Variability of Factors Influencing Coffee Export Performance in Indonesia

Rizky Yanuarti[1*)] and Dani Widjaya[2)]

[1)]Agribusiness Study Program, Faculty of Agriculture, University of Jember, Jln. Kalimantan 37, Jember, Indonesia
[2)]Independent Researcher, Ajung, Jember, Indonesia
*Corresponding author: rizkyyanuarti@gmail.com

Abstract

Empirical evidence is lacking on the nexus between coffee commodity output and commodity price volatility of developing countries especially during the pandemic era. The most visible impact from an economic perspective is the change of price expectation on people's basic needs which are in line with the decline of economic growth in Indonesia. This has significant implications, particularly considering the important role of coffee in supporting the country's economy. The aim of this study was to examine the factors that influence the performance of coffee exports in Indonesia. The novelty of this study lay on the used national dataset within the range of 20 years (2000-2020) which include the pandemic effect on coffee sector performance. We examined the relationship between variables and coffee exports in Indonesia using unit root tests, cointegration analysis, and an error correction model (ECM). The results show that total area, coffee production, coffee price, gross national income, and coffee imports have significant influences on coffee exports. The variables of total area and coffee production impact coffee exports negatively in the long term, while coffee price, gross national income, and coffee imports have mixed effects. In the short term, total area and coffee production significantly affect coffee exports, while coffee prices and gross national income show no significant impact. Coffee imports have a significant negative influence on coffee exports in the short term. These findings contribute to understanding the dynamics of the coffee industry in Indonesia.

Keywords: Error correction model, coffee, export performance

INTRODUCTION

The Covid-19 pandemic has affected almost all population and many sectors in the world, including Indonesia. The agricultural sector is one affected sector which will cause major transformations for future practic as a result of this pandemic (Ridaura et al., 2021). The impact of Covid-19 on the food and agriculture sector has led to the vulnerability of food supply chains, although the degree of disruption varies globally (Fan et al., 2021). Another impact caused by Covid-19 is the change of economic, social and political (Setyoko & Kurniasih, 2022). Covid-19 is projected to reduce Indonesia's economic growth by 1% to 4% (Tambunan, 2021). The most visible impact from an economic perspective is the change of price expectation on people's basic needs which are in line with the decline of economic growth in Indonesia (Meyer et al., 2022).

Indonesia has several commodities which contribute to economic growth by participating in the export market and supplying world demand, one of which is coffee (Soegoto *et al.,* 2022). Coffee has a major role in supporting the national economy of Indonesia. The development of coffee farming is dominated by smallholder plantations, followed by large state plantations, and large private plantations (Dasipah *et al.,* 2021). Indonesia is the world's fourth largest coffee producer since 2014 (UNComtrade, 2020). However, the development of Indonesian coffee production and trade is still very dynamic (Fatkurohim *et al.,* 2022).

Generally, coffee consists of several types in Indonesia, but Robusta and Arabica are the most popular (Apriliyanto *et al.,* 2018). Basically, coffee is sold in the form of green beans to be marketed on international scale (export-import) (Boaventura *et al.*, 2018). The selling price of coffee on the international market is highly dependent on global economic conditions. Several empirical research studies on factors affecting coffee export volatility before Covid-19 have been carried out in the period of 2012-2022 (Hussein, 2015; Muhire *et al.*, 2018; Srinivasan & Kalaivani, 2012; Winingsih & Yustirania, 2022; Putri *et al.,* 2020; Sitanini *et al.,* 2020; Iladini & Neli, 2020). Those studies focus exclusively on factors affecting coffee export volatility and trade of developing countries. The overall thrust of these results is that domestic price, exchange rate, gross domestic product, coffee production, and world coffee price become factors which have significant influence on coffee exports. Coffee price is the main highlight regardless of the sample period, data frequency, model specification, country coverage, and estimation method.

