08% to the real effective exchange rate.

With regard to palm oil prices (DLP), 97.40% of the variance is initially explained by its own shocks, 2.39% by terms of trade, and 0.20% by the real effective exchange rate. By the 14th period, own shocks still dominate at 93.12%, followed by 3.80% from terms of trade, 1.78% from the real effective exchange rate, and 1.28% from real worker incomes.

As for real worker incomes (DLRW), the initial period variance is largely self-explained at 99.37%, with 0.34% linked to the real effective exchange rate, 0.19% to palm oil prices, and 0.089% to terms of trade. By the 14th period, 85.69% of the variance is attributed to its own shocks, 9.82% to the real effective exchange rate, 3.42% to palm oil prices, and 1.06% to terms of trade.

Looking at the results of the variance decomposition as a whole, it can be seen that the strongest decomposition occurs in real worker wages, while the second strongest decomposition occurs in terms of trade. Despite this, it can be said that the decomposition is weak and that the real exchange rate and palm oil prices are the strongest variables.

After variance decomposition, causality analyses were performed between the variables. The causality analyses were performed using the Granger causality analysis, and the results are shown in Table 15.

Table 15: Granger Causality Test Results

	VAR		
Variables	**Chi-sq.**	**dF.**	**Prob.**
DLREER => DLTOT	0.425225	4	0.98
DLREER => DLP	2.554513	4	0.63
DLREER => DLRW	4.763581	4	0.31
DLREER => ALL	8.341739	12	0.75
DLTOT => DLREER	2.750088	4	0.60
DLTOT => DLP	6.841427	4	0.14
DLTOT => DLRW	8.223303	4	0.08*
DLTOT => ALL	19.09036	12	0.08*
DLP => DLREER	2.487314	4	0.64
DLP => DTOT	3.128145	4	0.53
DLP => DLRW	1.264556	4	0.86
DLP => ALL	7.181149	12	0.84
DLRW => DLREER	16.10624	4	0.00***
DLRW => DTOT	1.899681	4	0.75
DLRW => DLP	4.988570	4	0.28
DLRW => ALL	22.62090	12	0.03**

According to the results of the Granger causality test, it was found that real worker wages are causally related to the real effective exchange rate at a 1% significance level with a ratio of 16.106, and to all other variables in the model at a 5% significance level with a ratio of 22.620.

Additionally, it was observed that there is a causal relationship between trade terms and real wages at a 10% significance level of 8.223, and between trade terms and all variables at a

10% significance level of 19.090. However, although these results related to trade terms are theoretically meaningful, they must be statistically significant at a level of 5% or lower to be statistically meaningful. Since the results are not statistically significant, it is concluded that they are insufficient to explain the model.

