

DETERMINANTS OF INDONESIA'S CINNAMON EXPORT VOLUME TO THE UNITED STATES: AN ERROR CORRECTION MODEL APPROACH

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ABSTRACT

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Cinnamon is one of Indonesia's leading export spice commodities. The United States (US) is the strongest importer country of Indonesian cinnamon. However, since 2013 the volume of Indonesian cinnamon exports to the US has decreased. If this decline continues, it could shift Indonesia's position in the cinnamon export market. This research aims to provide an overview of and analyze the influence of export prices, GDP, production, and exchange rate on Indonesia's cinnamon exports to the US from 1990 to 2022. The data used are from the Food and Agriculture Organization (FAO), World Bank, and Organization for Economic Co-operation and Development (OECD). This research uses descriptive analysis with graphical analysis and inference analysis with the Error Correction Model (ECM). The results showed that in the long term, decreasing export prices can increase demand for cinnamon exports from the US. In the short term, large production that does not meet the quality standards can reduce cinnamon exports. The increase in US people's income and the strengthening of Rupiah can increase the volume of Indonesian cinnamon exports to the US in both the long and short term.



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1. INTRODUCTION

The agriculture, forestry, and fisheries sectors are some of Indonesia's key sectors in its economy and development. This is shown by the Gross Domestic Product (GDP) of these sectors, which ranks third as the sector with the largest contribution to Indonesia's GDP, averaging 12.4% or approximately IDR 2,428.9 trillion [1]. According to The Ministry of Agriculture Republic Indonesia [2], the plantation subsector in the agricultural sector had the highest contribution in 2022, amounting to 3.69% of Indonesia's GDP. Moreover, the plantation subsector also contributes significantly to Indonesia's export performance. This is proven by its consistently positive trade balance compared to the other subsectors in the agricultural sector, which showed negative balances during 2015-2019 [3].

The plantation subsector produces various kinds of commodities and one of them is spices. Historically, spices have played an important role in Indonesia's economy. Research by [4] states that Indonesian spices have great opportunities in the international market. One promising spice commodity that has the potential to be traded is cinnamon [5]. *Cinnamomum Buranii* is a plant whose bark, branches, and twigs can be used as spices, and it has various benefits ranging from cooking spices to health benefits. Compared to other spice commodities, cinnamon is one of the top three commodities with the largest export volume to the global market from 1990 to 2021 [6]. Indonesia has been the world's largest producer of cinnamon from 1990 to 2016. Alongside Indonesia, China, Vietnam, and Sri Lanka are the largest cinnamon exporters globally. On average, from 1990 to 2022, China exported around 39 thousand tons of cinnamon, Indonesia around 35 thousand tons, Vietnam around 22 thousand tons, and Sri Lanka exported around 12 thousand tons of cinnamon [6]. This shows that Indonesia has great potential in exporting cinnamon to the global market.

Indonesia exports cinnamon to various countries. Compared to Brazil, Netherlands, India, and Singapore, the United States is the strongest destination country for Indonesian cinnamon exports. However, since 2013, Indonesia's cinnamon exports to the United States have declined. In 2013, Indonesia exported 24,145 tons of cinnamon, whereas in 2022, the export volume decreased to 14,011 tons, marking a 21.6% decline from 2021. If this decline continues, it could potentially diminish Indonesia's strategic position in the cinnamon export market.

According to [7], there are various factors that influence a country's exports, including 1) consumer preferences for domestic and foreign goods, 2) prices of goods domestically and internationally, 3) currency exchange rates, 4) consumer incomes domestically and internationally, 5) international transport costs, and 6) government policies on international trade. Research by [8] identified factors such as economic distance, GDP of the destination country, real effective exchange rate (REER), and Indonesia's real GDP as determinants of Indonesia's cinnamon exports to its ten main destination countries, while population and prices have no significant influence. Furthermore, research by [9] shows that the RCA index and real GDP of importing countries have a significant positive influence on Indonesia's cinnamon trade flow to 11 main destination countries, while the population of importing countries, economic distance, export prices, and real exchange rates have a significant negative influence. The difference between this study and previous studies is in the independent variables and the analysis methods used. This study uses time series data that considers the stationarity of the data.