Meanwhile, the Covid-19 pandemic has resulted in world economic turmoil, and one of them has had an impact on the agricultural sector, including the selling price of coffee. The selling price of coffee is an important factor to encourage farmers to do coffee farming. The selling price is very closely related to the income that will be obtained by farmers. In addition, the factor of land availability is also a determining factor for coffee production in Indonesia. The area of smallholder coffee plantations in Indonesia has increased from 2020 to 2021 by 1.18% (BPS, 2021). Moreover, this indicates that the prospects for coffee farming in the future are still great. On the other hand, the quantity of coffee exports and imports is also one of the considerations for farmers to do coffee farming since it is related to the demand volume and its price. Indonesia's coffee export value reached USD 1.17 billion in 2017 and was ranked fourth in the world's coffee exporters (UNComtrade, 2020). This value can be said to be large enough to be taken into consideration by farmers in the producing area. However, most small scale farmers did not view this potential as a great chance so the possibility of their performance undergoing a reduction.

Recent research on export performance mainly focused on volatility price and its relation to farmers' welfare (Damanik & Ayu, 2020; Fitriani *et al.,* 2021; Zikria, 2020). More advance the research on effects of climate variables, commodity price, and combination of climate variables with commodity price with the combination of several macroeconomics condition (Hussien, 2015; Oko-Isu *et al.,* 2019),

To fill the gap, studies related to the factors that influence the performance of coffee exports in Indonesia need to be done. The novelty of this study lay on the used national dataset within the range of 20 years and including the pandemic effect on coffee sector performance. Export performance is not only interesting but also important to

analyze as the Covid-19 pandemic has quite affected the stability of the world economy, especially in terms of volatility in coffee prices (Nopriyandi & Haryadi, 2017; Prajanti *et al.,* 2020). Besides that, it is also necessary to look at the effect of coffee production (Mardhiah *et al.,* 2020), land area (Chen, 2021), gross national income (Muttoharoh *et al.*, 2018), and coffee imports on the performance of coffee exports in Indonesia.

MATERIALS AND METHODS

This research used a quantitative descriptive approach. Descriptive explanations were obtained from data sourced from the official website of an institution, a collection of the latest books and journals related to the impact of Covid-19 on the export performance of coffee farming. A quantitative approach was carried out by collecting secondary data from Food and Agricultural Organization (FAO) for the last 20 years (2000-2020), specifically related to data on coffee exports (kg), total coffee area (ha), Indonesian coffee production (kg), coffee price (USD), gross national income (USD), and imports coffee (kg). Error correction model (ECM) is employed to analyze the factors that affect the export of Indonesia's coffee in the short term and in the long run by using E-views

software. Table 1 shows a detailed explanation on the variables used in the equation.

ECM is a time series data analysis used for variables that have dependencies which are often called cointegration (Enders, 2010). Error correction term (ECT) coefficient must be significant to state whether the error correction model is appropriate or not (Pakpahan, 2012). ECM by using the Engle-Granger methodology was used, the models for these analyses as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 EC_{t-1} + e_t \ldots (1)$$

Where

$$EC_{t-1} = Y_{t-1} - (\beta_0 + \beta X_{t-1}) \ldots (2)$$

Stationary Test (unit root test)

The procedure begins by doing a stationary test. First, perform a unit root test (unit roots) with the Phillips-Perron (PP) unit root test. The root of this unit can create statistically significant regression and a high coefficient of determination (Suryana *et al.,* 2014). The null hypothesis of the PP test is that there is a unit root, with the alternative that there is no unit root (Phillips & Perron, 1988). If the p value is above a critical size, then the null cannot be rejected there and the series appears to be a unit root. Second, the integration degree test of each variable is critical

Table 1. Variable description used in error correction model (ECM) analysis on coffee commodity in Indonesia 2023

Factors		Description	Units	Measure	Source
Y	Coffee export	The total volume of Indonesia's green coffee exports within one year	kg	scale	FAOSTAT
X_1	Total area	Total area of coffee plantations in Indonesia	ha	scale	FAOSTAT
X_2	Coffee production	Indonesia's green coffee production within one year	kg	scale	FAOSTAT
X_3	Coffee price	The price of green coffee per kg at the Indonesian producer level	USD kg^{-1}	scale	FAOSTAT
X_4	Gross national income	The entire value of goods and services produced by Indonesia in a certain period and is measured in units of money	USD	scale	FAOSTAT
X_5	Coffee import	The total volume of Indonesian green coffee imports within one year	kg	scale	FAOSTAT

Source: Food and Agriculture Organization, accessed on February 5th 2023

in determining whether or not the variables employed are static. Lastly, the cointegration test is run after it has been determined that the data utilized in the study are integrated to the same degree by producing residuals. According to Granger representation theory, if both variables X and Y are cointegration, their relationship can be described as ECM (error correction model) (Gujarati, 2012).

