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Between GDP, Inflation, and Exchange Rate: Determinants Analysis Of Indonesia's Crumb Rubber Export Volume (2013–2023)

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Abstract. *According to BPS (2023), the increasing global demand for crumb rubber presents an opportunity for Indonesia as one of the world's leading rubber producers. Therefore, analyzing the factors affecting crumb rubber export volume is crucial. This study aims to identify and analyze the effects of the Gross Domestic Product (GDP) of Indonesia's main crumb rubber export destinations, inflation in these destination countries, and the US dollar exchange rate, both partially and simultaneously, on Indonesia's crumb rubber export volume. The primary export destination countries examined in this study are Japan, China, India, South Korea, and Brazil. This research employs a quantitative descriptive analysis technique using secondary time-series data from 2013 to 2023. The study applies multiple linear regression analysis based on the Generalized Least Squares (GLS) method. The results indicate that GDP, inflation, and the US dollar exchange rate have a significant simultaneous impact on Indonesia's crumb rubber export volume to its main destination countries. Partially, inflation has a significant negative effect, whereas GDP and the US dollar exchange rate have a significant positive impact on the export volume. Based on these findings, the authors recommend that the government and exporters pay close attention to per capita GDP and the USD exchange rate.*

Keywords: *Export, Gross Domestic Product, Inflation, US Dollar Exchange Rate*

1. INTRODUCTION

The rubber industry plays a crucial role in the national economy, providing employment opportunities for many people. Indonesia ranks as the world's second-largest producer of natural rubber (BAPPEBTI, 2020). In 2019, Indonesia's natural rubber production reached 3.3 million tons, comprising crumb rubber, concentrated latex, and ribbed smoked sheets (BAPPEBTI, 2020). Nearly all of Indonesia's processed crumb rubber is exported, adhering to the global SIR-20 export standard, with approximately 95% of total natural rubber production being shipped abroad (Agus et al., 2018).

Indonesia, along with Malaysia and Thailand, is currently formulating strategies to collaborate with rubber-based product manufacturers in other countries to ensure comprehensive oversight of the rubber produced by these three nations. These countries also continue to optimize their domestic rubber-based product industries to boost domestic rubber consumption while focusing exports on finished rubber products. The International Tripartite Rubber Council (ITRC) has implemented the Agreed Export Tonnage Scheme (AETS), encouraging the Indonesian government to enhance its efforts in increasing exports of rubber-based products.

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The Ministry of Industry supports the growth of the crumb rubber processing sector through Economic Policy Package XVI. This policy relaxes the Negative Investment List for the crumb rubber industry, aiming to foster its growth and increase national industry players' awareness of production efficiency and environmental concerns (Ministry of Industry, 2021).

The volume of Indonesia's crumb rubber exports to major destination countries, including Japan, China, India, South Korea, and Brazil. The highest export volume to Japan occurred in 2019, reaching 493.7 tons, while the lowest was in 2020, at 380.8 tons. China exhibited significant fluctuations, with the highest volume recorded in 2020 at 307.7 tons and the lowest in 2022 at 150.6 tons. India, South Korea, and Brazil also showed notable fluctuations. India reached its highest export volume in 2019 at 192.7 tons, South Korea at 169.2 tons, and Brazil at 80.6 tons in the same year. Canada's highest export volume was recorded in 2020 at 73.1 tons, while the lowest was in 2023 at 59.6 tons. Meanwhile, Germany saw its highest export volume in 2019 at 60 tons and the lowest in 2023 at 32.7 tons **(**Source: Statistics Indonesia, 2024)**.**

Exports to Japan have generally declined from 2019 to 2023, with a slight increase in 2021. However, Japan consistently maintains a high demand for Indonesia's crumb rubber, with export volumes among the highest compared to other countries. China, as one of the world's largest natural rubber importers, demonstrates volatile import patterns (Trademap, 2024). China experienced a significant increase in imports in 2020, followed by a decline in 2021, before rebounding in 2023. India's export volume showed a declining trend from 2019 to 2023, with the most significant drops occurring in 2022 and 2023. Despite this, India remains among the top importers of Indonesian crumb rubber due to its large population, which generates substantial domestic demand for rubber-based products.

