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Competitiveness and Factors Affecting Indonesia's Natural Rubber Export: An Evidence from Eight Main Destination Countries

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Abstract

Research Originality: This research contribution focused on Indonesia's natural rubber productivity and the role of importer industrial sector development in Indonesia's natural rubber exports.

Research Objectives: This research analyzed Indonesia's natural rubber export competitiveness and the effect of productivity, importer industrial sector development, and export price on Indonesia's natural rubber export volume.

Research Methods: This research used secondary data from the World Bank, FAO, and UN Comtrade. The dataset covers eight countries from 2002 to 2022. Revealed comparative advantage (RCA), export product dynamics (EPD), and x-model potential export products are applied to analyze export competitiveness. In contrast, panel regression is applied to analyze the determinants of export.

Empirical Results: The results showed that Indonesia's natural rubber competitiveness has declined since 2018. Nevertheless, Indonesia's natural rubber is still competitive, and its expansion in the main-destination countries is considered potential. Natural rubber productivity, importer industrial sector development, and export price positively and significantly impact natural rubber export volume.

Implications: Indonesia's natural rubber competitiveness has declined. Hence, improving natural rubber quality would be suggested. Moreover, the positive impact of productivity can be maximized by building supporting infrastructure and upgrading production technologies.

Keywords:

Competitiveness, Export, Natural Rubber, Productivity, Panel Regression

How to Cite:

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INTRODUCTION

The agricultural sector is important for Indonesia (Sugiharti et al., 2020). This fact is demonstrated by the agricultural sector, which has consistently occupied the top three sectors and made the largest contribution to the GDP. In addition, the agricultural sector plays an important role in maintaining economic stability during crises or economic shocks (Muta'ali, 2019). Not only that, this sector also supplied some of Indonesia's top commodities in the world market, namely coffee, palm coconut, cocoa, and natural rubber (Kementerian Perdagangan, 2022). Natural rubber is an important raw material for the industrial sector. Approximately 70 percent of the world's natural rubber production is used in vehicle tire manufacturing. It is also used to manufacture other items such as shoe soles, propulsion belts, rubber pipes, cables, insulators, and medical gloves.

According to FAO (2023), Indonesia was the second-largest natural rubber producer, with a production volume of 3.14 million tons in 2022. In addition, Indonesia was also the second-largest exporter in 2022, with an export value of US$3.54 billion (UN Comtrade, 2023). Moreover, not only to Asia, Indonesia also exported its natural rubber to other continents, namely Africa, Oceania, America, and Europe, with a total of more than 50 destinations. In 2022, there were eight export-destination countries with an export value worth more than US$100 million, namely Japan, the United States, China, India, South Korea, Turkey, Brazil, and Canada.

Despite the fluctuation, the export volume of Indonesia's natural rubber has increased since 2000 to reach its peak in 2017, which is 2.99 million tons. However, there was a significant decrease in 2018–2022, around 954 thousand tons, or 31.94 percent. Similar to Indonesia, other natural rubber exporters, such as Thailand, decreased by 10.47 percent. However, the other three countries, Malaysia, Vietnam, and Côte d'Ivoire, had a successive increase of 0.98 percent, 31.72 percent, and 116.32 percent. The fall in export performance since 2018 is also visible in seven of the eight most prominent importers of Indonesian natural rubber. The only country that experienced growth in Indonesian natural rubber export contribution was Japan, with an increase of 3.5 percentage points. Meanwhile, the most significant export contribution drop was in India, which reached 38.7 percentage points from the original 60.9 percent in 2017 to 22.2 percent by 2022. (UN Comtrade, 2023).

The decline in natural rubber exports would have a negative impact on Indonesia. For the government, the decline in natural rubber exports will lead to a decrease in foreign exchange and national income and hamper the Ministry of Agriculture's target of exporting agricultural commodities worth 1,200 trillion rupiahs by 2024 (Direktorat Jenderal Perkebunan, 2023). Besides, this decline will also have an impact on society. This condition is because the decline in demand for Indonesian natural rubber will lead to a decline in economic activity in plantations and the natural rubber industry, so the company will reduce the labor force to reduce the cost of production. This reduction in the workforce will lead to unemployment and poverty.

Based on the explanation, it can be shown that there is a problem in the performance of Indonesia's natural rubber exports, i.e., the continuous decline in the volume of exports

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in 2018–2022, with the greatest decline compared to other exporting countries, and the decrease in the contribution of Indonesia's natural rubber exports to the eight main destination countries in the same period. Hence, this research is interested in analyzing the competitiveness of Indonesia's natural rubber in the eight main destination countries and the factors affecting the export volume of Indonesia's natural rubber. The researchers expect the results to provide contributions and implications for future regulation and policy related to improving the performance of Indonesia's natural rubber exports.

Competitiveness describes the ability of a country to generate more wealth for its people than any other country on the world market (Aiginger et al., 2013; Durand et al., 1992; Salvatore, 2019). An export commodity is competitive if it can enter and compete in foreign markets (Tambunan, 2013). Competitiveness is closely related to the concepts of comparative advantage and competitive advantage. The concept of comparative advantage states that countries should specialize in commodities with the smallest absolute weakness to compete in the global market (Salvatore, 2019). Meanwhile, the concept of competitive advantage states that an industry's global competitiveness is determined by production factors, demand conditions, supporting industries, and company strategy, structure, and competition (Porter, 1998). Several methods have been used to analyze export competitiveness, e.g. revealed comparative advantage (RCA) index (Jiang & Lin, 2020; Matkovski et al., 2019; Nagy & Jámbor, 2019; Rossato et al., 2018), export product dynamics (EPD) (Azahari et al., 2021; Immanuel et al., 2019; Prasetyani et al., 2020; Pratama et al., 2020), and x-model potential exports (Destiarni et al., 2021; Fikri Aldi Dwi Putro & Nia Kurniawati Hidayat, 2023; Akbar & Widyastutik, 2022; Nurhayati et al., 2018)

Trade occurs when demand and supply interact. Demand represents the customer, whereas supply represents the provider of products and services. The quantity of demand for a commodity is negatively correlated with its price. On the contrary, the quantity of supply for a commodity is positively correlated with its price (Mankiw, 2019). Related research indicates a discrepancy in the link between exports and commodity prices. An increase in commodity prices had both positive (Kitano, 2022; Akbar & Widyastutik, 2022; Oktora & Firdani, 2019) and negative effect on exports (Rodrigue & Tan, 2019; Tiyastuti et al., 2023).

