Revealing Competitiveness and Key Drivers of Nickel (HS 75) Exports: Evidence from Seven Major Destinations, 2014–2023

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Abstract. The downstream policy is implemented to encourage Indonesia's processed nickel products. Processed nickel under Harmonized System (HS) 75 is a value-added product that has potential for the Indonesian economy. Globally, Indonesia's exports of nickel HS 75 have increased significantly. This increase occurred after the implementation of the downstream policy. However, the increase in export volume did not occur uniformly across all trading partner countries, hence further analysis of the implemented downstream policy is necessary. This study aims to analyse the effect of the down streaming policy and macroeconomic variables such as the destination country's GDP per capita, real prices, exchange rate, and the RCA index significantly affect the export volume of nickel (HS 75), while population and the downstream policy do not have significant effect. These findings indicate that the downstream policy has not yet effectively increased export volumes to trading partner countries.
Keyword: Nickel, Panel Regression, The Downstream Policy.

1. Introduction

International trade activities, specifically exports and imports, play a crucial role in the national economy as they contribute significantly to a country's economy development. Exports, in particular, are vital for Indonesia's economic growth since they generate foreign exchange earnings [1]. The sector that predominantly drives Indonesia's export contribution is the non-oil and gas sector [2]. Within this sector, the manufacturing industry and the mining industry are the largest contributors to export performances, accounting for 76.84% and 21.35% of total exports, respectively.

The growth potential of Indonesia's processing and mining sectors is strongly supported by the country's substantial nickel reserves. According to Kementerian Energi dan Sumber Daya Mineral [3], Indonesia accounts for approximately 52% of global nickel reserves. Moreover, the implementation of down streaming policies in the mining sector has accelerated the development of the processing industry, particularly through the establishment of nickel smelters across the country. By 2020, there were 292 Mining Business Licenses for Production Operations, 4 contracts of work, and 11 operational nickel smelters [4]

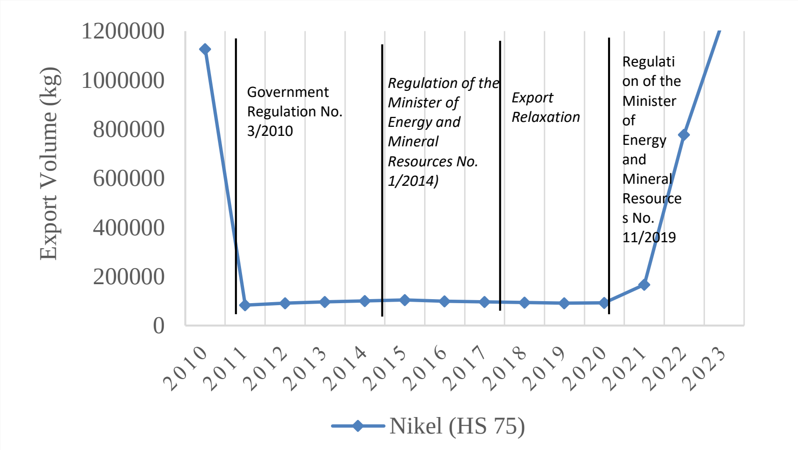
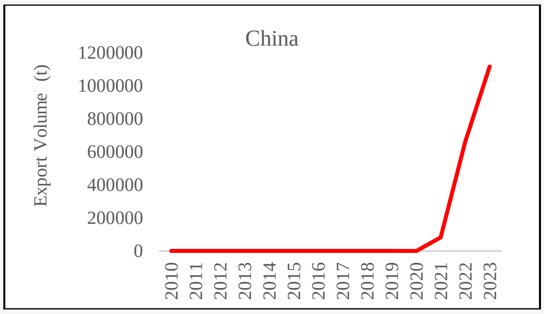


Figure 1. Global Export Volume of Processed Nickel (HS 75), 2010–2023.

The relatively low market value and the limited supply of nickel ore estimated to last only 7.3 more years have driven Indonesia to adopt several policy measures. To address these challenges, the government introduced a series of down streaming policies aimed at increasing the price and safeguarding domestic nickel reserves. Nevertheless, these policies have not been fully effective due to inadequate infrastructure and limited investment inflows [5]. In response, the government enacted Peraturan Kementerian Energi dan Sumber Daya Mineral No. 11 of 2019, which strictly prohibits the export of unprocessed nickel ore as January 1, 2020, permitting only the export processed nickel products. Since the implementation of this regulation, Indonesia has begun to exhibit a positive trend in the export volume of processed nickel , as presented in figure 1.



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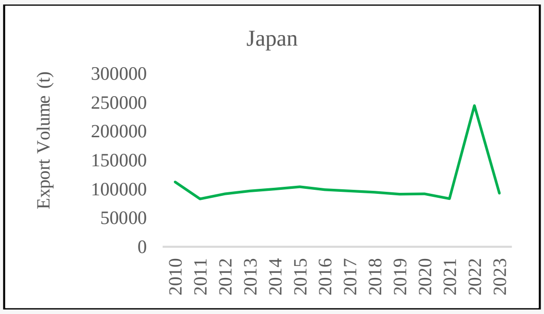

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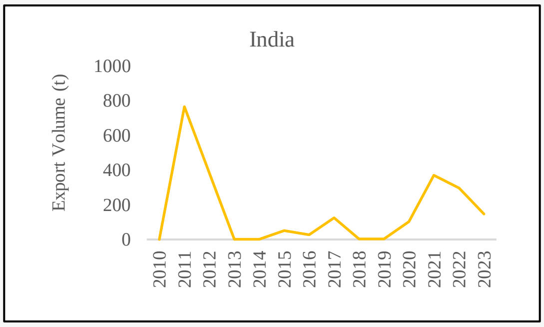

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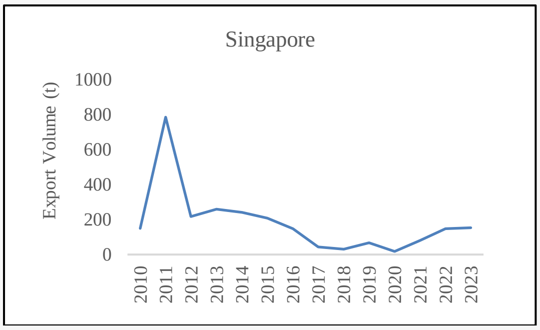