South Korea's export volume has shown a clear downward trend from 2019 to 2023. However, its geographical proximity to Indonesia facilitates logistics and reduces transportation costs, making it a key export destination. Brazil's export volume also declined from 2019 to 2023, with the most significant drop in 2023. Despite this downward trend, Brazil's growing automotive industry continues to drive demand for crumb rubber used in tire and vehicle component production. Canada's export volume has remained relatively stable, with minor fluctuations year-to-year. Germany has shown a consistent decline in crumb rubber imports from Indonesia between 2019 and 2023.

Although the export volume of crumb rubber has generally declined, Japan, China, India, South Korea, and Brazil continue to be Indonesia's largest export destinations compared to other countries.

In 2020, Indonesia's crumb rubber export volume decreased by 9.63% compared to the previous year but rebounded in 2021 (Central Bureau of Statistics, 2021). According to Adi (2017), an increase in GDP per capita enhances consumers' purchasing power, thereby driving imports. At the same time, higher GDP per capita also strengthens production capacity, allowing for greater export activity. With higher purchasing power, consumers tend to buy more goods and services. Countries with high GDP per capita provide a larger and more attractive market for Indonesian crumb rubber exporters. The GDP per capita of Indonesia's key crumb rubber export destinations from 2019 to 2023 is presented in Table 1.

Table 1. GDP per Capita of Indonesia's Key Crumb Rubber Export Destinations (2019-2023) (US$)

Year	Year GDP per Capita (US$)				
	Japan	China	India	South Korea	Brazil
2019	49,416.0	27,543.9	2,019.4	9,902.4	9.029,8
2020	37,040.8	37,908.7	2,001.8	9,721.3	7.074,2
2021	48,085.0	7,617.5	1,939.6	9,525.5	7.972,5
2022	47,617.3	7,562.6	2,052.6	9,239.7	7.681,3
2023	41,766.5	28,614.1	2,480.8	8,912.4	7.294,4

Source: World Bank, 2024

The GDP per capita of Indonesia's key export destinations reflects their economic strength and varying levels of societal prosperity. Japan's GDP per capita increased in 2021, reaching $48,085 billion, compared to $37,040.8 billion in 2020. China's GDP per capita showed a general upward trend, peaking in 2023 at $28,614.1 billion. India's GDP per capita rose in 2022 to $2,052.6 billion, compared to $1,939.6 billion in 2021. South Korea's GDP per capita peaked in 2019 at $9,902.4 billion. Meanwhile, Brazil experienced a decline in 2020 to $7,074.2 billion, followed by a recovery in 2021 to $7,972.5 billion.

When inflation rises, consumers' purchasing power generally declines. Inflation reduces the value of money, making goods and services more expensive. As a result, consumers may have less disposable income, limiting their spending ability. Conversely, low inflation helps maintain purchasing power (OCBC, 2023). Inflation in export destination countries affects consumer purchasing power and the demand for rubber products. High inflation in these countries can reduce consumer spending on imported goods. The inflation rates of Indonesia's crumb rubber export destinations from 2019 to 2023 are shown in Table 2.

Table 2. Inflation Rates in Indonesia's Key Crumb Rubber Export Destinations (2019-2023) (%)

Year	Inflation Rate (%)				
	Japan	China	India	South Korea	Brazil
2019	0.1	4.9	3.73	0.38	7.66
2020	3.3	3.42	6.62	0.54	7.73
2021	0.09	5.98	5.13	2.5	9.21
2022	0.09	5.97	6.70	8.09	8.3
2023	3.6	4.23	5.60	3.6	3.28

Source: Macrotrends, 2024

Fluctuating inflation in these countries has influenced Indonesia's crumb rubber export volume. Japan experienced its highest inflation rate in 2023 at 3.6%. India recorded the highest increase in 2022 at 6.7%, while Brazil saw peak inflation at 9.21% in 2021. China's inflation reached 5.98% in 2021, and South Korea experienced the highest inflation rate in 2022 at 8.09%. When inflation is high, consumer purchasing power tends to weaken, which is reflected in fluctuating export volumes over the years.