Production is the action of converting input into output. It is one factor that can influence the supply of a commodity. When total production declines, so does supply. According to Salvatore (2019), export activity occurs when a country has met its local demands and has a surplus of production to sell to another country. Thus, production and exports have a positive relationship. This is supported by related studies undertaken by Sari, Supriana, and Rahmanta (2021).

Productivity is the ratio of total output to input. This metric indicates the efficiency of the production process. The efficiency of the production process depends on the quality of the inputs, which include land, capital, labor, and entrepreneurship. Productivity rises when overall output rises while the input remains constant. As productivity increases,

production costs fall while overall production rises. As a result, productivity correlates positively with exports. Recent studies also showed a positive link between productivity and exports (Akim & Ngui, 2019; Hidayat et al., 2022; Malikov et al., 2020).

Gross Domestic Product (GDP) is a metric that measures the total added value or income derived from all goods and services produced in an economy in a specific territory over a specified period. GDP calculated at constant prices might show the rise in the quantity of commodities produced over time. The industrial sector's value added is the added value generated by industrial sectors or sectors that process raw materials obtained from the primary sector and the industrial sector itself. Natural rubber is a raw material in the industrial sector to make a wide range of products. As a result, the value added by the importing countries to the industrial sector is positively correlated with natural rubber exports. Although no study has analyzed the causal relationship between these variables specifically, recent studies showed a positive relationship between exports and the importer's GDP (Abdullahi et al., 2022; Phiri et al., 2021; Sugiharti et al., 2020).

METHODS

This study used data from secondary sources, namely UN Comtrade, FAO, and World Bank. For the competitiveness analysis, the data is compiled in the form of a time series from 2002 to 2022 and a cross-section covering five main exporters of natural rubber: Indonesia, Thailand, Côte d'Ivoire, Malaysia, and Vietnam. For the determinants analysis, the data is compiled into panel data covering eight major destination countries of Indonesia's natural rubber export: Brazil, Canada, China, India, Japan, South Korea, Turkey, and the United States from 2002 to 2022. Table 1 shows the research variable description used for panel regression.

Table 1. Variable Definitions

Variable	Source	Definition
Dependent Indonesia's natural rubber export volume	UN Comtrade	Total volume of natural rubber (HS 4001) exported by Indonesia to the destination country (kg) each year
Independent Indonesia's natural rubber productivity	FAO	The ratio of the total production of natural rubber (kg) to the area of produced land (m2) each year
Value added of importer's industrial sector	World Bank	Total value added, in million-dollar units of 2015, generated by the industrial sector (ISIC division 05-43) of a country each year
Indonesia's natural rubber export price	UN Comtrade	The ratio of the total value of natural rubber exports (US$) to the total export volume of natural Rubber (kg) from Indonesia to the country of destination each year

Revealed Comparative Advantage (RCA) is a method for determining a country's comparative advantage in specific commodities on the global market or within specific countries. Balassa (1965) contended that comparative advantage can be proved through a country's foreign trade patterns, which reflect relative costs. Vollrath (1991) suggested

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utilizing the RCA index developed by Balassa in his research on evaluating several markers of comparative advantage. When the RCA index for a commodity exceeds one (RCA > 1), the exporting country has a comparative advantage in the destination country market, with a value higher than the global average. Countries with RCA > 1 have a significant export potential for these items. Equation (1) shows the formula to obtain the RCA index.

$$RCA = \frac{X_{ij}/X_i}{W_{ij}/W_i} \quad (1)$$

Where X_{ij} is export value of commodity-j to country-*i*. X_i is export value of all commodities to country-*i*. W_{ij} refers to world export value of commodity-*j* to country-*i*. W_i refers to world export value of all commodities to country-*i*

Export Product Dynamics (EPD) is a method used to analyze a country's export competitiveness in certain commodities (Destiarni et al., 2021). EPD assesses a commodity's market position in the destination country and its performance in terms of company strength and market attractiveness (Nabi & Luthria, 2002). The results of the EPD are in the form of a matrix consisting of information regarding the market share of certain commodities and all export commodities in the destination country. The X-axis represents the market share of a specific commodity or business strength, whereas the Y-axis represents the market share of all export commodities or market attractiveness. Equations (2) and (3) show the formula to obtain those two indicators.

X-axis: Growth in the contribution of certain export commodities (business strength)

$$x = \frac{\sum_{t=1}^{T}\left(\left(X_{ij}/W_{ij}\right)_t \times 100\% - \left(X_{ij}/W_{ij}\right)_{t-1} \times 100\%\right)}{T} \quad (2)$$

Y-axis: Growth in the market share of products (market attractiveness)

$$y = \frac{\sum_{t=1}^{T}\left(\left(X_i/W_i\right)_t \times 100\% - \left(X_i/W_i\right)_{t-1} \times 100\%\right)}{T} \quad (3)$$

Where (x,y) is the coordinate of EPD point. X_{ij} is export value of commodity-*j* to country-*i*. X_i is export value of all commodities to country-*i*. W_{ij} refers to world export value of commodity-*j* to country-*i*. W_i refers to world export value of all commodities to country-*i*. T represents time periods.