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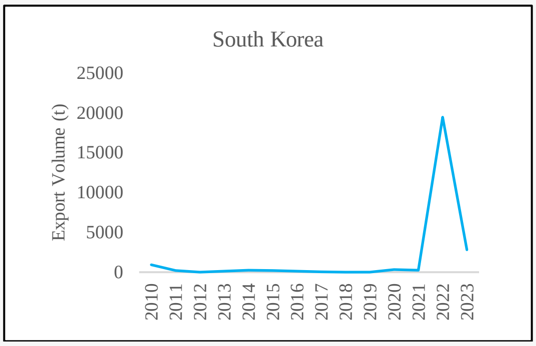

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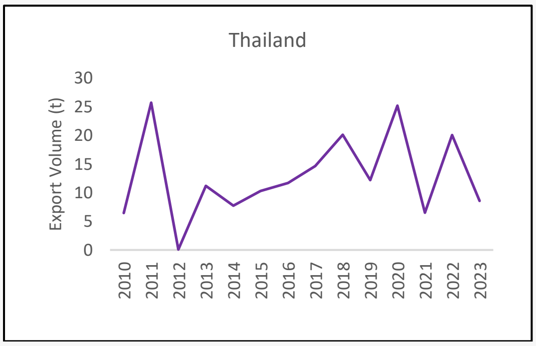

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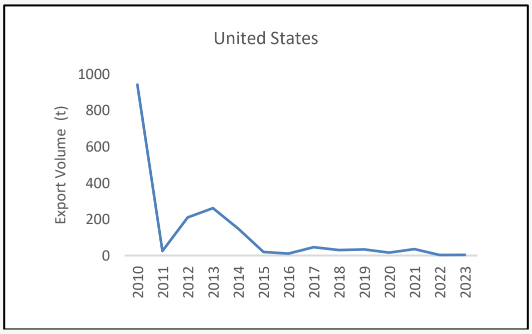

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Figure 2. Export Volume of Nickel (HS 75) to Seven Destination Countries, 2010–2023.

Between 2010 and 2023, Indonesia exported nickel to a number of countries worldwide. Nevertheless, UN Comtrade data identifies seven countries as the most consistent destinations for Indonesia's nickel exports. As shown in figure 2, from 2010 to 2019, export volumes to China and South Korea followed a relatively steady upward trend. In contrast, exports to Singapore, India, the United States (USA), and Thailand displayed more growth trend was only evident in exports to China and Singapore, while the other destinations experienced a decline.

Salvatore notes that commodity prices and supply levels are positively correlated, implying that higher export values tend to be accompanied by greater quantities supplied [6]. This relationship should, in principle, lead to an increase in the export volume of a given commodity. However, as illustrated in figure 2, despite the introduction of down streaming policies intended to enhance valued-added and strengthen the competitiveness of processed nickel products, Indonesia's export volumes to key destination countries have exhibited a declining trend. This suggests that other factors may be influencing Indonesia's export performance. Furthermore, the observed negative patterns in several countries compare to alternative commodities, underscoring the need to examine Indonesia's position within the global nickel market.

A number of prior studies have examined issues related to export performance. Fadlillah & Wahyuni [7], using the Error Correction Model (ECM), found that government policies exert both short-run and long-run effects. Similarly, Setiawan & Setiawina [8] reported that US dollar exchange rate had a negative and significant impact on nickel ore exports, whereas production, the wholesale price index (IHPB), and foreign direct investment (FDI) had positive and significant effects on Indonesia's nickel ore exports during the 1995-2014 period. Sihotang & Ishak [9] further revealed that nickel prices, along with the interaction between GDP and the export ban on nickel ore, positively and significantly influenced stock prices. In a related study on processed cocoa exports to nine destination countries, Maulana & Kartiasih [10] found that GDP, population size, the revealed comparative advantage (RCA) index, and export tax policies significantly increased export volumes, whereas the prices of processed cocoa exerted a negative effect.

While numerous studies have explored the short- and long-term effects of Indonesia's nickel export ban, few investigated how such policies shape the dynamics of export performance over time and their implications for destination countries. To address this gap, this study employs panel data regression as an appropriate methodological approach. The analysis is restricted to six key variables: destination countries' GDP per capita, the revealed comparative advantage (RCA) index, the real exchange rate, population size of the destination countries, and the real price of nickel (HS 75).

Building upon the background outlined above, this study seeks to achieve the following objectives:

To present an overview of the GDP per capita of destination countries, the revealed comparative advantage (RCA) index, the real exchange rate, population size, and the real price of nickel (HS 75) in Indonesia's export destination countries for the period 2014-2023.

To assess the competitiveness of Indonesia's nickel (HS 75) exports to seven destination countries during 2014-2023.

To examine the effects of destination countries' GDP per capita, the revealed comparative advantage (RCA) index, the real exchange rate, population size, and the real price of nickel on Indonesia's nickel (HS 75) export volume to destination countries during 2014-2023.

2. Literature study

2.1. International trade

International trade has become a crucial point in global economic growth, and the role of institutions in facilitating such trade is highly significant. The following are some of the main theories relevant in the context of international trade:

1. Absolute advantage theory
The theory of absolute advantage, introduced by Adam Smith, states that a country with an absolute advantage will specialize in and export certain types of goods. Furthermore, a country that does not have an absolute advantage will not produce goods that are similar to those produced by another country.

2. Comparative advantage theory
The theory of comparative advantage, developed by David Ricardo, explains that international trade occurs when there are differences in comparative advantage among countries. Salvatore explains that even if a country is less efficient than another in producing two commodities, it should specialize in producing and exporting the commodity in which it has a smaller absolute disadvantage, while importing the commodity in which it has a larger absolute disadvantage.

3. Modern Hecksher-Ohlin theory
According to experts, the Heckscher-Ohlin (H-O) theory is a continuation of classical trade theory, which aims to identify the factors influencing trade between two countries. This theory focuses on the relative differences in factor endowments and factor prices between countries as the main drivers of trade. In the Heckscher-Ohlin model, the factor endowments referred to are land, labor, and capital.

2.2. Demand and supply theory

Demand and supply represent the interaction between producers and consumers in a market. Demand theory explains that the quantity of goods or services purchased by consumers depends on the price level within a given period. The lower the price of a good, the higher the demand for it, assuming other variables remain constant (ceteris paribus). Conversely, the higher the price of a good, the lower the quantity demanded.

