STRUCTURAL EQUATION MODELING OF COCOA EXPORT PERFORMANCE IN INDONESIA (2015–2024)

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Abstract

Cocoa is a strategic commodity that contributes significantly to Indonesia's agricultural export performance. However, its export performance has fluctuated due to global price dynamics, exchange rate volatility, and variations in export volume. This study analyzes Indonesia's cocoa export performance from 2015 to 2024 using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The secondary data include export volume, export value, average export price, and the rupiah exchange rate against the U.S. dollar. The SEM-PLS results indicate that export volume has a strong and significant positive effect on export value ($\beta = 0.64$, $p = 0.000$), demonstrating that increases in export quantity play a major role in enhancing Indonesia's cocoa export performance. Export price shows a positive but marginal effect ($\beta = 0.28$, $p = 0.056$), suggesting that price movements contribute to export value but are not statistically significant at the 5% level. Meanwhile, the exchange rate has a significant negative effect on export value ($\beta = -0.47$, $p = 0.001$), indicating that rupiah depreciation tends to suppress cocoa export performance. The model explains 74.2% of the variance in export value ($R^2 = 0.742$), reflecting strong predictive capability. These findings provide an empirical basis for formulating data-driven strategies to strengthen Indonesia's cocoa export performance through improvements in production capacity, pricing strategies, and exchange rate stability.

Keywords: Cocoa, Export, SEM-PLS, Agribusiness.

INTRODUCTION

Indonesia is one of the largest cocoa producers in the world (ICCO, 2024). This commodity plays an important role in the national agricultural sector, serving as a source of income for farmers and as a contributor to the country's foreign exchange through export activities (Statistics Indonesia, 2024). However, over the past decade, Indonesia's cocoa export performance has shown significant fluctuations in volume and export value. This condition indicates that cocoa export performance is influenced by various interrelated internal and external factors. Several key factors affecting cocoa exports include the international price of cocoa, annual export volume, and the rupiah exchange rate against the US dollar (Kemausuor & Adjei, 2017). These factors not only reflect global market dynamics but also serve as indicators of the competitiveness of Indonesian cocoa products in the international market. Changes in exchange rates can increase or decrease export competitiveness, while fluctuations in world cocoa prices directly affect the economic value of exported commodities. Therefore, understanding the relationship between these variables is crucial for improving national cocoa export performance.

Cocoa (*Theobroma cacao*) is an agricultural commodity with high economic value and is used as a primary raw material in the food and beverage industry, particularly in chocolate. (ICCO, 2024). In trade internationally, cocoa is a commodity whose movements are greatly influenced by global demand, world price dynamics, and weather conditions in major producing countries (Kemausuor & Adjei, 2017). Indonesia, along with the Ivory Coast (West Africa), Ghana (West Africa), and Nigeria, is an exporter of the main cacao seed. Indonesia's cocoa exports include raw beans, fermented beans, and various derivative products such as cocoa butter, cocoa powder, and cocoa paste (UN Comtrade, 2024).

Domestic supply availability determines a country's export capacity, while fluctuating international prices significantly influence a product's competitiveness in the global market. The

rupiah exchange rate against the US dollar also plays a significant role in determining export profitability, as exchange rate fluctuations can strengthen or weaken Indonesia's cocoa price position on the global market (Sugiharti et al., 2020). Furthermore, major importing countries such as the United States, Germany, the Netherlands, and Malaysia significantly influence the direction and dynamics of global cocoa trade.

Data from the Central Statistics Agency (BPS) shows that the value of Indonesian cocoa exports in the last ten years has fluctuated due to various factors, including changes in international prices, product quality issues, and market structure dynamics (Central Statistics Agency, 2024). Competition between producing countries and changes in global trade policies also influence the performance of national cocoa exports. To analyze the relationship between these factors more comprehensively, a statistical method is required that can capture causal linkage pathways and evaluate direct as well as indirect effects between variables. The appropriate method for this objective is *Structural Equation Modeling* with *the Partial Least Squares* (SEM-PLS) approach. This method is effective for datasets with relatively small sample sizes and does not require the assumption of normal data distribution. (Hair et al., 2021).