Indonesian cinnamon exports to the United States are a particularly interesting thing to study due to Indonesia's position as the largest producer of cinnamon in the world, and the United States' role as the main importer of cinnamon in the world is a big opportunity for Indonesia to export cinnamon to the United States. Given these issues, this research aims to determine an overview of Indonesian cinnamon exports to the United States from 1990 to 2022 and analyze the factors influencing them. This research uses the Error Correction Mechanism (ECM) method to get the long-term and short-term effects of the independent variable on the dependent variable. Furthermore, the application of the ECM method is due to its superiority over Multiple Linear Regression (MLR), where ECM can address stationarity issues that, if applied to MLR, could potentially result in a spurious regression in time series data [10].

2. RESEARCH METHODS

2.1 Data Sources

The data used in this research is annual time series data from 1990 to 2022 (consisting of 33 observations). Cinnamon in this study is classified under the Harmonized Systems (HS) code 0906. Secondary data from FAO, World Bank, and OECD was used. This includes the volume of Indonesian cinnamon exported to the United States (Y) in thousand tons, the export prices (X_1) in USD/ton, real GDP of the United States (X_2) in billion USD, the Indonesian cinnamon production (X_3) in thousand tons and the real effective exchange rate (X_4).

2.2 Data Analysis

This study applies descriptive analysis and inferential analysis methods. We are using Eviews 12 for estimating the ECM model. ECM model uses Ordinary Least Square (OLS) estimation. This study applies the natural logarithm transformation method to variables such as the volume of Indonesian cinnamon export to the US, the real GDP of the US, and Indonesian cinnamon production in order to standardize the numbers and reduce the risk of heteroscedasticity problems.

The steps of performing the ECM model are as follows:

1. Stationarity testing. The stationarity test used in this study is the Augmented Dickey-Fuller (ADF) unit root test. The ECM model can be performed if all variables are non-stationary at the level and stationary in the same order, which is the first difference.
2. Forming the long-run model. It is formed by regressing the independent variables onto the dependent variable at the level. It can be written as follows:

$$\ln Y_t = \alpha_0 + \alpha_1 X_{1t} + \alpha_2 \ln X_{2t} + \alpha_3 \ln X_{3t} + \alpha_4 X_{4t} + \varepsilon_t \quad (1)$$

Where ε_t is the error term in the long-run equation.

3. This study applies Cointegration testing. This test was conducted by testing the stationarity of the error in the long-run equations (ε_t). Cointegration testing is performed using the ADF tests known as the Augmented Engle-Granger test. If the error in the long-term is stationary at level $I(0)$, then it can be said that the dependent and independent variables are cointegrated.
4. Forming the short-run/ECM model. If there is a cointegration, then the relationship between variables can be expressed as ECM. ECM is formed by regressing the independent variables onto the dependent variable in the first difference and adding the first lag of the error long-run equation ($\hat{\varepsilon}_{t-1}$). It can be written as follows:

$$\Delta \ln Y_t = \beta_0 + \beta_1 \Delta X_{1t} + \beta_2 \Delta \ln X_{2t} + \beta_3 \Delta \ln X_{3t} + \beta_4 \Delta X_{4t} + \lambda ECT_t + u_t \quad (2)$$

Where Δ : delta, ECT_t : $\hat{\varepsilon}_{t-1}$, λ : speed of adjustment, u_t : error term in the short-run equation. The ECM model is considered valid if the speed of adjustment (λ) is negative and statistically significant. If the λ is positive, it indicates that the variables are moving away from the long-term equilibrium; thereby, the ECM model can not be used.