Meanwhile, supply theory describes the relationship between price and the quantity of goods supplied by producers. The higher the price of a good, the greater the quantity supplied by producers, assuming other variables remain constant (ceteris paribus). Conversely, the lower the price of a good, the smaller the quantity supplied [11]

2.3. Exports

According to Mankiw [12], exports refer to the activity of selling domestically produced goods and services abroad. Ibrahim and Halkam [13] further explain that exports represent a trading system in which goods are shipped from one country to another in accordance with prevailing regulations. Total exports reflect the aggregate commodities sold by a country to foreign markets in a given year. Exports play a crucial role in a country's economy as they enhance public welfare and generate foreign exchange revenues, thereby fostering economic growth.

2.4. Nickel (HS 75)

Nickel is naturally occurring metallic element and one of the most found in the earth's crust [14]. Meanwhile, nickel (HS 75) refers to nickel ores that have undergone processing (smelting), thereby increasing their added value [15]. According to LPEM FEB UI [16], the HS 75 nickel product group includes: Nickel mattes, nickel oxide sinters, and other intermediate products of nickel metallurgy (HS 7501); Unwrought nickel (HS 7502); Nickel waste and scrap (HS 7503); Nickel powders and flakes (HS 7504); Nickel bars, rods, profiles, and wire (HS 7505); Nickel plates sheets, strip, and foil (HS 7506); Nickel tubes, pipes, and tube or pipe fittings (couplings, elbows, sleeves) (HS 7507); and Other articles of nickel (HS 7508).

2.5. Gross domestic product per capita

Gross Domestic Product (GDP) per capita is the ratio of GDP to the total population representing the average income earned by each individual. GDP per capita has a positive influence on a country's export volume. According to Krugman and Obstfeld [17], countries with higher GDP per capita tend to have greater purchasing power, thereby increasing demand for goods or services exported from other countries.

2.6. Population

According to Badan Pusat Statistik (BPS) [18], the population refers to all individuals residing within the territory of the Republic of Indonesia for one year or more. The population size is strongly and positively correlated with the demand for the quantity of commodities purchased at every price level [19]. Salvatore [6] explain that further emphasized that an increase in population leads to higher domestic demand for specific commodities.

2.7. Real price

Export prices can be calculated by dividing the value of exports by the export volume can be calculated by dividing the value of exports by the export volume. Pindyck and Rubinfeld [20] stated that nominal price is relative to the aggregate price level. Countries with high purchasing power and significant demand trend to accept goods at higher prices; thus, an increase in the real price of export products can enhance the export volume to destination countries capable of adjusting to such price levels [17].

2.8. Revealed Comparative Advantage (RCA)

The Revealed Comparative Advantage (RCA) index is one of the methods used to measure comparative advantage in a particular region. It can identify export specialization patterns and quantitatively assess whether a country's industry is competitive in the international market. An RCA value greater than one indicates strong product competitiveness in that region, whereas a value less than one reflects relatively weak competitiveness [21]. Destination countries with high demand and income levels tend to import goods from countries with a strong RCA [22].The RCA is calculated using the following equation:

$$RCA = \frac{X_{ij}}{X_j}\left(\frac{W_{ij}}{W_j}\right)^{-1} \tag{1}$$

Where X_{ij} represents the export value of commodity j from country i, X_{it} is the total export value of country i, X_{wj} denotes the world export value of commodity j, and X_{wt} is the total world export value.

2.9. Real exchange rate

The real exchange rate is calculated by multiplying the domestic price level by the nominal exchange rate and dividing it by the foreign price level. According to Krugman and Obstfeld [17], the exchange rate has a negative correlation with export volume. An appreciation of the exchange rate tends to reduce export volume, whereas depreciation tends to increase it.

2.10. Trade policy

Trade policy refers to government regulations related to trade that directly affect the quantity of goods and services export or imported by a country [12]. In Indonesia, one such policy is the restriction or prohibition of exports. The government introduced an export ban on nickel ore through Ministry of Energy and Mineral Resources (Kementerian Energi dan Sumber Daya Mineral) Regulation No. 11 of 2019 concerning the Second Amendment to Peraturan Menteri ESDM No. 25 of 2018 on Mineral and Coal Mining Management. This regulation, which comprehensively prohibits the export of nickel ore with a grade below 1.7%, has been in force since in January 1, 2020. The policy aims to encourage further domestic processing of nickel ore, thereby adding value to Indonesia's exports. Consequently, the imposition of the nickel ore export ban is expected to enhance the country's processed nickel exports.

3. Methods

This study focuses on analysing the competitiveness and determinants of Indonesia's nickel exports (HS 75). The research scope covers seven of Indonesia's major trading partners, namely China, the United States, Japan, Singapore, India, South Korea, and Thailand. These seven countries were selected because they collectively account for approximately 90–99% of Indonesia's total nickel exports worldwide [5].

The study employs secondary data. The dependent variable is the export volume of Indonesia's nickel (HS 75) to the seven trading partner countries, obtained from UN Comtrade. The export volume of nickel (HS 75) is calculated by summing the export volumes of HS 7501 to HS 7508 annually for each destination country. The independent variables include population, GDP per capita, RCA (Revealed Comparative Advantage), real price, and real exchange rate of the seven trading partner countries, all of which are sourced from the World Bank.

Additionally, the study incorporates a dummy variable to represent the nickel export ban policy officially implemented in 2020. The research period spans from 2014 to 2023. This timeframe was chosen because it reflects a critical phase in Indonesia's nickel down streaming policy: the relaxation of the nickel ore export ban began in 2014, while 2020 marked the turning point with the full enforcement of the raw material export ban.

The study employs both descriptive and inferential analyses. Descriptive analysis is used to provide an overview of GDP per capita, population, real price, and real exchange rate. It is also applied to examine the competitiveness of nickel (HS 75) in the destination countries. The descriptive analysis utilizes line charts and scatter plots.

For the inferential analysis, the study applies panel data regression using the Fixed Effect Model (FEM) with Seemingly Unrelated Regression (SUR) weights, which is considered appropriate for addressing potential heteroskedasticity and contemporaneous correlation in panel data [23]. The statistical software used for the analysis are EViews 12 and Microsoft Excel.