Another crucial factor affecting Indonesia's crumb rubber exports is the exchange rate of the US dollar. Foreign exchange rates significantly impact a country's export performance (Dolatti, 2019). Exchange rates represent the agreed price levels for trade between two countries. A stronger foreign currency relative to a domestic currency can increase exports, whereas currency depreciation can reduce exports (Soundres & Liliana, 2002).

A stronger rupiah generally reduces exports while increasing imports (Juliana & Aswitari, 2021). This study uses the US dollar exchange rate because it is the standard international currency, widely traded, stable, and universally accepted (Latief, 2001). The exchange rate trends of the US dollar against Indonesia's main export destinations from 2019 to 2023 are presented in Table 3.

Table 3. US Dollar Exchange Rates Against Indonesia's Crumb Rubber Export Destinations (2019-2023) (US$)

Year	US Dollar Exchange Rate (US$)				
	Japan	China	India	South Korea	Brazil
2019	139.01	66.91	70.42	70.16	3.94

2020	86.77	86.9	74.1	65.36	5.16
2021	132.75	56.45	73.92	80.27	5.39
2022	131.5	46.74	78.6	73.95	5.16
2023	90.49	77.08	82.6	91.45	4.99

Source: World Bank, 2024

Based on fluctuating export volumes and Indonesia's membership in the International Tripartite Rubber Council (ITRC), understanding the factors driving increases and decreases in crumb rubber exports is crucial. This study examines the determinants influencing Indonesia's crumb rubber export volumes to key destinations—Japan, China, India, South Korea, and Brazil—between 2013 and 2023, focusing on GDP per capita, inflation rates, and the US dollar exchange rate.

2. RESEARCH METHOD

This research employs quantitative descriptive analysis techniques. Based on its characteristics, the study adopts an associative strategy. Associative research is used to determine the relationship between two or more variables (Firdaus and Zamzam, 2018), whereas a causal relationship is one that exhibits a cause-and-effect nature (Sugiyono, 2018). In this study, the influence of Gross Domestic Product (X1), Inflation (X2), and the US Dollar Exchange Rate (X3) on the export volume of Indonesia's crumb rubber to its main destination countries (Y) is examined. The locations selected for this research include Japan, China, India, South Korea, and Brazil. The choice of these five countries is based on data from the Central Bureau of Statistics (2023), which indicates that the volume of crumb rubber exported to the international market falls into the category of Indonesia's main export destinations for crumb rubber during the period from 2013 to 2023. Data for this study were obtained from the official websites of the Central Bureau of Statistics, Trading Economics, Macrotrends, and the World Bank.

This study utilizes multiple linear regression analysis based on the Generalized Least Squares method. A panel data regression model is employed, combining time series data and cross-sectional data. Data collected at one point in time for many observational units are referred to as cross-sectional data (Diputra et al., 2012). Time series data are a series of observed values measured over a certain period at uniform intervals, while cross-sectional data refer to data obtained by observing many subjects simultaneously (Wahidah et al., 2018). The data analysis was conducted using STATA version 17.

3. RESULTS AND DISCUSSION

Table 4. Results of Descriptive Statistical Test

Variable	Obs	Mean	Std. Dev.	Min	Max
Lny	55	5.245279	0.6393596	3.602777	6.216406
lnx1	55	9.46862	1.055664	7.267386	10.80803
X2	55	3.915636	2.911475	0.05	9.74
lnx3	55	4.098382	0.9400229	1.294727	5.076423

Source: Appendix 6

Based on Table 4, the total number of observations in this study is 55 data points, which combine data from 5 countries over the period 2013–2023 (11 years). The descriptive statistical analysis of all observations can be explained as follows:

1. **Dependent Variable: Indonesia's Crumb Rubber Export Volume**

   Indonesia's crumb rubber export volume to the main destination countries (Y) is the dependent variable. In this study, the export volume is measured in tons. Based on the descriptive analysis, the export volume (Y) has a minimum value of 3.602777, a maximum value of 6.216406, a mean of 5.245279, and a standard deviation of 0.6393596. The comparison between the mean and the standard deviation (5.245279 > 0.6393596) indicates that the mean is considerably higher than the standard deviation, suggesting that the export volume of Indonesia's crumb rubber to its destination countries during the period 2013–2023 exhibits high fluctuations. The minimum export volume of 3.602777 was recorded in Brazil in 2023, while the maximum value of 6.216406 was recorded in China in 2013.

2. **Independent Variable: Gross Domestic Product (GDP)**

   Gross Domestic Product (X1) is an independent variable. In this study, GDP is measured in US dollars (US$) and is presented as annual data. Based on the data presented in Table 4, the GDP variable (X1) has a minimum value of 7.267386, which was recorded in India in 2013, a maximum value of 10.80803 from Japan in 2019, a mean of 9.46862, and a standard deviation of 1.055664.

3. **Independent variable inflation**

   Inflation (X2) is an independent variable. In this study, inflation is measured in percentage (%) and is presented as annual data. According to the data in Table 4, the inflation variable (X2) has a minimum value of 0.05, which was recorded in China in

2013, a maximum value of 9.74 from Brazil in 2016, a mean of 3.915636, and a standard deviation of 2.911475.

4. **Independent Variable: USD Exchange Rate**

The USD Exchange Rate (X3) is an independent variable. In this study, the exchange rate is measured in dollars and is presented as annual data. Based on the data in Table 4, the USD exchange rate (X3) has a minimum value of 1.294727, which was recorded in Brazil in 2013, a maximum value of 5.076423 from China in 2013, a mean of 4.098382, and a standard deviation of 0.9400229.

Selection of Panel Data Regression Model

a. Chow Test

Table 5. Results of the Chow Test

R-squared: Obs per group:

Within = 0.6091 min = 11

Between = 0.8047 avg = 11.0

Overall = 0.7478 max = 11

F(3,47) = 24.41

corr(u_i, Xb) = 0.4979 Prob > F = 0.0000

Lny	Coefficient	Std. err.	t	P > |t|	[95% conf.	Interval]
lnx1	.156549	.0429722	3.64	0.001	.0701001	.2429978
x2	-.069942	.0151185	-4.63	0.000	-.1003565	-.0395276
lnx3	.1220498	.0418788	2.91	0.005	.0378005	.2062991
_cons	3.536637	.4345719	8.14	0.000	2.662391	4.410883

Source: Appendix 7 of the author's thesis

Based on the output in Table 5, since the probability (Prob) is less than the significance level (α), the Chow Test indicates that the Fixed Effects Model is the appropriate model. Consequently, if the Chow Test favors the Fixed Effects Model, the next step is to perform the Hausman Test.

b. Hausman Test

Table 6. Results of the Hausman Test

Random-effects GLS regression		Number of obs	=	55
Group variable: id		Number of groups	=	5
R-squared:		Obs per group:		
Within	= 0.6089	min	=	11
Between	= 0.8076	avg	=	11.0
Overall	= 0.7502	max	=	11
		Wald chi2(3)	=	84.14
corr(u_i, X) = 0 (assumed)		Prob > chi2	=	0.0000

Y	Coefficient	Std. err.	Z	P > z	[95% conf.	Interval]
X1	.1610552	.0423875	3.80	0.000	.0779773	.2441332
X2	-.0721651	.0149859	-4.82	0.000	-.101537	-.0427932
X3	.1333689	.0415833	3.21	0.001	.0518671	.2148707
_cons	3.456283	.4519467	7.65	0.000	2.570484	4.342082

sigma_u	.29741203	
sigma_e	.17810475	
rho	.73604123	(fraction of variance due to u_i)

Source: Appendix 8 of the author's thesis

Based on the probability value (Prob > chi²) of 0.000, which is less than 0.05, the Hausman Test confirms that the Fixed Effects Model (FEM) is preferred.