5. Model significance testing. This study includes the coefficient of determination (R^2), simultaneous test (F-test), and partial test (t-test).
6. Testing classical assumptions. This study includes normality assumptions using the Jarque-Berra test, homoscedasticity assumptions using the Breusch Pagan Godfrey test, multicollinearity detection by looking at the VIF values of each variable, and non-autocorrelation assumptions using the Breusch Godfrey test.

3. RESULTS AND DISCUSSION

3.1 Graphical Analysis

3.1.1 Indonesian Cinnamon Exports Volume to the United States, 1990-2022

Cinnamon is one of Indonesia's export commodities that has a great demand in the international market. **Figure 1** shows the export volume of Indonesian cinnamon to the United States from 1990 to 2022, which has exhibited fluctuations over the years. The lowest export volume occurred in 1998 at 9,590 tons, marking a decrease of approximately 61.88% from 1997. Meanwhile, the highest export volume of Indonesian cinnamon to the United States during the period from 1990 to 2022 occurred in 2017 at 27,898.1 tons.

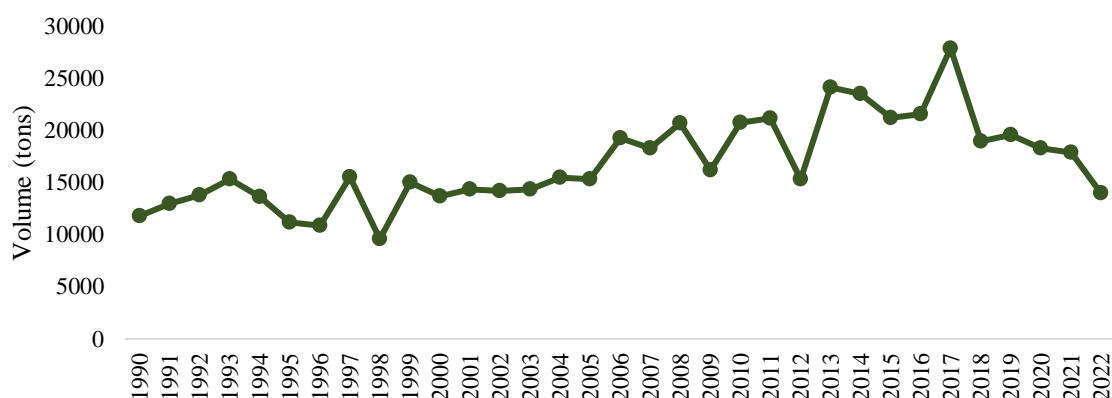


Figure 1. Indonesian Cinnamon Export Volumes

3.1.2 Export Prices of Indonesian Cinnamon to the United States, 1990-2022

Price is a crucial indicator in commercial transactions and trade activities. **Figure 2** illustrates that the export prices of Indonesian cinnamon in the United States have fluctuated with an increasing trend, starting at \$1.77/ton in 1990 and reaching \$4.96/ton by 2022. **Figure 2** also indicates that the price trends of Indonesian cinnamon in the world market and the US market are highly similar, suggesting that the dynamics of Indonesian cinnamon export prices are influenced by the US market.