The purpose of this study is to analyze the development trends of Indonesian cocoa exports during the period 2015–2024, assess the influence of export volume, average price, and exchange rate on cocoa export value using the SEM-PLS method. The results can provide a basis for formulating policies and strategies to strengthen Indonesia's cocoa export performance.

RESEARCH METHODS

Research Type and Design

This research is quantitative with a descriptive and explanatory approach. The descriptive approach is used to describe the development and characteristics of Indonesian cocoa export performance, while the explanatory approach aims to explain the causal relationships among variables that influence cocoa export performance (Ghozali & Latan, 2020). The data used are secondary time series data from 2015 to 2024, which are analyzed to examine how fluctuations in export volume, average export price, and the rupiah exchange rate against the US dollar affect Indonesia's cocoa export value.

Location and Time of Research

This research was conducted at the national level (Indonesia) using secondary data sourced from national and international institutions. The research was conducted in 2025, with data coverage from 2015 to 2024.

The data sources used include:

- Statistic Indonesia / Badan Pusat Statistik (BPS) for data on cocoa export volume and export value,
- UN Comtrade Database (UNCTAD) for international trade statistics,
- Bank Indonesia (BI) for data on the rupiah exchange rate against the US dollar, and
- International Cocoa Organization (ICCO) for international cocoa price data.

Data Analysis Technique

The analysis was carried out using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method to examine the relationships between variables: export volume, export price, exchange rate, and export value, and is suitable for analyzing complex models with relatively small sample sizes and non-normal data distributions (Wong, 2013). The SEM-PLS method was

chosen because it can handle relatively small data volumes, non-normal data distributions, and complex models (Hair et al., 2021).

The stages of SEM-PLS analysis include:
1. Develop a structural model (*inner* model) that describes the relationship between latent variables.
2. Develop a measurement model (*outer* model) that explains the relationship between latent variables and their indicators.
3. Conduct validity and reliability tests to ensure that the indicators used represent the construct accurately.
4. Estimate *the path coefficient* to determine the magnitude of the influence of each independent variable on the dependent variable.
5. Assess *the R-square* values to measure the predictive power and contribution of variables in the model.

RESULTS AND DISCUSSION

Data Description

This study utilizes annual secondary data from 2015 to 2024, covering four key interrelated variables in the context of the Indonesian cocoa trade (Table 1). The first variable is export volume (X_1), which indicates the amount of cocoa exported annually in tons. The second variable is the export price per kilogram (X_2), which represents the average value of cocoa export transactions in USD per kg. Furthermore, the third variable is the Rupiah exchange rate against the US Dollar (X_3), which plays a key role in determining export price competitiveness in the international market. And the fourth variable is the annual export value (Y), which is the total foreign exchange earnings from cocoa exports each year, and serves as the dependent variable in this study. These four variables are analyzed to examine the relationships and influences between them in supporting strategic policymaking related to national cocoa exports.

Table 1. Statistics Data Export Cocoa Indonesia (2015–2024)

Year	Export Volume (Ton)	Export Price (USD/Kg)	Mark Exchange (Rp/USD)	Mark Exports (Million USD)
2015	300,000	2.3	13,500	690.0
2016	290,000	2.5	13,300	725.0
2017	320,000	2.4	13,400	768.0
2018	310,000	2.6	14,200	806.0
2019	305,000	2.7	14,000	823.5
2020	295,000	2.8	14,500	826.0
2021	310,000	2.9	14,200	899.0
2022	315,000	3.1	14,300	976.5
2023	325,000	3.2	14,400	1,040.0
2024	330,000	3.3	14,500	1,089.0

(Source: UN Comtrade, BPS, And Bank Indonesia, 2025)