Table 2. EPD Matrix of Market Position

Market attractiveness (Y)	Business Strength (X)	
	Falling/Stagnant (-)	Rising/Dynamic (+)
Rising/Competitive (+)	Falling Stars	Rising Stars
Falling/Noncompetitive (-)	Retreat	Lost Opportunity

Source: Nabi & Luthria (2002)

The x-model potential export products combines the findings of RCA and EPD analyses. This method categorizes product potential in specific areas based on the previous two indicators (Kementerian Perdagangan, 2013). This is done to focus market development on potential countries (Nurhayati et al., 2018). Table 3 displays the possible x-model results. Trading partner countries that are in the optimistic market group indicate that the exporting country has a comparative advantage or competitiveness in a commodity, which is also supported by competitive ability and dynamic export markets. In contrast, a non-potential market suggests that the exporting country's commodities cannot compete with those trading partner countries.

Table 3. X-Model Categorization of Market Development

RCA	EPD	X-Model
≥1	Rising Star	Optimistic market
	Lost Opportunity	Potential market
	Falling Star	Potential market
	Retreat	Less potential market
<1	Rising Star	Potential market
	Lost Opportunity	Less Potential Market
	Falling Star	Less potential market
	Retreat	Not potential market

Source: Nurhayati et al. (2018)

In order to examine the second objective, which was to analyze the factors that affecting Indonesia's natural rubber export volume, we used panel regression. Equation (4) and (5) shows the general model of panel regression used in this study.

$$lnEV_{it} = \alpha + \beta_1 lnPV_{it} + \beta_2 lnIVA_{it} + \beta_3 lnEP_{it} + u_{it} \quad (4)$$

$$u_{it} = \mu_i + v_{it} \quad (5)$$

Where ln refers to natural logarithm, EV_{it} refers to Indonesia's natural rubber export volume to country-*i* in year-*t*. PV_{it} refers to Indonesia's natural rubber productivity in year-*t*. IVA_{it} is the value added of industrial sector in country-*i* in year-*t*. EP_{it} is the price of indonesia's natural rubber export to country-*i* in year-*t*. u_{it} is composite error. μ_i refers to individual effect. v_{it} is the idiosyncratic error.

There are three possible models that can be applied, namely common effect model (CEM), fixed effect model (FEM), and random effect model (REM). CEM assumed that there was no individual effect, while FEM assumed that the individual effect was fixed. REM assumed that the individual effect was random. To obtain the most suitable model, we used Chow test to choose between CEM and FEM, Hausman test to choose between REM and FEM, and BP-LM test to choose between CEM and REM.

Variance-covariance matrix testing is carried out when FEM is selected as the best model. This test consists of two tests, namely the Lagrange Multiplier (LM) test, which is used to detect heteroscedasticity and the λ-Lagrange Multiplier (λ_{LM}) test to detect

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cross-sectional correlation (Greene, 2012). The results of these two tests will determine the estimation method used in FEM (see Table 4).

Table 4. FEM estimation method

Heterokedasticity	Cross-sectional Correlation	Estimation Method
No	No	Ordinary Least Square (OLS)
Yes	No	Weighted Least Square (WLS)
Yes	Yes	Feasible Generalized Least Square (FGLS)/ Seemingly Unrelated Regression (SUR)

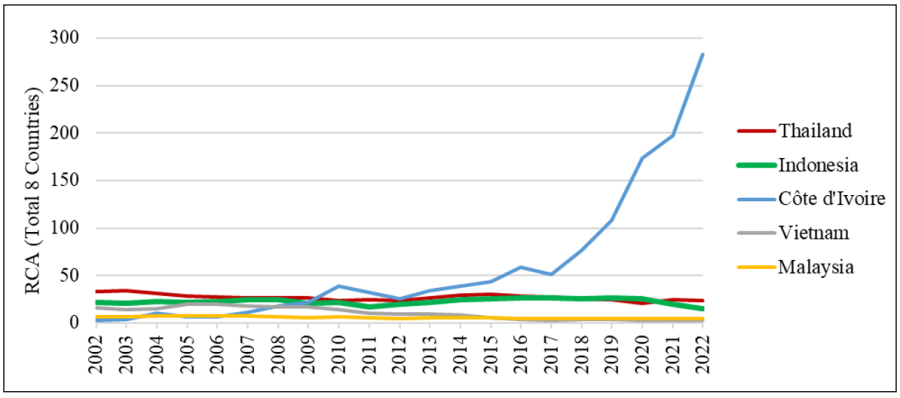
Source: Greene (2012)

When estimating using the OLS technique, there are several assumptions that must be met to produce a Best Linear Unbiased Estimator (BLUE). These assumptions are normality, homoscedasticity, nonautocorrelation, and nonmulticollinearity. The normality assumption requires that residuals spread following a normal distribution with mean zero and variance . The homoscedasticity assumption requires that the residuals have a constant variance. The nonautocorrelation assumption requires the absence of autocorrelation in the residuals. The nonmulticollinearity assumption requires the absence of a strong correlation between independent variables. These four assumptions are tested or detected, respectively, with the Jarque-Bera test, LM test, Durbin-Watson test, and VIF value.