c. Lagrange Multiplier (LM) Test

Table 7. Results of the Lagrange Multiplier Test

Breusch and Pagan Lagrangian Multiplier test for random effects

Model: lny[kode,t] = Xb + u[kode] + e[kode,t]

Estimated results:

	Var	Sd = sqrt (Var)
Lny	.4087807	6393596
E	.0317213	.1781048
U	.0884539	.297412

Test: Var(u) = 0

chibar2(01) = 79.37

Prob > chibar2 = 0.0000

Source: Appendix 9 of the author's thesis

Since the probability (Prob > chibar²) is 0.000, which is less than 0.05, the LM Test suggests that the Random Effects Model (REM) is the appropriate model.

Test of Classical Assumptions

a. **Normality Test**

Table 8. Results of the Normality Test

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi²(2)	Prob > chi²
r	55	0.1269	0.7653	2.54	0.2805

Source: Appendix 10 of the author's thesis

Based on the test results, the probability value is 0.2805, which is greater than 0.05. This indicates that the panel data regression model estimated using the random effects model has normally distributed residuals.

b. **Multicollinearity Test**

Table 9. Results of the Multicollinearity Test

Variable	VIF	1/VIF
lnx1	1.90	0.526959
x2	1.56	0.641906
lnx3	1.35	0.739848
Mean VIF	1.60	

Source: Appendix 11 of the author's thesis

Based on the test results, the VIF values for X1, X2, and X3 are 1.90, 1.56, and 1.35 respectively—all below the threshold of 10. In addition, the 1/VIF values for X1, X2, and X3 are 0.526959, 0.641906, and 0.739848 respectively—each greater than 0.10. Thus, it can be concluded that there is no indication of multicollinearity among the constructs.

Panel Data Regression Analysis

The panel data regression analysis in this study is conducted using the Random Effects Model (REM). The estimated model is given by: $Yit = \beta 0 + \beta\ 1X1it + eit$

Table 10. Results of the Panel Data Regression Analysis

Variable	Coefficient	Std. Err.	Z	P > z	[95% Confidence Interval]
lnx1	0.1610552	0.0423875	3.80	0.000	0.0779773 – 0.2441332
X2	-0.0721651	0.0149859	-4.82	0.000	-0.101537 – -0.0427932
lnx3	0.1333689	0.0415833	3.21	0.001	0.0518671 – 0.2148707
_cons	3.456283	0.4519467	7.65	0.000	2.570484 – 4.342082

Source: Appendix 12 of the author's thesis

Thus, the research model equation that can be formed is as follows:

Y = 3,456283 + 0,1610552X1 – 0,0721651X2 + 0,1333689X3+ eit

The interpretation is as follows:

a. The constant value of 3.456283 means that in the absence of GDP, inflation, and the US Dollar exchange rate, the export volume would be 3.456283.
b. The beta coefficient for GDP is 0.1610552. According to the interpretation provided, if the GDP in the importing country increases by 1 unit (or 1 percent) while the other variables remain constant, the export volume will decrease by 0.1610552. Conversely, if GDP decreases by 1 unit, holding other variables constant, the export volume will increase by 0.1610552.
c. The beta coefficient for inflation is -0.0721651, which implies that if inflation in the importing country increases by 1 percent and the other variables remain constant, the export volume will decrease by 0.0721651 percent. Conversely, if inflation decreases by 1 percent, holding other variables constant, then the export volume will increase by 0.0721651 percent.
d. The beta coefficient for the US Dollar exchange rate is 0.1333689, meaning that if the US Dollar exchange rate in the importing country increases by 1 unit, with other variables held constant, the export volume will decrease by 0.1333689. Conversely, if the US Dollar exchange rate decreases by 1 unit, holding other variables constant, the export volume will increase by 0.0898213.