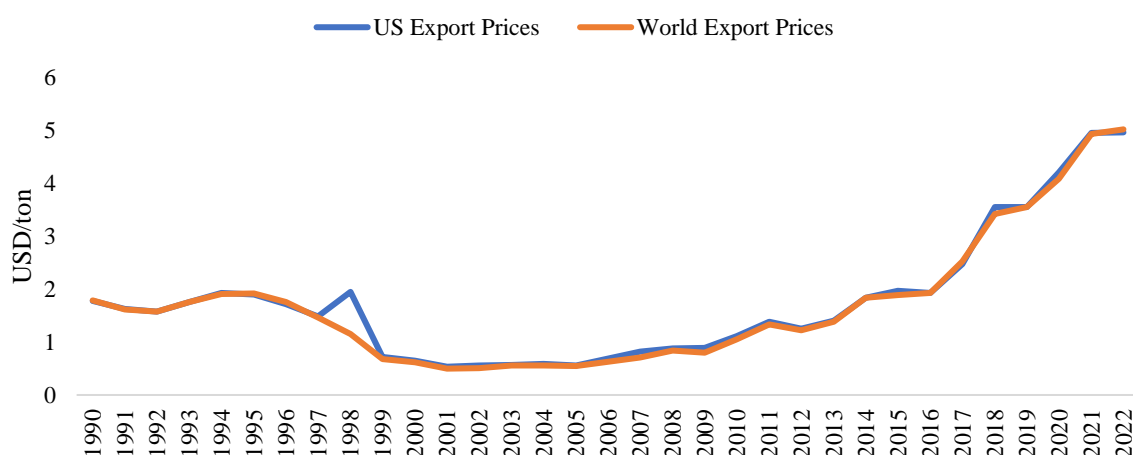


Figure 2. Indonesian Cinnamon Export Prices in the World and US Market

3.1.3 Real Gross Domestic Product of United States, 1990-2022

GDP is often used as a measure of a country's economic performance. The measure of the economic performance of the United States as the main destination country for Indonesian cinnamon exports can determine the amount of cinnamon that can be exported to the United States. If the US GDP becomes greater, the US's ability to buy commodities traded on international markets will increase. **Figure 3** shows that the

US economy developed every year from 1990 to 2022. In 1990, the real GDP of the United States was recorded at 9,811.05 US\$ and continued to increase until 2022 to 20,926.83 US\$.

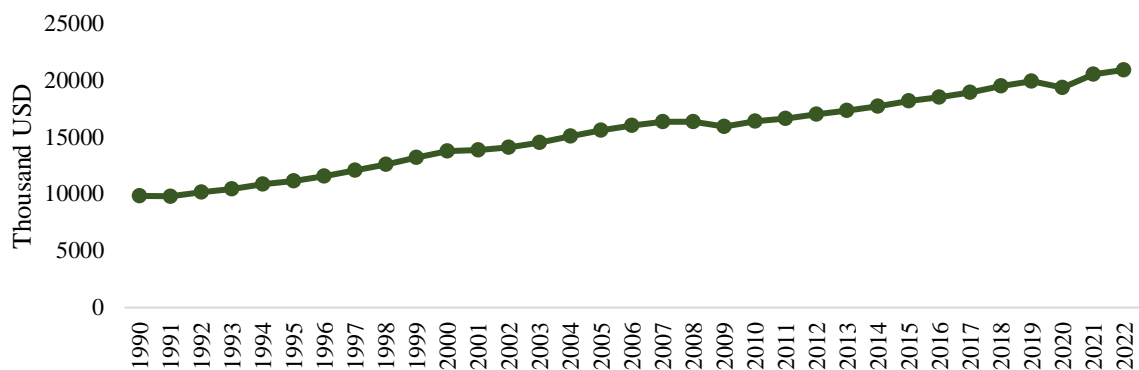


Figure 3. US Real GDP

3.1.4 Indonesian Cinnamon Production, 1990-2022

The important thing in a trade is production. Absolute comparative theory states that a country must specialize in the production and export of commodities with smaller absolute losses. Indonesian cinnamon production from 1990 to 2022 tends to fluctuate with an average of 65,273.15 tons. It is known that the average volume of Indonesian cinnamon exports to the United States in the same period was 16,850.88 tons. This means that 25.81 percent of Indonesia's cinnamon production was exported to the United States in that period. Figure 4 shows that the highest increase in cinnamon production occurred in 2003-2004. Meanwhile, the biggest decline occurred from 2019 to 2020, which was the impact of the Covid-19 pandemic.