RESULT AND DISCUSSION

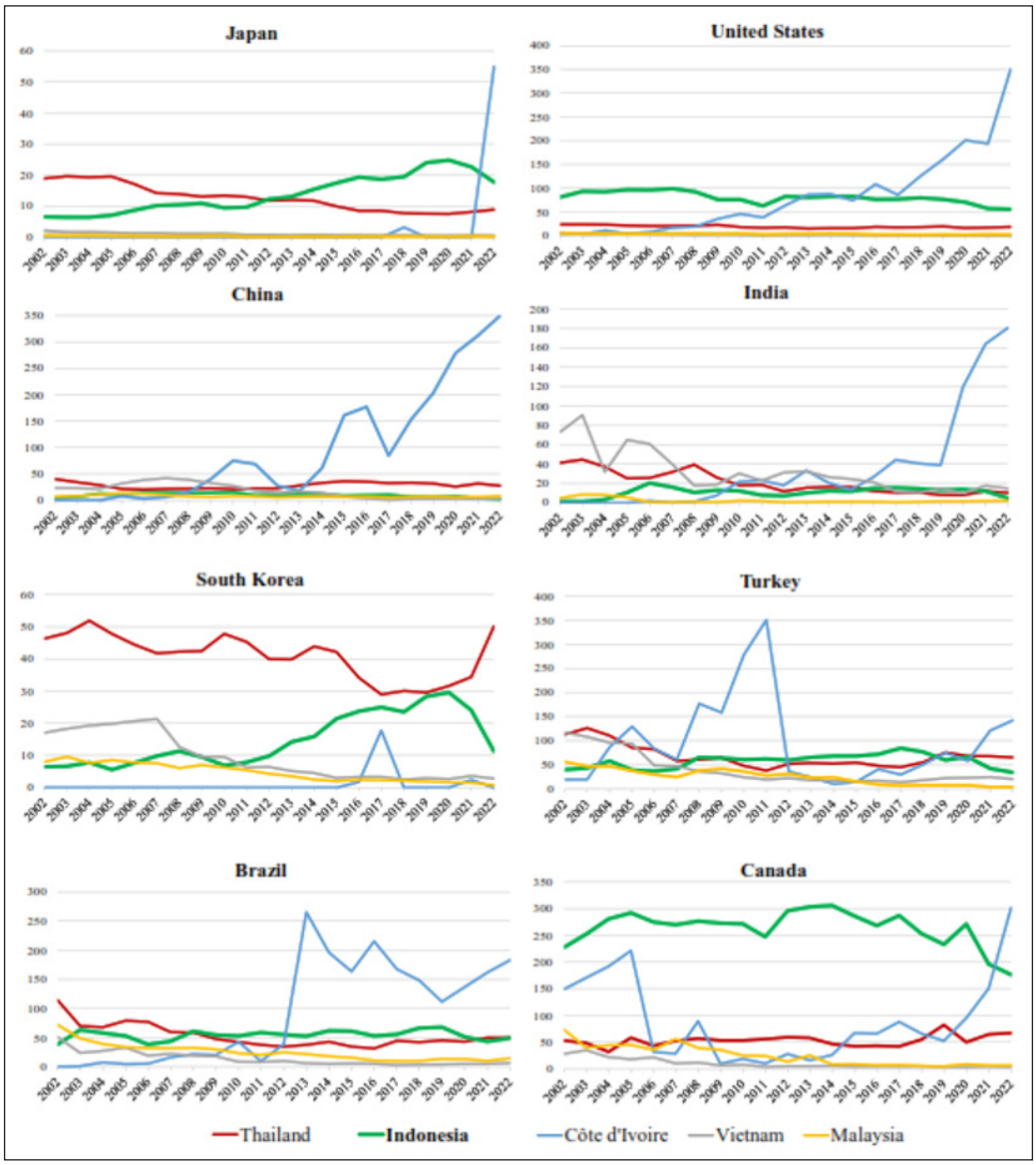
In general, Indonesian natural rubber was competitive in eight main destination countries from 2002 to 2022, with an average RCA of 22.5 (see Figure 1). The competitiveness of Indonesian natural rubber tends to be stable during this period. However, since 2020, there has been a significant decline in its competitiveness. In addition, compared to other exporting countries, RCA Indonesia is generally in second or third position, competing with Thailand and Côte d'Ivoire, which have experienced drastic increases since 2007.

Figure 1. RCA of Five Main Natural Rubber Exporters Countries in Main-Destination Countries



Indonesian natural rubber was generally competitive in Japan in 2002–2022 (see Figure 2). Indonesia's competitiveness has increased throughout this period despite a downward trend in the last two years. Indonesia's RCA value was first compared to other exporting countries in 2012–2021. However, in 2022, this position will be replaced by Côte d'Ivoire. Meanwhile, Indonesia's competitors' countries show various competitive developments in the Japanese market. Thailand, Indonesia's main competitor, also had competition in Japan, although it tends to decline yearly. Vietnam and Malaysia have also experienced a decreasing competitiveness trend. The competitiveness of Vietnam's natural rubber continued to decline until the RCA was below one (not competitive) in 2011. Malaysia tended to be uncompetitive throughout this period. Unlike the others, Côte d'Ivoire had high competitiveness in Japan even though it only exported natural rubber to Japan in 2018 and 2022.

Figure 2. RCA of Five Main Natural Rubber Exporter Countries in Each Main-Destination Country



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In contrast to the Japanese market, although it still had competitiveness, the value of Indonesia's RCA tended to decline from year to year from 2002–to 2022 in the United States. Also, Indonesia, which always had the highest RCA value until 2012, had to be replaced by Côte d'Ivoire, which experienced an extraordinary increase in competitiveness during that period. Meanwhile, the competitiveness of Thailand, Vietnam, and Malaysia in the United States market also tended to decline, like Indonesia. In China, the competitiveness of Indonesian natural rubber also experienced a decline even though it had increased from the beginning of the period until 2010. RCA Indonesia was generally ranked third. This data shows the serious competition from Indonesian natural rubber in the Chinese market. Just like Indonesia, Thailand, Vietnam, and Malaysia have also experienced a decline in competitiveness since the middle of the period. However, Côte d'Ivoire, which only started exporting natural rubber to China in 2005, experienced a very large increase in RCA until the end of the period.