Table 1 shows the development of Indonesian cocoa exports over the past ten years. From 2015 to 2024, cocoa export volume generally increased, from approximately 300,000 tons to 330,000 tons. This upward trend indicates that market demand for Indonesian cocoa remains stable and even tends to increase. Along with the increase in volume, the export price per

kilogram also showed a positive trend, from USD 2.3/kg in 2015 to USD 3.3/kg in 2024. This price increase may reflect improvements in the quality of Indonesian cocoa products or increased global demand. The rupiah exchange rate against the US dollar fluctuated during this period, with a tendency to weaken from approximately IDR 13,300/USD to IDR 14,500/USD. This movement occurred alongside a significant increase in cocoa export value, which rose from USD 690 million to over USD 1 billion. However, this growth in export value does not automatically imply that a weaker currency enhanced the competitiveness of Indonesian cocoa products. Potential pressures from rising production costs and economic uncertainty due to exchange rate volatility raise critical questions regarding the actual impact of the exchange rate on export performance. This complex phenomenon necessitates a deeper analysis through Structural Equation Modeling - Partial Least Squares (SEM-PLS) to dissect the causal relationships between variables and determine whether the exchange rate served as a primary driver or, conversely, a hindrance to export performance.

SEM-PLS Analysis Results

Model Measurement (Outer Model)

Evaluation of the measurement model was conducted to test the validity and reliability of the latent constructs used in the study. Table 2 shows all the resulting constructs that met the evaluation criteria. Each indicator in variables X1 (Export Volume), X2 (Export Price), X3 (Exchange Rate), and Y (Export Value) had a loading factor value above 0.7, indicating a strong correlation with the latent construct (Hair et al., 2021).

Table 2. Results of Measurement Model Evaluation

Construct	Indicator	Loading Factor	AVE	CR	Cronbach Alpha
X1	X1.1	0.82	0.67	0.89	0.85
X2	X2.1	0.79	0.65	0.87	0.83
X3	X3.1	0.84	0.66	0.88	0.86
Y	Y.1	0.91	0.71	0.91	0.88

(Source: Primary Data Analysis, 2025).

The Average Variance Extracted (AVE) values for all constructs were also above the minimum threshold of 0.5, indicating that the latent variables were able to explain more than 50% of the variance in their indicators. This indicates that convergent validity was met. Furthermore, the *Composite Reliability* (CR) and *Cronbach's Alpha* for all constructs were also above 0.7, indicating that each construct has good internal consistency and is reliable. Thus, it can be concluded that all constructs in this model are valid and reliable, and suitable for use in further structural analysis.

Model Structural (Inner Model)

An inner model analysis was conducted to test the extent to which the independent constructs (X1: Export Volume, X2: Export Price, and X3: Exchange Rate) influence the dependent construct (Y: Export Value). The bootstrapping test results presented in **Table 3** reveal several important findings. First, the Export Volume variable (X1) has a significant positive effect on Export Value with a path coefficient of 0.64, a t-statistic of 5.21, and a p-value of 0.000. This indicates that an increase in export volume significantly contributes to an increase in the value of Indonesian cocoa exports. Second, the Export Price variable (X2) shows a positive effect with a path coefficient of 0.28. However, the t-statistic of 1.92 and p-value of 0.056 indicate that this effect is only marginally significant, or at the 10% significance level. This means that price

has a tendency to have a significant effect, but it is not statistically strong enough at the 95% confidence level.

Third, the Rupiah Exchange Rate variable against the USD (X3) shows a significant negative effect on Export Value. During the study period, the value of Indonesian cocoa exports increased from USD 690 million to USD 1.089 billion, in line with rising export prices and relatively stable export volumes. However, the analysis results show that the exchange rate variable has a negative and significant effect on export value (coefficient -0.47; p-value 0.001). This indicates that the depreciation of the rupiah actually suppresses cocoa export performance. This condition can be caused by increasing costs of supporting materials (such as packaging, additional materials, and logistics), as well as economic instability that hinders export competitiveness. Thus, the increase in cocoa export value during the study period was more influenced by increases in export prices and volumes, rather than by changes in the exchange rate.