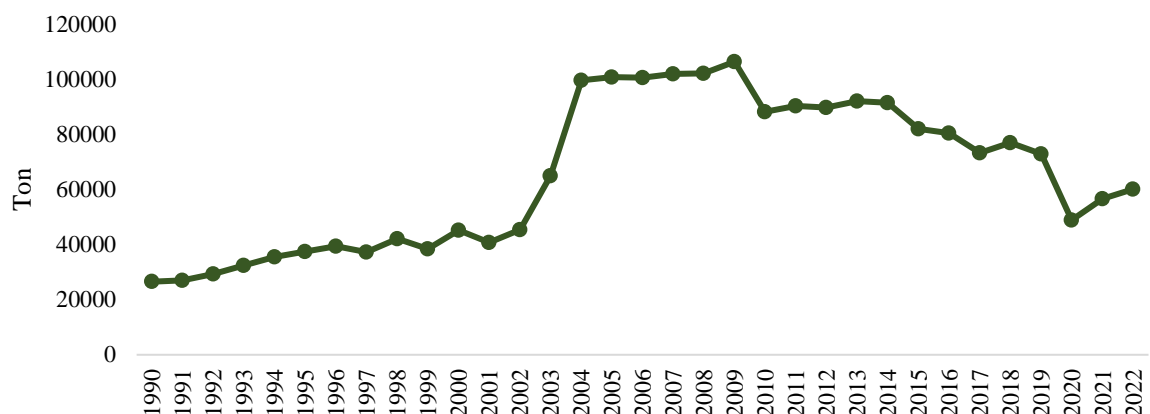


Figure 4. Indonesian Cinnamon Production

3.1.5 Real Effective Exchange Rate, 1990-2022

The real effective exchange rate is one of the measuring tools to see a country's competitiveness in international trade. Figure 5 shows the fluctuating movement of the Rupiah/USD during 1990-2022. From 1996 to 1998, the rupiah exchange rate experienced depreciation from 125.82 in 1996 to 57.42 in 1998. From 2000-2022, the rupiah exchange rate against the USD experienced depreciation and appreciation, as shown by fluctuations in the following figure.

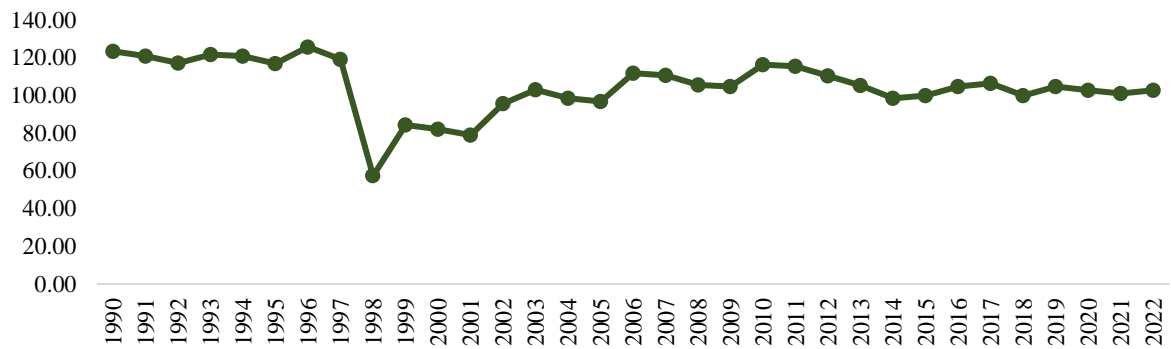


Figure 5. Real Effective Exchange Rate

3.2 Variables Affecting the Volume of Indonesian Cinnamon Exports to the United States, 1990-2022 Stationarity Test

Error Correction Model (ECM) can be carried out if all the variables are not stationary at the level and are stationary in the same order. The stationarity test used in this research is the Augmented Dickey-Fuller (ADF) applied to data on the level and first difference. Based on the stationarity test results in **Table 1**, it can be concluded that with a significance level of 5 percent, the variables used in this research are not stationary at level but stationary at first difference.

Table 1. ADF Stationarity Test Results

Variable	Level		First Difference	
	p-value	Explanation	p-value	Explanation
$\ln Y$	0.9642	Non-stationary	0.0001	Stationary
X_1	0.9997	Non-stationary	0.0057	Stationary
$\ln X_2$	0.8729	Non-stationary	0.0003	Stationary
$\ln X_3$	0.9585	Non-stationary	0.0014	Stationary
X_4	0.1433	Non-stationary	0.0000	Stationary

3.2.1 Long Term Model

The long-term model is formed by regressing the independent variables against the dependent variable at level.