The competitiveness of Indonesian natural rubber in the Indian market was stable from 2002 to 2022, as shown by the RCA value, which was around 15 from 2005 to 2021. However, the competitiveness of Indonesian natural rubber in India will decline in 2022, putting Indonesia fourth. Meanwhile, the competitiveness of Thailand, Vietnam, and Malaysia tended to fluctuate with a decline throughout this period. On the other hand, Côte d'Ivoire's competitiveness has tended to increase since 2006, when Côte d'Ivoire began exporting natural rubber to India.

With an increasing RCA value, Indonesian natural rubber tended to be competitive in South Korea. However, Indonesia's RCA value has decreased since 2021. Thailand consistently outperformed Indonesia during that period by occupying the first position. Even though it experienced a decline until 2019, Thailand's RCA continued to increase until the end of the period. Meanwhile, despite their competitiveness in the South Korean market, Vietnam's and Malaysia's RCA tended to decline yearly. In contrast to other export destination countries, Côte d'Ivoire only exported natural rubber to South Korea in 2016, 2017, and 2021.

From 2002–2022, the five natural rubber exporting countries were competitive in Turkey. Indonesia's RCA tended to increase until 2017 and decrease until 2022. Indonesia had outperformed the other four countries in 2013–2017. Meanwhile, RCA in Thailand, Vietnam, and Malaysia decreased yearly. In contrast, Côte d'Ivoire's RCA experienced fluctuations, with a large increase in 2011 and a drastic decrease the following year. At the end of the period, Côte d'Ivoire managed to surpass the four ASEAN countries.

Indonesian natural rubber had competitiveness in Brazil despite a decline in RCA in 2019–2022. Indonesia had outperformed other countries in 2009–2011. In contrast to Indonesia, the other three ASEAN countries tended to experience a decline in competitiveness over time. Meanwhile, Côte d'Ivoire began exporting natural rubber in 2003. Since that year, Côte d'Ivoire's natural rubber competitiveness continued to increase until 2013. Even though it fell in 2013–2019, Côte d'Ivoire continued to have the highest RCA until the end of the period.

From 2002–2022, Indonesian natural rubber had competitiveness in Canada, with stable RCA. Since 2002, Indonesia has always been at the top, with the highest RCA

compared to other exporting countries. However, at the end of the period, Indonesia experienced a decline until it was in second place in 2022. Meanwhile, Canada's other four countries tended to be competitive, even with varying RCA changes. Like Indonesia, Thailand's RCA tended to be stable. However, Vietnam's and Malaysia's RCA tended to decline during this period. In contrast to the others, Côte d'Ivoire experienced enormous RCA changes throughout this period. In 2002–2011, Côte d'Ivoire's RCA declined sharply and then rose drastically in 2012–2022.

Figure 3. Market Position of Indonesian Natural Rubber in Main-Destination Countries

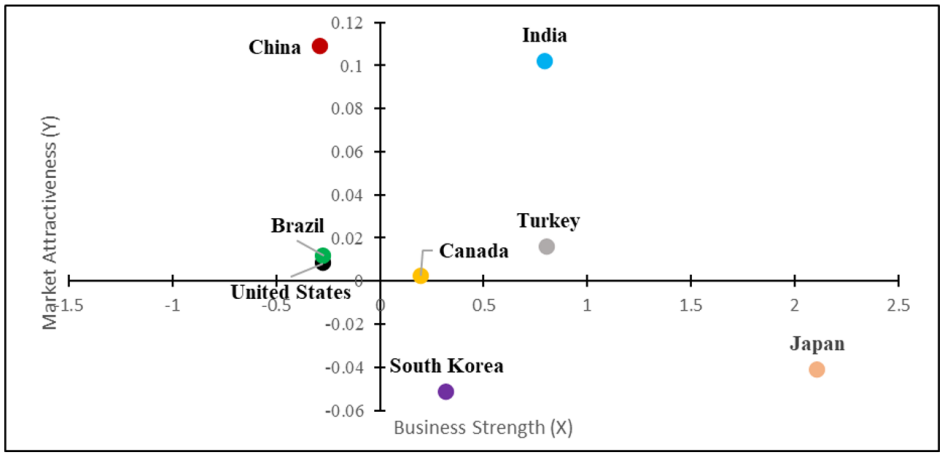

Figure 3 shows that the position of Indonesian natural rubber in the Canadian, Turkish, and Indian markets is in a rising star position. This position shows that Indonesia's natural rubber market share tends to increase, which is accompanied by an increase in the total market share of Indonesia's exports. India's higher position compared to Turkey and Canada indicates that the attractiveness of the Indian market for Indonesian commodities is greater or more competitive. Meanwhile, the positions of India and Turkey, which are further to the right compared to Canada, indicate that the strength of the Indonesian natural rubber commodity business in these two countries is stronger or more dynamic.

Meanwhile, the position of Indonesian natural rubber in Brazil, the United States, and China is in a falling star position. This position indicates that Indonesia's natural rubber market share tends to decline but is accompanied by an increase in Indonesia's total export market share. China's higher position compared to the other two countries shows that the attractiveness of the Chinese market is higher, or it could be said that the Chinese market is more competitive than others. China's position, which is further to the left, shows that the strength of Indonesia's natural rubber business in China is weaker or stagnant compared to Brazil and America.

The Indonesian natural rubber market position in Korea and Japan is in a lost opportunity position. This condition indicates that Indonesia's natural rubber market share tends to increase but is not followed by an increase in Indonesia's total export market share. South Korea's lower position compared to Japan indicates that the attractiveness of

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the Indonesian commodity market in Japan is lower or less competitive. Japan's position, which is far to the right of South Korea, shows that the strength of Indonesia's natural rubber business is stronger or more dynamic.