The empirical model employed in this study to analyse the determinants of Indonesia's nickel exports (HS 75) to its seven main trading partners is specified as follows:

$$LnEX_{it} = \beta_0 + \beta_1 LnRCA_{it}{}^{*} + \beta_3 LnGDPPC_{it}{}^{*} + \beta_3 LnER^{*}_{it} + \beta_4 LnPOP_{it} - \beta_5 LnP^{*}_{it} + \beta_6 DUM_{it} + \alpha_i + v_{it} \tag{2}$$

EX_{it}	: Export volume of nickel (HS 75) from Indonesia to country i in year t.
$GDPPC_{it}$	: GDP per capita of country i in year t.
POP_{it}	: Population of country i in year t.
RCA_{ij}	: Revealed Comparative Advantage index of Indonesia's nickel export to country i in year t.
P_{it}	: Real export price of nickel in country i in year t.
ER_{it}	: Real exchange rate between Indonesia and country i in year t.

DUM_{it} : Dummy variable representing the nickel export ban policy (1 = 2020 onwards, 0 = otherwise).

α_i : country-specific intercept that captures time invariant characteristics not included in the model.

v_i : random error term representing other factors influencing exports but not included in the model.

The panel data regression analysis in this study begins with the model selection stage to determine the most appropriate model between the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). The Chow test is used to compare CEM with FEM, the Hausman test is applied to compare FEM with REM, while the Breusch-Pagan Lagrange Multiplier (BP-LM) test is employed to compare CEM with REM. If the selected model is FEM, further examination of the variance–covariance structure is conducted using the LM test and the λ_{LM} test, the results of which determine the appropriate estimation method. In contrast, if the selected model is CEM or REM, the analysis proceeds directly to the classical assumption tests.

The classical assumption tests conducted in this study include the normality test using the Jarque-Bera method to examine the distribution of residuals, the multicollinearity test assessed through the Variance Inflation Factor (VIF), where a value below 10 indicates the absence of multicollinearity among independent variables, the homoscedasticity test to ensure constant error variance, and the autocorrelation test using the Durbin-Watson statistic. Once the selected model passes these assumption tests, the significance of the model is further evaluated. The significance tests include the coefficient of determination (R^2), which measures the proportion of variance in the dependent variable explained by the independent variables, the F-test to assess whether the independent variables jointly affect the dependent variable, and the t-test to examine the partial effect of each independent variable on the dependent variable while holding other variables constant.

After obtaining the estimated regression coefficients from the selected model, the final step is to interpret the results to provide meaningful insights in line with the objectives of this research.

4. Results

4.1. Overview of GDP per Capita, Competitiveness Index (RCA), Real Exchange Rate, Population, and Real Prices of Nickel Export Destination Countries (HS 75), 2014–2023

The GDP per capita of Indonesia's nickel (HS 75) export destination countries during 2014–2023 shows a generally increasing trend. Based on figure 3, Singapore and the United States have the highest GDP per capita compared to other nickel export destinations. Meanwhile, three of Indonesia's major export destination such as India, Thailand, and China record relatively lower GDP per capita than the others. This indicates that countries with higher GDP per capita, such as Singapore and the United States, have a greater potential to import nickel (HS 75) from Indonesia compared to countries with lower income levels.

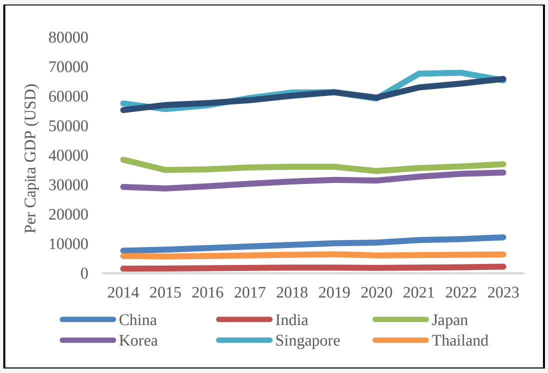

Figure 3. Per capita GDP trends of the destination countries, 2014–2023.

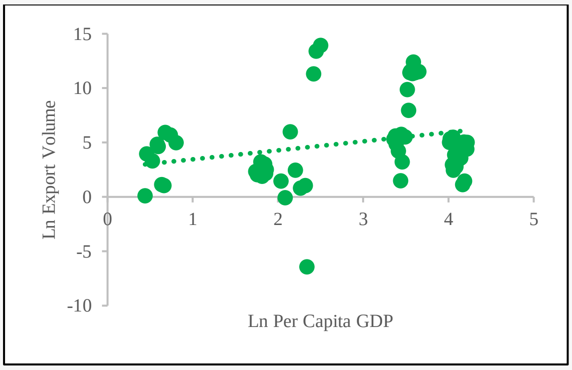

Figure 4. Scatter plot of Ln export volume and Ln per capita GDP.

Based on the scatter plot presented in figure 4, the relationship between GDP per capita and the export volume of nickel (HS 75) to destination countries shows a generally positive pattern. This indicates that the higher the GDP per capita of an export destination country, the greater the export volume from the exporting country to that market. This finding is consistent with Krugman and Obstfeld [17], who argue that countries with higher GDP per capita tend to possess stronger purchasing power. Consequently, this encourages exporting countries to increase their export volume to such destinations.

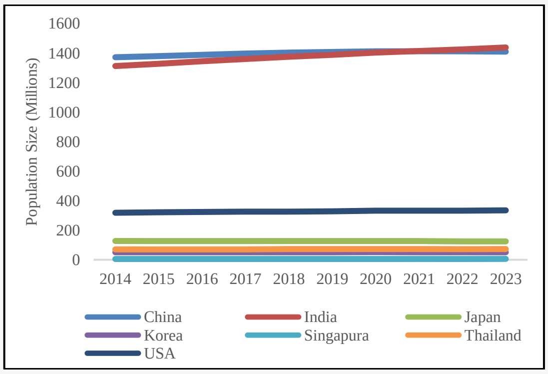

Figure 5. Population trends of the destination countries, 2014–2023.