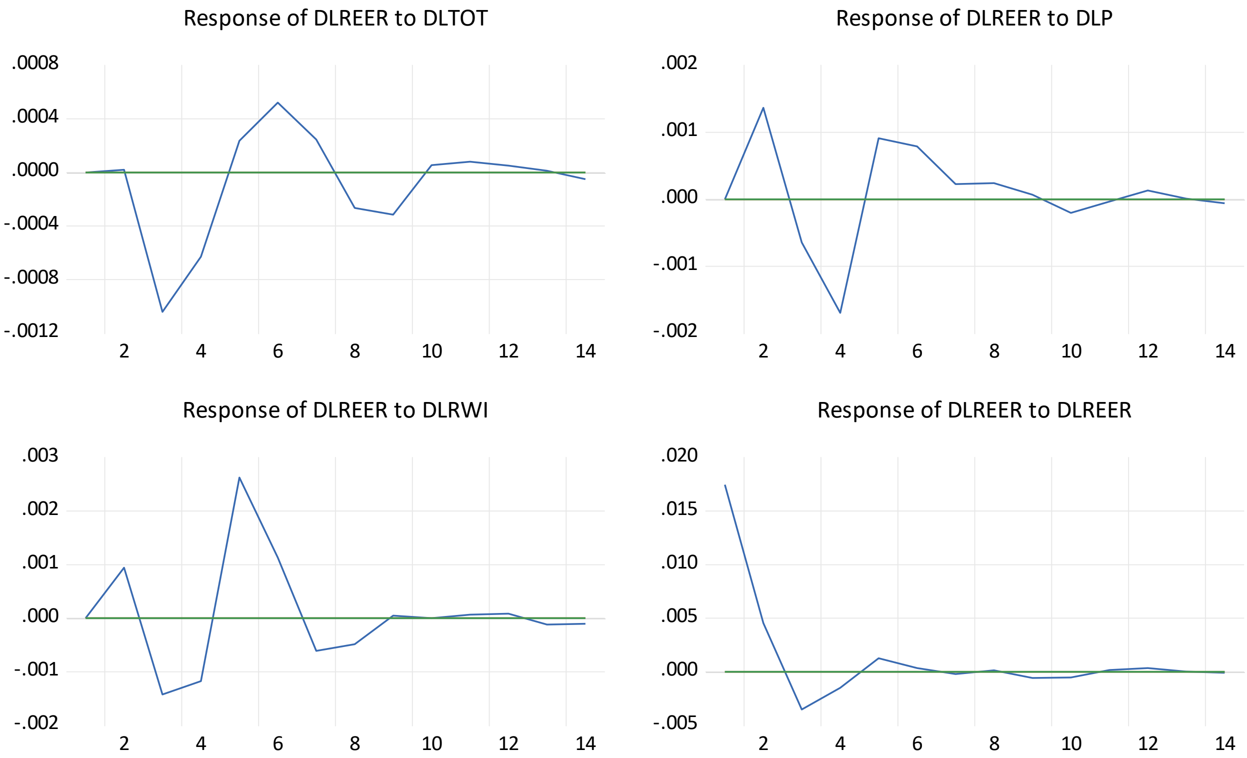

Figure 3 – Impulse-Response Analysis Results

Figure 3 shows the reactions of the real exchange rate to the effects of other variables. As can be seen, despite the shock in trade terms, the real exchange rate initially responds negatively until the third period, then responds positively from the third to the sixth period. After the sixth period, the real exchange rate responds negatively to the shock and follows a balanced trend with trade terms after the ninth period.

Despite changes in palm oil prices, the real exchange rate responds positively until the second period and then negatively until the fourth period. After the fourth period, the real exchange rate responds positively again and is seen to have reached equilibrium with palm oil prices after the seventh period.

When examining the response of the real exchange rate to changes in real wages, the real exchange rate responded positively until the second period and negatively from the second to the third period. The real exchange rate responded positively again to real wages until the 5th period, showed a negative response again until the seventh period, and has followed a balanced trend since the ninth period.

The real exchange rate also shows a negative response to shocks originating from itself until the third period, followed by a positive response until the fifth period, and then reaches equilibrium after the sixth period.

6. CONCLUSION

Dutch Disease refers to the adverse effects that arise from a sudden increase in a country's currency value, often triggered by the discovery or exploitation of a valuable natural resource. This phenomenon is linked to the appreciation of the real exchange rate, which in turn leads to reduced productivity in competitive production-based sectors such as manufacturing and agriculture. These dynamics contribute to both direct and indirect de-industrialization, leading to negative economic impacts and what is commonly known as the resource curse.

Palm oil production has increased dramatically over the last two decades due to its low cost and lack of trans fatty acids. This increase is consistent with a considerable global increase in consumption, owing to its varied usage in the food, non-food, and biofuel industries. Today, palm oil is used in the majority of packaged food and personal hygiene goods sold in supermarkets. The palm oil trade has greatly increased Indonesia's economic growth, creating employment opportunities and generating foreign exchange earnings. Indonesia stands as the foremost global producer of palm oil, dominating the market by supplying approximately half of the world's palm oil. This dominant position solidifies Indonesia as the largest exporter of this widely used commodity, strongly influencing the global palm oil industry. However, Indonesia's dominance in palm oil production and exports raises concerns about the potential for the Dutch Disease phenomenon.

This study aims to investigate whether palm oil production in Indonesia, through changes in the real exchange rate, has led to the Dutch Disease in the Indonesian economy. The study adopts a model framework originally developed by Kuralbayeva et. al. (2001), which is designed to empirically investigate the Balassa-Samuelson effect. The analysis utilizes monthly data from the period 2009:M01 to 2022:M12, including Indonesia’s real effective exchange rate, terms of trade, palm oil prices, and real wages. Using a general VAR model, the study explores the short- and long-term effects of the terms of trade, palm oil prices, and real wages on the real effective exchange rate.

According to the findings of the study, there is a cointegration relationship among the variables in the long run. Based on the results of the Granger causality test, there is a causality from real wages and all other variables to the terms of trade at the 10% significance level; however, since it is not below the 5% significance level, this relationship is not considered statistically significant. Another result of the Granger causality test indicates that there is a causality from real wages to the real effective exchange rate at the 1% significance level, and to all other variables at the 5% significance level.

Based on the findings, it is observed that the real exchange rate is less affected by the terms of trade than expected, whereas real wages have an impact on the real exchange rate. These findings alone are not sufficient to confirm the presence of Dutch Disease. This suggests that palm oil production and exports in the country do not significantly influence the terms of trade, that sectoral competitiveness remains relatively balanced, and although wage dynamics affect the real exchange rate, they do not fully align with the typical indicators of Dutch Disease. Considering the potential threat of Dutch Disease in Indonesia, policy initiatives might be inspired by the Norwegian approach by directing palm oil earnings into a sovereign wealth fund and investing in advanced manufacturing, renewable energy, and educational programs. Enhancing institutional frameworks, encouraging value-added processing, and expanding export markets are likely to lower the risk of negative currency impacts and bolster long-term economic stability. Future studies could offer more comprehensive insights by utilizing various methodological approaches could enhance the findings.

RESEARCHERS' CONTRIBUTION STATEMENT

The authors' contribution to the study is 50%.

DECLARATION OF CONFLICT OF INTEREST

There is no conflict of interest with any institution or individual within the scope of this study.

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