Table 5. Market Development Potential for Indonesia's Natural Rubber In Main-Destination Countries

Country	Avg. RCA	EPD	Market Development
Japan	13.434	Lost Opportunity	Potential Market
United States	80.241	Falling Star	Potential Market
China	10.115	Falling Star	Potential Market
India	10.330	Rising Star	Optimistic Market
South Korea	14.165	Lost Opportunity	Potential Market
Turkey	55.783	Rising Star	Optimistic Market
Brazil	56.331	Falling Star	Potential Market
Canada	261.152	Rising Star	Optimistic Market

Table 5 shows the potential for developing the Indonesian natural rubber market in India, Turkey, and optimistic Canada. The optimistic market shows that Indonesian rubber has a comparative advantage or competitiveness in natural rubber commodities, which is accompanied by competitive ability and dynamic export markets. Meanwhile, Indonesian natural rubber in the markets of Japan, the United States, China, South Korea, and Brazil has potential market development. This condition indicates that Indonesian natural rubber has strong competitiveness in that country even though it is experiencing a decline in export market share (lost opportunity) or natural rubber market share (falling star). Thus, Indonesian natural rubber is still promising and worthy of development in the eight main destination countries.

Table 7. Model Selection

Test	Statistic	df	Crit. Value	p-value	Decision	Conclusion
Chow	12.306	7;157	2.068	0.000	Reject H_0	FEM
Hausman	7.949	3	7.815	0.047	Reject H_0	FEM

Based on the results shown in Table 7, FEM was chosen as the best model. The p-value obtained for the Chow test is lower than the significance level (α) used, 5 percent. Therefore, the right decision is to reject H0. This shows that there are individual effects, so the FEM is more suitable than the CEM. Next, the Hausman test produces a decision to reject H0. This shows that individual effects are fixed, so the FEM is better than REM.

Table 8. Variance-Covariance Matrix Testing

Test	Statistic	df	Crit. Value	p-value	Decision	Conclusion
LM	214.774	7	14.067	0.000	Reject H_0	Heterokedastic
	134.068	28	41.337	0.000	Reject H_0	Cross-sectional correlation

Table 8 shows that both the LM test and produce a decision to reject H0 (α = 0.05). The test results show the presence of heteroscedasticity and cross-sectional correlation. Thus, the estimation method that will be used to estimate the regression coefficient is FGLS-SUR. The Jarque-Bera test result, which was used to test the normality assumption, concluded that the errors were normally distributed (see Table 9). Furthermore, Table 10 shows that there is no variable with VIF value over ten (VIF > 10). Hence, it can be concluded that there was no multicollinearity. Therefore, the model has met all the required assumptions.

Table 9. Normality Test

Test	Statistic	df	Crit. Value	p-value	Decision	Conclusion
Jarque-Bera	5.381	2	5.992	0.068	Accept H_0	Errors normally distributed

Table 11 shows that the p-value of the F-*t*est is smaller than the significance level used (α = 0.05), so the decision is to reject H0. Thus, at a significance level of 5%, at least one variable affects the volume of Indonesia's natural rubber export. Meanwhile, the t-test results provide information that all independent variables have a p-value smaller than the significance level used. Thus, the productivity of Indonesian natural rubber, the importer's industrial sector value added, and the export price of Indonesian natural rubber significantly affect the volume of Indonesian rubber exports. The adjusted-R2 value of 0.982 shows that 98.2 percent of the variation in the export volume of Indonesian natural rubber as a variable can be described by the independent variable in the model.

Table 10. Variance Inflation Factor

Variable	VIF
ln(PV)	1.457
ln(IVA)	1.219
ln(EP)	1.224

In contrast, 1.8 percent of the variation in the dependent variable is explained by variables outside the model. Equation (6) shows the estimated regression model.

$$\widehat{lnEV} = (-14{,}541 + \hat{\mu}_i) + 0{,}560 lnPV^* + 1{,}218 lnIVA^* + 0{,}251 lnEP^* \qquad (6)$$

Where shows that the variable is significant (p<0.05). μ_i refers to individual effects (see Table 12).

Based on the estimation results shown in Table 11, Indonesia's natural rubber productivity significantly and positively impacts the export volume of Indonesian natural rubber at a significance level of 5%. The regression coefficient value of 0.56 indicates that when other variables are constant, a 1 percent increase in Indonesian natural rubber productivity will increase the volume of Indonesian natural rubber exports by 0.56 percent. The positive relationship between natural rubber productivity follows production

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theory, which sees increasing productivity as how efficiently the production process takes place. When natural rubber productivity is high, more natural rubber will be produced, increasing Indonesia's export capacity. Apart from that, productivity also indicates a reduction in the costs required to achieve the same output, increasing the profits obtained from natural rubber exports. This result also matches related research that shows a positive relationship between productivity and exports (Akim & Ngui, 2019; Hidayat et al., 2022; Malikov et al., 2020).

Table 11. Panel Regression Estimation Results

Variable	Coefficient	Std. Error	t-Stat	Crit. Value	p-value
C	-14.541	2.020	-7.129	-1.655	0.000
Ln(PV)	0.560	0.098	5.679	1.655	0.000
Ln(IVA)	1.218	0.074	16.370	1.655	0.000
Ln(EP)	0.251	0.028	8.945	1.655	0.000
R^2	Adjusted-R^2		F-stat		p-value
0,983	0,982		933,920		0,000

Table 11 shows that, at a significance level of 5%, the importer's industrial sector value added has a significant and positive effect on the volume of Indonesian natural rubber exports. Based on the estimates obtained, an increase in the importer's industrial sector value added by one percent will increase the volume of Indonesian natural rubber exports by 1.218 percent, assuming other variables are constant. This positive influence is by production theory, where the more output is produced, the more input is used. Natural rubber is a raw material for various industrial sectors. Thus, increasing the output of the industrial sector in the destination country will increase the demand for natural rubber. This result is supported by the related studies that show a positive relationship between importer's GDP and exports (Abdullahi et al., 2022; Phiri et al., 2021; Sugiharti et al., 2020).