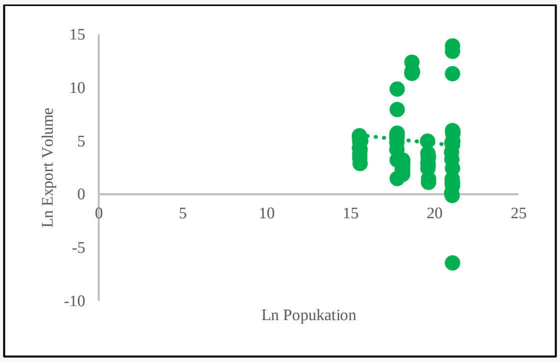

Figure 6. Scatter plot of Ln export volume and Ln Population.

The development of population in most export destination countries shows a relatively stable or stationary pattern. A positive trend in population growth is only observed in India, where the population has increased consistently each year. Among the selected countries, India and China record the largest populations, while other countries such as South Korea, the United States, Singapore, Thailand, and Japan have comparatively smaller populations.

Based on figure 6, the relationship between population size and export volume to the destination countries shows a negative pattern. This indicates that the larger the population growth of an importing country, the lower the growth of export volume to that country. This phenomenon can be explained by the self-sufficiency effect, which suggests that countries with large populations tend to shift toward domestic production rather than relying on imports [24]. Consequently, the export volume from the exporting country to such destinations also tends to decline.

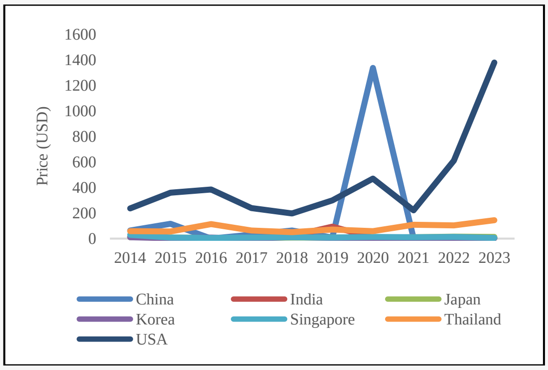

Figure 7. Price GDP trends of the destination countries, 2014–2023.

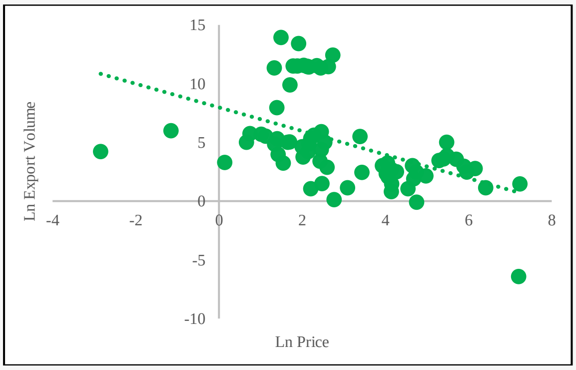

Figure 8. Scatter plot of Ln export volume and Ln price.

Nickel (HS 75) prices exhibited a varied pattern throughout the period 2014 to 2023. Figure 7 shows that most countries experienced relatively low and stable price fluctuations, with significant exceptions in China and the United States, which displayed sharp price movements during certain periods. The United States recorded notable price volatility, particularly in 2016, followed by a significant increase in 2023, making it the country with the highest price at the end of the observation period. Meanwhile, China experienced a sharp spike in 2020, which was subsequently followed by a steep decline in the following year. Other countries such as India, Japan, Korea, Singapore, and Thailand tended to maintain stable and relatively low prices throughout the analysis period. Nevertheless, Thailand demonstrated a consistent upward trend from year to year, albeit on a moderate scale.

Based on figure 8, there appears to be a tendency of a negative relationship between export volume and price. This finding contrasts with the theory proposed by Pindyck and Rubenfield [20], which states that the correlation between export volume and price is negative. However, this result is supported by the study of Marchandry [25], which found that international prices positively affect nickel exports in East Luwu Regency. This outcome can also be explained using the supply theory approach, which suggests that higher prices lead to an increase in the quantity of commodities supplied. This implies that the higher the price, the greater the volume of commodity exports to the destination countries.

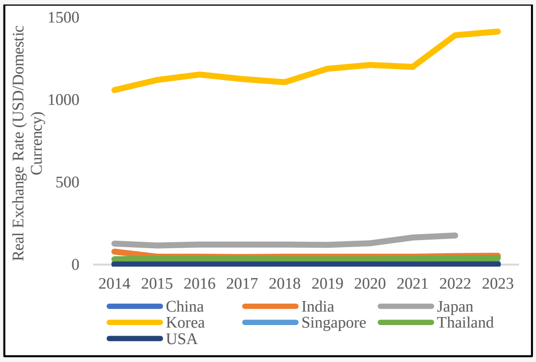

Figure 9. Exchange rates trends of the destination countries, 2014–2023.

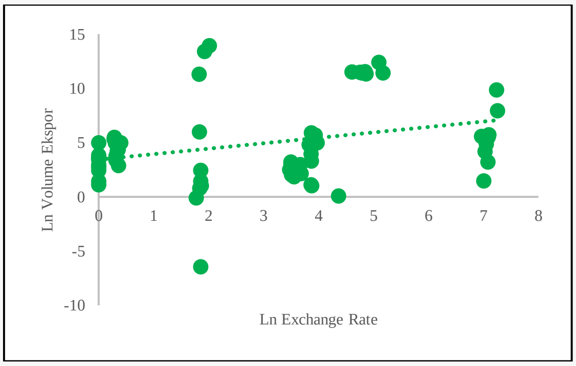

Figure 10. Scatter plot of Ln export volume and Ln per capita GDP of the destination countries.

The exchange rate development of most export destination countries tended to remain relatively stable and within a low range throughout the observation period, except for Korea, which consistently recorded the highest level and demonstrated a clear upward trend. Based on figure 9, the exchange rate of Singapore's currency against the US dollar was the highest among other countries. Meanwhile, Japan ranked second as the country with the second-highest exchange rate among Indonesia's nickel (HS 75) export destinations during the study period.

Referring to figure 10, the relationship between exchange rate and nickel (HS 75) export volume shows a positive pattern. This finding contrasts with the theory explained by Krugman & Obstfeld [17], which states that exchange rates and export volumes are negatively correlated. However, this result is in line with the study of Utami & Agustina [21], which found that exchange rates and export volumes are positively related. This may occur due to high import demand in export-oriented industries, which causes depreciation of the exchange rate in Indonesia's export destination countries. Such depreciation reduces domestic production capacity, leading importing countries to increase purchases from exporting countries offering cheaper commodities.