Table 3. Results Test Bootstrapping

Connection	Path Coefficient	T- Statistics	P- Value	Information
X1 → Y (Volume → Export)	0.64	5.21	0.000	Significant
X2 → Y (Price → Export	0.28	1.92	0.056	Marginal Significant
X3 → Y (Exchange rate → Export)	- 0.47	3.88	0.001	Significant Negative

(Source: Primary Data Analysis, 2025).

The coefficient of determination (R^2) value produced in this analysis was 0.742, indicating that the three independent variables were able to explain 74.2% of the variation in cocoa export value. This indicates that the model has quite strong predictive power in explaining export performance during the study period.

SEM-PLS diagram

The SEM-PLS model used in this study visually depicts the direction and strength of the relationship between variables in the Indonesian cocoa export system. In this model, three independent variables: Export Volume (X1), Export Price per Kg (X2), and Rupiah Exchange Rate against the Dollar (X3) are analyzed for their influence on the dependent variable, Annual Export Value (Y). The following model illustrates the direction and strength of the relationship between variables in the SEM-PLS analysis:
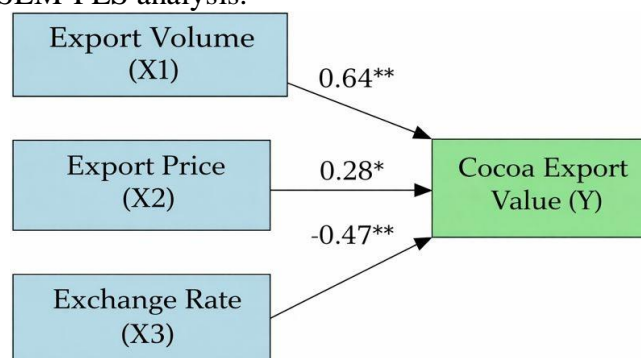

Figure 1. Results of SEM-PLS Analysis
(Source: Primary Data Analysis, 2025)

The analysis results show that Export Volume (X1) has the most dominant and significant influence on Export Value. This is reflected in the large path coefficient of this variable in the model, indicating that higher export volumes lead to higher Indonesian export values. Meanwhile, the Export Price variable (X2) has a marginally significant effect on Export Value. This means that price fluctuations have an impact, but not as strongly as volume, in influencing export value. On the other hand, the Rupiah Exchange Rate (X3) shows a negative and significant effect, indicating that a weakening exchange rate tends to reduce export value. This model emphasizes that the strategy to increase the value of Indonesian cocoa exports needs to focus on increasing export volume by strengthening farmer production, improving logistics efficiency, and optimizing the supply chain. Furthermore, price and exchange rate stabilization also remain important as supporting factors for the overall success of cocoa exports.

CONCLUSIONS AND SUGGESTIONS

The analysis of Indonesian cocoa export data over the past ten years using the SEM-PLS method shows that export volume has a positive and significant effect on export value, indicating that increasing the number of exports directly increases the total value of cocoa exports. Export prices also have a positive but marginal effect, while the rupiah exchange rate against the US dollar has a significant negative effect, indicating that a weakening rupiah can actually reduce the competitiveness of cocoa exports. Overall, the combination of these three variables is able to explain most of the variation in the value of Indonesian cocoa exports, so improving export performance requires considering aspects of production, prices, and exchange rate stability in an integrated manner.

The government and industry players should increase the productivity and efficiency of cocoa production to maintain sustainable export volumes. Export pricing strategies need to be designed to be competitive and profitable for farmers through quality improvement and the development of value-added products. Furthermore, the stability of the rupiah exchange rate must be maintained, as extreme fluctuations can impact export revenues. Further studies are also needed, taking into account non-economic factors such as trade regulations, global consumption trends, and sustainability aspects to make Indonesia's cocoa export strategy more adaptive and competitive.

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