Table 12. Individual Effects

Country	Individual Effect	Country	Individual Effect
Japan	0,294	South Korea	0,447
United States	-0,439	Turkey	0,656
China	-1,174	Brazil	0,312
India	-0,256	Canada	0,158

This research also found that the export price of Indonesian natural rubber has a positive and significant impact on the volume of Indonesian natural rubber exports. Based on the regression coefficient estimation results, an increase in the export price of natural rubber by one percent will increase the volume of Indonesian natural rubber exports by 0.251 percent. This is based on supply theory, which states that price positively affects the supply side of goods and services (Mankiw, 2019). As a natural rubber supplier,

Indonesia will increase the quantity of exports if there is an increase in the price of natural rubber because the price increase will provide more profits for Indonesia as a producer. The result that was obtained is in line with the previous studies (Kitano, 2022; Akbar & Widyastutik, 2022; Oktora & Firdani, 2019).

CONCLUSION

This research found that Indonesian natural rubber competitiveness has declined since 2018, especially in the United States and China. Nevertheless, Indonesia's natural rubber is still competitive in the eight main destination countries. The Indonesian natural rubber market in eight destination countries is between the rising star, falling star, and lost opportunity positions. The rising star position occurs in India, Turkey, and Canada. The falling star position occurs in the United States, China, and Brazil.

Meanwhile, lost opportunity positions occurred in Japan and South Korea. However, Indonesian natural rubber is still promising and worthy of development in the eight main countries. Optimistic market development potential occurs in India, Turkey, and Canada. Meanwhile, potential market development occurs in Japan, the United States, China, South Korea, and Brazil. This research also found that Indonesia's natural rubber productivity, the development of the importer industrial sector, and export prices affected the volume of Indonesia's natural rubber exports in the eight main destination countries from 2002 to 2022. These three variables partially have a positive and significant effect on the volume of Indonesian natural rubber exports.

With Côte d'Ivoire's new competitor in the world natural rubber market, the Indonesian government is expected to establish cooperation and agreements with Côte d'Ivoire and other major exporting countries so that the export price of natural rubber can increase again. The Indonesian government is expected to increase the productivity of natural rubber and the quality of Indonesian natural rubber through various ways, such as facilitating producers to use various technologies in their production processes and providing knowledge to rubber producers. Apart from that, road infrastructure is also important to reduce production costs, considering that most producers are located outside Java.

REFERENCES

Abdullahi, N. M., Zhang, Q., Shahriar, S., Irshad, M. S., Ado, A. B., & Huo, X. (2022). Examining the Determinants and Efficiency of China's Agricultural Exports using a Stochastic Frontier Gravity Model. *PLoS ONE*, *17*, 1–20. https://doi.org/10.1371/journal.pone.0274187.

Aiginger, K., Bärenthaler-Sieber, S., & Vogel., J. (2013). Competitiveness under New Perspectives. *Work Package 301, MS46, Research Paper on Competitiveness under New Perspectives.*

Akbar, F. M., & Widyastutik. (2022). Analysis of Competitiveness, Dynamics, and Determinants of Main Commodity Export Demand from Indonesia to United Kingdom. *Jurnal Ekonomi dan Kebijakan Pembangunan*, *11*(2), 108–131. https://doi.org/10.29244/jekp.11.2.2022.108-131.

https://journal.uinjkt.ac.id/index.php/etikonomi
DOI: https://doi.org/10.15408/etk.v24i1.37841

Akim, K. A., & Ngui, D. M. (2019). Productivity and Export Performance: Micro-Level Evidence from the Manufacturing Sector in Nigeria. *Frontiers of Economics in China*, *14*(3), 428–460. https://doi.org/10.3868/s060-008-019-0019-0.

Azahari, D. H., Purba, H. J., Erwidodo, Darwis, V., Dabukke, F. B. M., Hestina, J., & Yusuf, E. S. (2021). The Competitiveness of Indonesia's Pepper Export and Its Challenges. *IOP Conference Series: Earth and Environmental Science*, *892*(1). https://doi.org/10.1088/1755-1315/892/1/012074.

Balassa, B. (1965). Trade Liberalisation and "Revealed" Comparative Advantage. *The Manchester School*, *33*(2), 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x.

Destiarni, R. P., Triyasari, S. R., & Jamil, A. S. (2021). The Determinants of Indonesia's CPO Export in Non - Traditional Market. *E3S Web of Conferences*, *232*, 1–12. https://doi.org/10.1051/e3sconf/202123202017.

Durand, M., Simon, J., & Webb, C. (1992). OECD's Indicators of International Trade and Competitiveness. In *OECD Economics Department Working Papers, issue 120*. https://doi.org/https://doi.org/10.1787/18151973.

Fikri Aldi Dwi Putro, & Nia Kurniawati Hidayat. (2023). Ekspor Teh Hitam Indonesia ke Jepang: Struktur Pasar dan Daya Saing. *Buletin Ilmiah Litbang Perdagangan*, *17*(2), 177–202. https://doi.org/10.55981/bilp.2023.227.

Greene, W. H. . (2012). *Econometric analysis* (7th ed.). New Jersey: Prentice Hall.

Hidayat, Susilastuti, D., & Karno. (2022). Pengaruh Produktifitas Perkebunan Karet Terhadap Ekspor Komoditas Karet Di Provinsi Kalimantan Barat. *JABE (Journal of Applied Business and Economic)*, *8*(3), 278. https://doi.org/10.30998/jabe.v8i3.11977.