4.2. Competitiveness of Nickel (HS 75) Exports to Seven Destination Countries in 2015–2023

Overall, figure 11 illustrates that Indonesia's nickel (HS 75) commodity exhibits low competitiveness in its export destination countries. Indonesia only outperformed its competitors, such as Canada and the United Kingdom, in the Chinese and Japanese markets. Meanwhile, in other markets, Indonesia's RCA values consistently remained below one. This indicates that Indonesia has not yet been able to compete effectively in the international market for nickel (HS 75).

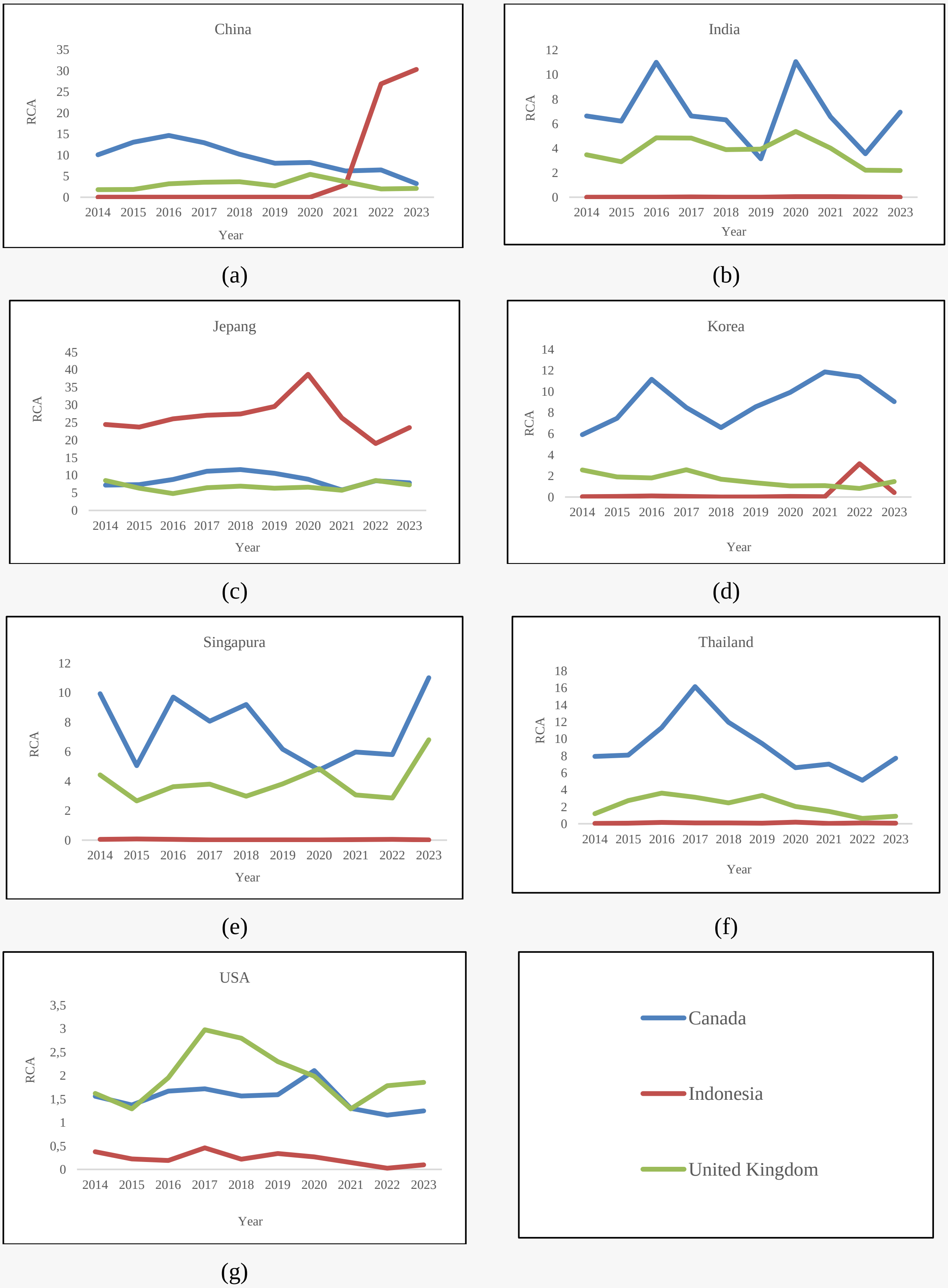

Figure 11. Competitiveness (RCA) trends of the United Kingdom, Indonesia, and Canada in export destination countries, 2014–2023.

Referring to figure 12, export volume and RCA demonstrate a strong positive relationship. This suggests that the higher the competitiveness of nickel (HS 75), the greater the growth of export volume to destination countries. This result aligns with the theory of comparative advantage, which states that when a country possesses a comparative advantage, production is directed primarily toward that commodity, thereby increasing export volumes to foreign markets.

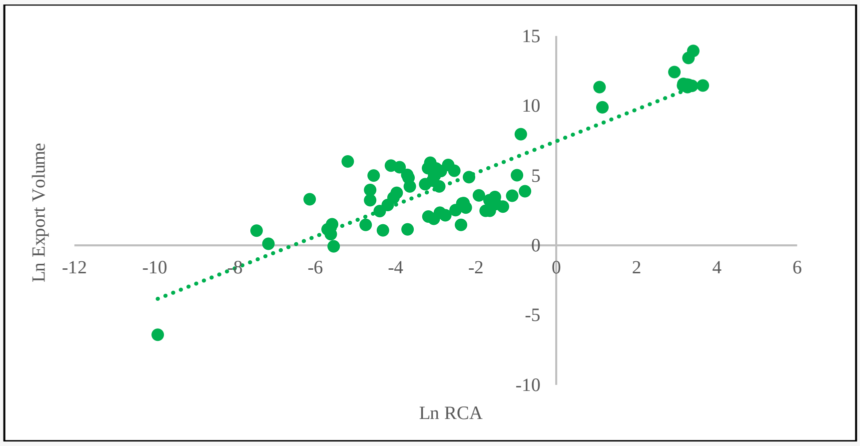

Figure 12. Scatter plot of Ln export volume and Ln RCA.