Table 2. Parameter Estimation of Long-Term Model

Variable	Coefficient	Standard Error	t-statistics	p-value
C	19.9554	7.1792	-2.7796	0.0048*
X_1	-0.0926	0.0434	-2.1359	0.0208*
$\ln X_2$	1.3023	0.3725	-3.4959	0.0008*
$\ln X_3$	-0.1327	0.1616	-0.8214	0.2092
X_4	0.0074	0.0023	3.2401	0.0015*
Summary Statistics				
R-squared	0.6709	F-statistics		14.2722
Adj. R-squared	0.6239	p-value (F-statistic)		0.0000*

Based on **Table 2**, the long-term model equation can be written as follows:

$$\widehat{\ln Y_t} = 19.9554 - 0.0926X_{1t}^* + 1.3023\ln X_{2t}^* - 0.1327\ln X_{3t} + 0.0074X_{4t}^* \quad (3)$$

Note: *) Significant at 5 percent

Table 2 shows the p -value of the F-statistic is 0.000, which is smaller than the significance level ($\alpha = 0.05$) resulting rejection of H_0 . It can be concluded that at a significance level of 5 percent, there is at least one independent variable that has a significant effect on the volume of Indonesian cinnamon exports to the United States in the long term. There are three variables that are partially significant in the long term, namely X_1 (export price of cinnamon) has a negative effect, X_2 (real GDP of the United States) and X_4 (real effective exchange rate) have a positive effect. This is proven by the results of the t -test on each variable resulting in a p -value less than the significance level ($\alpha = 0.05$). Apart from that, **Table 2** also shows the adjusted r -squared is 0.6239, meaning that in the long term, the independent variable is able to explain the variation of the dependent variable by 62.39 percent, while the remaining 37.61 percent is explained by other variables outside the model.

3.2.2 Cointegration Test

The cointegration test is carried out by testing the stationarity of the error in the long-run equation by performing the ADF tests known as the Augmented Engle-Granger test. **Table 3** shows that the ECT variable or error long-term models have p -value less than the significance level ($\alpha = 0.05$). So that a decision is obtained to reject H_0 which means the ECT variable has been stationary at the level. This shows that the long-term equation model in this research is a cointegrated model. Because of that, the relationship between variables can be expressed in the model Error Correction Model (ECM).

Table 3. Cointegration Test Results

Variable	t -statistics	p -value	Explanation
ECT	-3.8419	0.0270	Stationary at level $I(0)$

3.2.3 Short Term Model

The short-term model is formed by regressing the independent variables onto the dependent variable in the first difference and adding the first lag of the error long-run equation ($\hat{\varepsilon}_{t-1}$) or error correction term (ECT).

Table 4. Parameter Estimation of Short-Term Model

Variable	Coefficient	Standard Error	t -statistics	p -value
C	-0.0285	0.0456	-0.6246	0.2698
ΔX_1	-0.0268	0.0804	-0.3329	0.3709
$\Delta \ln X_2$	2.5035	1.5965	1.5681	0.0644*
$\Delta \ln X_3$	-0.4269	0.2042	-2.0913	0.0232**
ΔX_4	0.0069	0.0022	3.2144	0.0017**
ECT	-0.8474	0.2066	-4.1006	0.0002**
Summary Statistics				
R-squared	0.6207	F-statistics		8.5096
Adj. R-squared	0.5478	p -value (F-statistic)		0.0000**

Based on **Table 4**, the short-term model equation can be written as follows:

$$\widehat{\Delta \ln Y}_t = -0.0285 - 0.0268\Delta X_{1t} + 2.5035\Delta \ln X_{2t}^* - 0.4269\Delta \ln X_{3t}^{**} + 0.0069\Delta X_{4t}^{**} - 0.8474ECT_t^{**} \quad (4)$$

Note: **) Significant at 5 percent. *) Significant at 10 percent.