Immanuel., Suharno., & Rifin, A. (2019). The Progressive Export Tax and Indonesia's Palm Oil Product Export Competitiveness. *Buletin Ilmiah Litbang Perdagangan*, *13*(2), 211–232. https://doi.org/10.30908/bilp.v13i2.417.

Jiang, L., & Lin, C. (2020). Analysis on the International Competitiveness of China's Trade in Services. *Emerging Markets Finance and Trade*, *56*(13), 3033–3043. https://doi.org/10.1080/1540496X.2019.1611558.

Kitano, S. (2022). How Do World Commodity Prices Affect Asian Commodity Exporting Economies? The Role of Financial Frictions. *Applied Economics Letters*, *29*(1), 84–90. https://doi.org/10.1080/13504851.2021.1887446.

Malikov, E., Zhao, S., & Kumbhakar, S. C. (2020). Estimation of Firm-Level Productivity in the Presence of Exports: Evidence from China's Manufacturing. *Journal of Applied Econometrics*, *35*(4), 457–480. https://doi.org/10.1002/jae.2757.

Mankiw, N. G. (2019). *Principles of Economics* (9th ed.). New Jersey: Cengage Learning.

Matkovski, B., Kalaš, B., Zekić, S., & Jeremić, M. (2019). Agri-food competitiveness in South East Europe. *Outlook on Agriculture*, *48*(4), 326–335. https://doi.org/10.1177/0030727019854770.

Muta'ali, L. (2019). *Dinamika Peran Sektor Pertanian Dalam Pembangunan Wilayah di Indonesia*. Yogyakarta: UGM PRESS.

Nabi, I., & Luthria, M. (2002). *Building Competitive Firms: Incentives and Capabilities*. Washington D.C.: The World Bank.

Nagy, J., & Jámbor, Z. (2019). Competitiveness in Dairy Trade-the Case of EU and the Visegrad Group Countries. *Agris On-Line Papers in Economics and Informatics*, *11*(4), 61–74. https://doi.org/10.7160/aol.2019.110406.

Nurhayati, E., Hartoyo, S., & Mulatsih, S. (2018). Pengembangan Pasar Ekspor Lada Indonesia. *Buletin Ilmiah Litbang Perdagangan*, *12*(2), 267–288. https://doi.org/10.30908/bilp.v12i2.335.

Oktora, S. I., & Firdani, A. M. (2019). Natural Rubber Economics between China and Southeast Asia: The Impact of China's Economic Slowdown. *Journal of Asian Finance, Economics and Business*, *6*(2), 55–62. https://doi.org/10.13106/jafeb.2019.vol6.no2.55.

Phiri, J., Malec, K., Majune, S. K., Appiah-Kubi, S. N. K., Gebeltová, Z., Kotásková, S. K., Maitah, M., Maitah, K., & Naluwooza, P. (2021). Durability of Zambia's agricultural exports. *Agriculture*, *11*(1), 1–14. https://doi.org/10.3390/agriculture11010073.

Porter, M. E. (1998). *The Competitive Advantage of Nations*. Florence: The Free Press.

Prasetyani, D., Abidin, A. Z., Purusa, N. A., & Sandra, F. A. (2020). The Prospects and The Competitiveness of Textile Commodities and Indonesian Textile Product in the Global Market. *Etikonomi*, *19*(1), 1–18. https://doi.org/10.15408/etk.v19i1.12886.

Pratama, A. P., Darwanto, D. H., & Masyhuri, M. (2020). Indonesian Clove Competitiveness and Competitor Countries in International Market. *Economics Development Analysis Journal*, *9*(1), 39–54. https://doi.org/10.15294/edaj.v9i1.38075.

Rodrigue, J., & Tan, Y. (2019). Price, Product Quality, and Exporter Dynamics: Evidence From China. *International Economic Review*, *60*(4), 1911–1955. https://doi.org/10.1111/iere.12410

Rossato, F. G. F. S., Susaeta, A., Adams, D. C., Hidalgo, I. G., de Araujo, T. D., & de Queiroz, A. (2018). Comparison of Revealed Comparative Advantage Indexes with Application to Trade Tendencies of Cellulose Production from Planted Forests in Brazil, Canada, China, Sweden, Finland and the United States. *Forest Policy and Economics*, *97*, 59–66. https://doi.org/10.1016/j.forpol.2018.09.007.

Salvatore, D. (2019). *International Economics* (13th ed.). New York: John Wiley & Sons.

Sari, D. K., Supriana, T., & Rahmanta. (2021). Determinant Factors of Indonesian Rubber Export to Japan. *IOP Conference Series: Earth and Environmental Science*, *782*(2). https://doi.org/10.1088/1755-1315/782/2/022053.

Sugiharti, L., Purwono, R., & Esquivias, M. A. (2020). Analysis of Determinants of Indonesian Agricultural Exports. *Entrepreneurship and Sustainability Issues*, *7*(4), 2676–2695. https://doi.org/10.9770/jesi.2020.7.4(8).

Tambunan, T. T. . (2013). *Perekonomian Indonesia (Kajian Teoritis dan Analisis Empiris)*. Bogor: Penerbit Ghalia Indonesia.

Tiyastuti, E., Marwanti, S., & Fajarningsih, R. U. (2023). Competitiveness and Determinants of Indonesia's Natural Rubber Exports in Main Partner Countries. *Scientific Horizons*, *25*(12), 80–89. https://doi.org/10.48077/scihor.25(12).2022.80-89.

Vollrath, T. L. (1991). A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage. *Weltwirtschaftliches Archiv*, *127*(2), 265–280. https://doi.org/10.1007/BF02707986.

https://journal.uinjkt.ac.id/index.php/etikonomi
DOI: https://doi.org/10.15408/etk.v24i1.37841