4.3. Estimation Results and Interpretation of Panel Data on the Influence of Variables Affecting Nickel (HS 75) Export Volume to Seven Destination Countries in 2014–2023

Based on table 1, the results of the Chow test indicate that the Fixed Effects Model (FEM) is preferable to the Common Effects Model (CEM), while the results of the Hausman test suggest that the Random Effects Model (REM) is superior to FEM. However, since the time dimension in this study (9 years) is greater than the cross-sectional dimension (7 countries), FEM is considered more appropriate for use [26]. Furthermore, the LM test results show that the variance–covariance matrix exhibits heteroskedasticity and cross-sectional correlation. Therefore, the estimation method employed in this study is the Feasible Generalized Least Squares with cross-section Seemingly Unrelated Regression (FGLS-SUR).

Table 1. Summary of best model selection.

Model	P-value	Chow Test	Hausman Test	LM Test	λ_{LM} Tes
Volume Ekspor	0.05	0.0000	1.000	0.0000	0.0000

Subsequently, classical assumption tests were conducted, including multicollinearity detection and residual normality testing. The Variance Inflation Factor (VIF) values for all variables were found to be less than 10. The results of the normality test also indicated a p-value greater than the 5% significance level, implying the absence of multicollinearity problems and violations of the normality assumption. Following this, the estimation of the selected model was carried out, and the results are summarized in Table 2 below.

Table 2. Summary of best model selection.

Independent Variable	Export Volume		
	Coefficient	Error Standard	P-value
C	46.40110	88.86129	0.6036
LnRCA	1.100285	0.041252	0.0000[a]
LnGDPPC	2.172441	1.054535	0.0440[a]
LnER	1.306048	0.613937	0.0377[a]
LnPOP	-2.488571	4.760948	0.6032

LnP	-0.822625	0.063094	0.0000 [a]
Dummy	0.123995	0.171918	0.4737
R^2		0.994121	
R^2_{adj}		0.992883	
Prob F		0.00000	

[a] significant at 5 percent

The following is the regression model that was obtained:

$$\widehat{LnEX_{it}} = (46.4011 + \alpha_i) + 1.1002LnRCA_{it}{}^* + 2.17241LnGDPPC_{it}{}^* + 1.3060LnER^*_{it} \\ -2.4886LnPOP_{it} - 0.8226LnP^*_{it} + 0.1240DUM_{it} + v_{it} \quad (3)$$

Based on Table 2. the estimation results show that the export model has an adjusted R^2 value of 0.9929. indicating that the six independent variables in the model are able to explain the variation in Indonesia's nickel (HS 75) export volume to the seven destination countries by 99.28 percent. while the remaining 0.71 percent is explained by other variables outside the model. Furthermore. the F-test results indicate a rejection of H_0. which means that at least one independent variable significantly influences the export volume of Indonesia's nickel (HS 75) to the seven destination countries.

The estimation results reveal that the RCA variable significantly increases Indonesia's nickel (HS 75) export growth. The coefficient value of 1.1002 implies that a one percent increase in RCA will increase export volume by 1.1002 percent. ceteris paribus. This finding is consistent with the study of Olilingo [27] on processed cocoa. which showed that commodities undergoing downstream processing possess stronger competitiveness compared to raw products. Down streaming improves product quality and added value. thereby enhancing demand in the international market.

GDP per capita growth in the destination countries is found to significantly increase Indonesia's nickel (HS 75) export volume. The regression coefficient of 2.1724 indicates that if the GDP per capita of the destination countries increases by one percent. the export volume will rise by 2.1724 percent. assuming ceteris paribus. This result aligns with Maulana & Kartiasih [10]. in their study on nutmeg exports. which demonstrated that GDP per capita of importing countries significantly and positively affects Indonesia's export volume. This condition is also in accordance with demand theory. which explains that an increase in per capita income will boost demand for traded commodities [20].

The real exchange rate growth also significantly increases Indonesia's nickel (HS 75) export volume to the seven destination countries. The coefficient value of 1.3060 suggests that if the real exchange rate of the destination countries rises by one percent. the export volume will increase by 1.3060 percent. This finding is in line with Safitri & Hartati [28]. who found that the exchange rate has a positive effect on coal export volume.

Meanwhile. population growth does not have a significant effect on Indonesia's nickel (HS 75) export volume to the seven destination countries. This result is consistent with Putra & Bagus [29]. who showed that population does not significantly affect Indonesia's palm oil exports. This suggests that Indonesia has not been able to fully meet domestic demand. leading importing countries of Indonesia's nickel (HS 75) to switch to other exporters offering similar commodities [29].

The estimation results also show that price growth significantly reduces Indonesia's nickel (HS 75) export volume. The regression coefficient of -0.822625 implies that a one percent increase in price will reduce the export volume by 0.822625 percent. This finding supports the results of Maulana & Kartiasih [10]. who found that price negatively influences the export volume of processed cocoa to destination countries. It also reinforces the theory of Pindyck & Rubinfeld [20]. which states that the higher the price of a good. the lower the demand for that good. ceteris paribus. This occurs because consumers tend to switch to substitute products with lower prices.

Lastly. the policy variable is found to have no significant effect on Indonesia's nickel (HS 75) export volume to the seven destination countries. This is likely due to Indonesia's economic dependence on the Chinese market. which constrains export expansion to other countries. As explained by Yohana [30]. most investments in nickel smelters and processing are dominated by Chinese companies that seek to secure raw materials for their domestic industries. As a result. despite the government's efforts to boost nickel production and downstream processing capacity. a large portion of Indonesia's processed nickel continues to be re-exported to China for further processing or as inputs for other industrial products.

5. Conclusion

Based on the results and discussion of this study. it can be concluded that. in general. the population and real exchange rate in the destination countries of nickel (HS 75) exports experienced relatively stable changes each year. while GDP per capita tended to increase and population showed fluctuating trends. Furthermore. Indonesia's nickel (HS 75) was less competitive compared to its competitors in international markets. except in China and Japan. GDP per capita. the real exchange rate. and RCA were found to have a significant positive effect on the export volume of nickel (HS 75) to the destination countries. Conversely. price had a significant negative effect on the export volume of nickel (HS 75). Meanwhile. down streaming policy and population were not found to have a significant effect on Indonesia's nickel (HS 75) export volume.