Table 4 shows the p -value of the F-statistic is 0.000, which is smaller than the significance level ($\alpha = 0.05$), resulting in the rejection of H_0 . It can be concluded that at a significance level of 5 percent, there is at least one independent variable that has a significant effect on the volume of Indonesian cinnamon exports to the United States in the short term. There are three variables that are partially significant in the short term, namely X_3 (Indonesia cinnamon production) has a negative effect at the 10 percent significance

level, X_2 (real GDP of the United States), and X_4 (real effective exchange rate) have a positive effect at 5 percent significance level. This is proven by the results of the t -test on each variable, resulting in p -value less than the significance level ($\alpha = 0.05$ and 0.1). **Table 4** also shows the adjusted r -squared is 0.5478. In other words, the independent variable is able to explain the variation of the dependent variable by 54.78 percent in the short term, while the remaining 45.22 percent is explained by other variables outside the model.

The parameter estimation in **Table 4** shows the validity of the ECM model that has been formed. This is shown by the t -test on ECT is -4.1 which less than $-(t_{0.05(28)} = -1.70)$. It can be concluded that at a significance level of 5 percent, the ECT has a significant negative influence on the volume of Indonesian cinnamon exports to the United States. The coefficient of ECT (λ) is -0.8474 , which shows the speed of adjustment, meaning that at a significance level of 5 percent, the imbalance in the volume of Indonesian cinnamon exports in the previous year will be corrected by 84.74 percent in the current year. Meanwhile, the remaining 15.26 percent will be corrected in the following year.

3.2.4 Classical Assumption Test

Classical assumption testing was carried out on the ECM model, the results are summarized in **Table 5**. It can be concluded that at a significance level of 5 percent, all the classical assumptions are fulfilled.

Table 5. Summary of Classical Assumption Tests

Assumption	Type of Test	p-value	Decision
Normality	JB-test	0.9418	Failed to reject H_0 (assumption met)
Homoscedasticity	BPG-test	0.9865	Failed to reject H_0 (assumption met)
Non-Multicollinearity	VIF	$VIF < 10$	(assumption met)
Non-Autocorrelation	LM-test	0.6686	Failed to reject H_0 (assumption met)

Based on **Table 6**, it can be seen that all independent variables in the ECM model have a VIF of less than 10. It can be concluded that there is no multicollinearity between variables.

Table 6. Variance Inflation Factor (VIF)

Variable	VIF
ΔX_1	1.3732
$\Delta \ln X_2$	1.2604
$\Delta \ln X_3$	1.2785
ΔX_4	1.2519

3.2.5 Discussion

(1) Cinnamon Export Prices (X_1)

The export price of Indonesian cinnamon to the United States has a negative and significant effect in the long term but does not have a significant effect in the short term with a negative relationship direction. The results of this study are in line with research by [8] and [11], who found that the export price of Indonesian cinnamon commodities had a negative influence on export volume but did not have a significant effect. This means that changes in export prices do not change the volume of Indonesian cinnamon exports in the short term. The results of this study indicate that cinnamon is good with inelastic demand. Inelastic demand is a condition when the demand for a good is not affected when the price of the good changes. This is in line with research by [12], who found that cinnamon is a normal good with inelastic demand. Thus, the policy of increasing the export price can be implemented by exporters while still maintaining price flexibility in the long term.

(2) Real GDP of the United States (X_2)

US real GDP has a positive and significant effect on the volume of Indonesian cinnamon exports to the United States in both the long and short term. An increase in a country's real GDP indicates a strong country's economy. The strengthening of a country's economy reflects an increase in people's need for goods or services and an increase in people's purchasing power in that country. When the United States economy strengthens, as shown by increasing real GDP, the US people's need for goods or services will increase, one of which is the need for the cinnamon commodity traded from Indonesia. This is in accordance with demand theory which states that an increase in consumer income will increase demand for goods or services on the market [13]. The results of this research are also in line with research by [9] and [14], which states that the real GDP of importing countries has a positive and significant influence on the volume of Indonesian cinnamon exports.