Hypothesis Testing

a. **Partial t-test**

Table 11. Results of the t-test (Partial Significance Test)

Variable	Coefficient	Std. Err.	Z	P > z	[95% Confidence Interval]
lnx1	0.1610552	0.0423875	3.80	0.000	0.0779773 – 0.2441332

Variable	Coefficient	Std. Err.	Z	P > z	[95% Confidence Interval]
X2	-0.0721651	0.0149859	-4.82	0.000	-0.101537 – -0.0427932
lnx3	0.1333689	0.0415833	3.21	0.001	0.0518671 – 0.2148707
_cons	3.456283	0.4519467	7.65	0.000	2.570484 – 4.342082

Source: Appendix 13 of the author's thesis

Based on the partial t-test results:

1. For the GDP variable, the t-test yielded a t-value of 3.80 (which is greater than the critical value of 2.00) and a p-value of 0.000 (less than 0.05). The positive sign indicates a positive and significant effect on export volume; hence, H1 is accepted and H0 is rejected.
2. For the inflation variable, the t-test yielded a t-value of -4.82 (in absolute terms greater than 2.00) and a p-value of 0.000 (less than 0.05). The negative sign indicates a negative and significant effect on export volume; hence, H1 is accepted and H0 is rejected.
3. For the US Dollar exchange rate variable, the t-test yielded a t-value of 3.21 (greater than 2.00) and a p-value of 0.000 (less than 0.05). The positive sign indicates a positive and significant effect on export volume; hence, H1 is accepted and H0 is rejected.

b. **Simultaneous F-test**

Table 12. Results of the F-test (Simultaneous Significance Test)

Random-effects GLS regression		Number of obs	=	55
Group variable: id		Number of groups	=	5
R-squared:		Obs per group:		
Within	= 0.6089	min	=	11
Between	= 0.8076	avg	=	11.0
Overall	= 0.7502	max	=	11
		Wald chi2(3)	=	84.14
corr(u_i, X) = 0 (assumed)		Prob > chi2	=	0.0000

Y	Coefficient	Std. err.	z	P > z	[95% conf.	Interval]
X1	.1610552	.0423875	3.80	0.000	.0779773	.2441332
X2	-.0721651	.0149859	-4.82	0.000	-.101537	-.0427932
X3	.1333689	.0415833	3.21	0.001	.0518671	.2148707

_cons	3.456283	.4519467	7.65	0.000	2.570484	4.342082

sigma_u .29741203

sigma_e .17810475

rho .73604123 (fraction of variance due to u_i)

Source: Appendix 14 of the author's thesis

Based on the simultaneous test, since the p-value (Prob > chi²) is 0.000 (which is less than 0.05), H0 is rejected and H1 is accepted. This indicates that GDP, inflation, and the US Dollar exchange rate simultaneously have a significant effect on export volume.

c. **Coefficient of Determination (R^2)**

Table 13. Results of the Coefficient of Determination (R^2)

Random-effects GLS regression — Number of obs = 55

Group variable: id — Number of groups = 5

R-squared: — Obs per group:

Within = 0.6089 — min = 11

Between = 0.8076 — avg = 11.0

Overall = 0.7502 — max = 11

Wald chi2(3) = 84.14

corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

Y	Coefficient	Std. err.	z	P > z	[95% conf.	Interval]
X1	.1610552	.0423875	3.80	0.000	.0779773	.2441332
X2	-.0721651	.0149859	-4.82	0.000	-.101537	-.0427932
X3	.1333689	.0415833	3.21	0.001	.0518671	.2148707
_cons	3.456283	.4519467	7.65	0.000	2.570484	4.342082

Source: Appendix 14 of the author's thesis

Based on the coefficient of determination, the adjusted R Square is 0.7502, or 75.02%. This indicates that the independent variables (GDP, inflation, and the US Dollar exchange rate) explain 75.02% of the variation in export volume, while the remaining 24.98% is explained by other factors not included in the research model.