References

[1] R. Rahmaddi and M. Ichihashi. "Exports and Economic Growth in Indonesia: A Causality Approach based on Multi-Variate Error Correction Model." 2011.
[2] Badan Pusat Statistik. "Nilai Ekspor Migas dan Non Migas."
[3] Kementerian Energi dan Sumber Daya Mineral. "Peluang Investasi Nikel Indonesia." 2020.
[4] E. A. K. Wardhani and E. A. Djamhari. "Glorifikasi Pertumbuhan Ekonomi dan Trilemma Energi dalam Industri Nikel." MDPI. Feb. 2024. doi: 10.3390/su12041603.
[5] UN Comtrade. "Trade Data."
[6] D. Salvatore. *International Economics*. 11th ed. Hoboken. NJ: Wiley. 2014.
[7] S. Fadlillah and K. T. Wahyuni. "Kajian Kebijakan Larangan Ekspor Bijih Nikel Indonesia (Study of Indonesia's Nickel Ore Export Ban Policy)." 2022.
[8] I. Setiawan and N. Setiawina. "Analisis Daya Saing Serta Faktor-Faktor Yang Mempengaruhi Ekspor Bijih Nikel Di Indonesia." *Ekonomi Pembangunan Universitas Udayana*. vol. 8. 2019.
[9] K. Sihotang and G. Ishak. "Pengaruh Harga Nikel. PDB. Inflasi. Kurs. FDI Terhadap Harga Saham Perusahaan Tambang Nikel Menggunakan Larangan Ekspor Bijih Nikel Sebagai Moderasi Periode 2009 – 2023." *Journal of Economic. Business and Accounting*. vol. 7. 2024.
[10] A. Maulana and F. Kartiasih. "Analisis Ekspor Kakao Olahan Indonesia ke Sembilan Negara Tujuan Tahun 2000–2014." *Jurnal Ekonomi dan Pembangunan Indonesia*. vol. 17. no. 2. pp. 103–117. Jan. 2017. doi: 10.21002/jepi.v17i2.01.
[11] S. Sukirno. *Teori Pengantar Makroekonomi*. Jakarta: Rajagrafindo Persada. 2006.
[12] N. G. Mankiw. *Macroeconomics. 9th.ed.*. 9th.ed. New York: Worth Publishers. 2016.
[13] H. R. Ibrahim and H. Halkam. *Perdagangan Internasional dan Strategi Pengendalian Impor*. Lembaga Penerbitan Universitas Nasioanl (LPU-UNAS). 2021.
[14] D. D. Radhica and R. A. A. Wibisana. "Proteksionisme Nikel Indonesia dalam Perdagangan Dunia." *Journal of Trade Development and Studies*. vol. 7. pp. 74–84. 2023.
[15] N. R. Cahyani. "Kebijakan Pemberhentian Ekspor Biji Nikel Indonesia Tahun 2020: Tinjauan Neomerkantilisme." *Jurnal Ilmu Sosial dan Humaniora*. vol. 6. 2023. [Online]. Available: https://jayapanguspress.penerbit.org/index.php/ganaya423
[16] LPEM FEB UI. "Trade and Industry Brief." Jakarta. Oct. 2021. [Online]. Available: https://www.lpem.org/
[17] P. Krugman and M. Obstfeld. *International Trade: Theory and Policy*. 12th ed. Pearson. 2009.
[18] Badan Pusat Statistik. "Sensus Penduduk 2020."
[19] R. G. Lipsey. P. N. Courant. and C. T. S. Ragan. *Pengantar Makroekonomi*. Edisi Kesepuluh.. vol. Jilid 1. Jakarta: Binarupa Aksara. 1995.
[20] R. S. Pindyck and D. L. Rubenfield. *Microeconomics*. 7th ed. New Jersey: Pearson Education. Inc.. 2009.
[21] P. D. Utami and N. Agustina. "Aplikasi Regresi Data Panel Dalam Menganalisis Potensi Diversifikasi Pasar Ekspor Kakao Olahan Indonesia Ke Negara Non-Tradisional Tahun 2002-2018 (Application Of Panel Data Regression In Analysis Of Potential Diversification Of Indonesian Processed Cocoa Export Market To Non-Traditional Countries 2002-2018)." 2021.
[22] B. Seyoum. *Export–Import Theory. Practices. and Procedures*. 4th edition. Routledge. 2019.
[23] B. Baltagi. *Econometric Analysis of Panel Data*. 2005.
[24] L. Capoani. "Review of the gravity model: origins and critical analysis of its theoretical development." *SN Business and Economics*. vol. 3. no. 5. May 2023. doi: 10.1007/s43546-023-00461-0.
[25] D. D. Marchandry. I. A. N. Saskara. and A. A. B. P. Widanta. "Analysis of the Effect of International Prices. Production Volume. and the US Dollar Exchange Rate on Nickel Exports in East Luwu Regency." *International Journal of Social Science And Human Research*. vol. 06. no. 09. pp. 5544–5553. 2023. doi: 10.47191/ijsshr/v6-i9-27.
[26] D. N. Gujarati and D. C. Porter. *Basic Econometrics*. Fifth Edition. 2008.

[27] F. Z. Olilingo. N. Aini Umar. and I. R. Santoso. “Analysis of Export Competitiveness of Main Commodities of North Sulawesi Province.” *Jurnal Ekonomi dan Studi Pembangunan*. vol. 16. no. 2. 2024. doi: 10.17977/um002v16i22024p037.

[28] W. D. Safitri and R. Hartati. “Pengaruh Nilai Tukar. Produksi. Dan Harga Terhadap Volume Ekspor Batubara Di Provinsi Bengkulu.” *Jurnal Bisnis dan Ekonom*. vol. 11. pp. 57–68. 2020.

[29] G. H. Putra and A. A. B. P. Bagus. “Faktor Yang Mempengaruhi Nilai Ekspor Minyak Sawit Indonesia Ke Beberapa Negara Asia.” *Ekonomi Pembangunan Universitas Udayana*. 2022.

[30] H. Yohana. S. Diah. and A. Wulandari. “Dampak Investasi Nikel China Di Indonesia Ditinjau Dari Perspektif Pembangunan Berkelanjutan dan Ekonomi Politik Hijau.” 2024.