(3) Cinnamon Production (X_3)

Indonesian cinnamon production does not have a significant influence on the volume of Indonesian cinnamon exports to the United States in the long term, but it has a negative and significant effect in the short term. This result is not in line with the absolute comparative theory, which states that exporting countries are countries that have high domestic production and are better than the other countries. Then the excess production can be exported abroad. The findings in this inferential test are in line with the descriptive analysis via graphics, which show that in several years the movement between these two variables is not in line. While the volume of Indonesian cinnamon exports to the United States tends to decrease, Indonesian cinnamon production has increased. This may be caused by a change in the focus of cinnamon production, which is allocated to the domestic market due to an increase in domestic demand. Research by [15] states that although Indonesian cinnamon production is increasing, not all products will be exported to the international market, but they can also be sold in the domestic market due to domestic demand. In addition, not all Indonesian cinnamon is of high quality, making it difficult to meet the export standards required by trading partners in the international market [16]. A decrease in export volume can occur if the exporting country is unable to meet the non-tariff measures (NTM) standards determined by the destination country [17]. So, a large amount of cinnamon production that can not meet the quality standards of the importing country will not increase the volume of Indonesian cinnamon exports or may even reduce it.

(4) Real Effective Exchange Rate (X_4)

The real effective exchange rate has a positive and significant influence on the volume of Indonesian cinnamon exports to the United States in both the long and short term. In theory, a decrease in the REER, or when the Rupiah is weakening, will make the price of goods in Indonesia cheaper in the eyes of the United States. These conditions should increase demand for export goods from the United States. However, this research shows the opposite effect, which is when the REER will reduce the volume of Indonesian cinnamon exports to the United States. The decline in the REER indicates the weakening of the Rupiah against the USD, which makes the prices of goods in Indonesia more expensive. An increase in the price of this item can cause an increase in commodity production costs, one of which is cinnamon. The increase in production costs then increases the price of Indonesian cinnamon on the market and can lead to reduced demand for goods from the United States. The decline in demand for cinnamon from the United States has caused the volume of Indonesian cinnamon exports to the United States to decline. Research by [18] shows results that are in line with this research, that the Rupiah exchange rate against the currency of the export destination country has a negative and significant effect on Indonesian plywood exports. Furthermore, there is research that states that the depreciation of the rupiah exchange rate against the currency of the leading export destination country is detrimental to Indonesia's frozen yellowfin tuna exports due to production costs such as fuel oil and fishing gear as well as processing machines [19]. Likewise, research by [20] shows that the depreciation of the Rupiah actually reduced demand for exports of Indonesian agricultural commodities by China in 1999-2016.

4. CONCLUSIONS

During 1990-2022, Indonesia's cinnamon export to the United States experienced fluctuations. Analysis using the Error Correction Model found that export prices, the real GDP of the United States, cinnamon production, and the real effective exchange rate had a significant effect in both the long and short term. In the long term, a decrease in export prices could increase demand for cinnamon exports from the United States. Meanwhile, large amounts of cinnamon production that do not meet the quality standards of importing countries can reduce the volume of cinnamon exports in the short term. The increase in US people's income and the strengthening of Rupiah can increase the volume of Indonesian cinnamon exports to the United States in both the long and short term.

A recommendation was made for the government to maintain and strengthen bilateral relations with the United States, which is the main importer of Indonesian cinnamon. The government could also provide targeted subsidies for farmers, such as capital, seeds, or adequate materials so that they can produce cinnamon that meets standard quality. Cinnamon producers also need to pay attention to the quality of produced cinnamon along with increasing production quantities. Apart from that, developing techniques for processing cinnamon can also be carried out so that the commodities exported are not only raw goods but also processed goods like cinnamon powder or essential oils, which can provide added value to the international market.

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