Discussion of Research Results

Simultaneous Influence of GDP, Inflation, and the USD Exchange Rate on Indonesia's Crumb Rubber Export Volume to Destination Countries

The first hypothesis indicates that GDP, inflation, and the USD exchange rate simultaneously have a significant effect on Indonesia's crumb rubber export volume to destination countries. In other words, fluctuations in export volume are affected by the magnitude of GDP, inflation, and the USD exchange rate. This finding is supported by the overall F-test, which yielded a probability of 0.0000 (< 0.05), and by the coefficient of determination test showing that these independent variables explain 75.02% of the variation in export volume. Thus, H1 is accepted, meaning that GDP, inflation, and the USD exchange rate collectively have a significant influence on Indonesia's crumb rubber export volume to its main destination countries.

Influence of GDP on Indonesia's Crumb Rubber Export Volume to Destination Countries

Based on the t-test results for the GDP variable (X1), the calculated t-value is 3.80—exceeding the critical value of 2.00—with a significance level of 0.000 (< 0.05) and a positive coefficient. This indicates that GDP has a positive and significant effect on the export volume of crumb rubber. The regression coefficient for GDP is 0.1610552, which suggests that if the per capita income of the destination country increases by 1 US$, Indonesia's crumb rubber export volume will increase by 0.1610552. These findings are consistent with the study by Alvaro (2019), which also reported that GDP significantly influences crumb rubber export volume.

Influence of Inflation on Indonesia's Crumb Rubber Export Volume to Destination Countries

For the inflation variable (X2), the t-test yields a calculated t-value of –4.82 (in absolute terms, greater than 2.00) with a significance value of 0.000 (< 0.05) and a negative coefficient. This result indicates that inflation has a negative and significant effect on export volume. In other words, a 1% increase in the inflation rate in the destination country is associated with a significant decrease in Indonesia's crumb rubber export volume. These results align with the findings of Fairuz and Hassanah (2022) and Herniati and Indrajaya (2022), as well as with economic theory suggesting that rising prices can reduce the international competitiveness of a country's products (Setyari, 2017).

Influence of the USD Exchange Rate on Indonesia's Crumb Rubber Export Volume to Destination Countries

Regarding the USD exchange rate (X3), the t-test shows a calculated t-value of 3.21 (greater than 2.00) with a significance level of 0.000 (< 0.05) and a positive coefficient. This demonstrates that the USD exchange rate has a positive and significant effect on export volume. In this study, an increase in the USD exchange rate in the destination country is associated with an increase in Indonesia's crumb rubber export volume. Notably, this finding is in line with Mahendra (2018), who reported that the exchange rate influences Indonesia's exports, although his study found a negative effect on exports to China during 2010–2017. Conversely, the results of Budhi and Larasati (2018) indicate a positive and significant effect of the USD exchange rate on Indonesia's export values to China during 1997–2016.

4. CONCLUSION

This study aimed to empirically examine the influence of GDP, inflation, and the USD exchange rate on Indonesia's crumb rubber export volume to destination countries over the period 2013–2022. Based on the analysis, the following conclusions can be drawn:

1. **Collective Influence:** GDP, inflation, and the USD exchange rate collectively have a significant effect on the export volume of crumb rubber to destination countries during the period 2013–2023. The overall F-test ($p = 0.000000 < 0.05$) confirms that these variables simultaneously influence export volume.
2. **GDP Effect:** GDP has a positive and significant effect on export volume. The t-test for GDP ($t = 3.80$, $p = 0.000$) indicates that an increase in GDP is associated with an increase in Indonesia's crumb rubber export volume.
3. **Inflation Effect:** Inflation has a negative and significant effect on export volume. The t-test for inflation ($t = –4.82$, $p = 0.000$) suggests that higher inflation rates in the destination country lead to a decrease in export volume.
4. **USD Exchange Rate Effect:** The USD exchange rate also has a positive and significant effect on export volume. The t-test for the USD exchange rate ($t = 3.21$, $p = 0.000$) demonstrates that an increase in the USD exchange rate is associated with an increase in Indonesia's crumb rubber export volume.

Overall, the empirical findings support the hypothesis that GDP, inflation, and the USD exchange rate significantly and simultaneously affect Indonesia's crumb rubber export volume to its primary destination countries.

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