Long and Short Run Model Estimation

The model that was used to estimate the response of coffee performance in export volume to changes in price and non-price factors in Indonesia is implicitly and generally given as follow:

$$CEt = f(TAt, CPt, CR, GNIt, CIt).......(3)$$

Where CE is coffee exports (kg), TA is total area (ha), CP is coffee production (kg), CR is coffee price (USD), GNP is gross national income (USD), and CI is coffee imports (kg). Furthermore, we estimated the following equation from our generalized model in equation (1), to empirically examine or capture the long run and short run of the response which leads us to:

$$CEt = \beta_0 - \beta_1 TAt + \beta_2 CPt + \beta_3 CRt - \beta_4 GNIt - \beta_5 CIt \dots\dots (4)$$

Where β_0 is the regression constant and β_{1-5} are parameter estimates.

Cointegration Test

Cointegration test is used to establish if there is a correlation between several time series in the long term (Granger, 1986). Cointegration tests identify scenarios where two or more non-stationary time series are integrated together in a way that they cannot deviate from equilibrium in the long term. The cointegration can be specified as (Granger, 1986):

$$Y_t = \alpha_0 + \alpha_1 Z_t + u_t \dots\dots\dots (3)$$

Where is time series equation, is a stationary cointegrating error component, the vector of explanatory variable, is cointegrating vector or long-run parameter. If the probability result is less than error rate (0.05) then we can proceed to estimating the short-run equation.

Statistical Test

The statistical tests conducted there are three of the F test, R^2/adjusted R-squared test, and t-test. The F test by looking at the proba-bility of F-statistic on regression output with 5% significant level. Test coefficient of determination (R^2/adjusted-R^2) to explain how much the ability of the independent variables describes the dependent variable in the model. The t-test to partially test each variable by comparing the probability of t value or significance <0.05 (Girsang *et al.*, 2018).

RESULTS AND DISCUSSION

Stationary Test (unit root test)

The unit root test is used to see the stationarity of the data being analyzed. Unit root test was essential in determining the order of integration of the variables prior to the empirical model estimations. This is because estimation of the empirical model without prior knowledge on the order of integration of the variables would lead to a spurious regression problem. All the variables were not stationary at their levels thus the need for differencing them to make them stationary (Onu *et al.*, 2017). Table 2 shows the results of the unit root test at the level. Based on Table 2 it is known that only the dependent variable (coffee exports) and the independent variable coffee imports have stationary data. The next test is to look for

stationary data for all variables at a certain level of difference.

Then a degree of integration test is carried out to find out at what degree the data will be stationary. Testing the degree of integration needs to be done if the obtained data was not stationary at the degree level. After testing at the first level of difference it is known that the variables of coffee export and coffee import are included in the stationary category. Table 3 shows that the variables of total area, coffee production, coffee price (the price of green coffee per kg at the Indonesian producer level), and gross national income have a probability value of >0.05. So that the variable is referred to as non-stationary data. Furthermore, after testing at the second difference level, it is known that all independent variables are classified into the stationary category. This condition indicates that the processed data is feasible to proceed to the next level of analysis.

Long Run Regression Model

Parameter estimation of the long-term equation is estimated after the stationary test is applied. Based on Table 4, it is known

that the R square value is 0.6128, which means that 61.28% increase and decrease in coffee export volume is influenced by the total area (X_1) (Prajanti *et al.*, 2020; Sihombing *et al.*, 2020), coffee production (X_2) (Aryati, 2020; Fitriani *et al.*, 2021), coffee price (X_3) (Hung Anh & Bokelmann, 2019), gross national income (X_4) (Bekele & Mersha, 2019) and import coffee volume (X_5) (Fatkurohim *et al.*, 2022). While 38.72% is influenced by other factors outside the observed model. The influence exerted by these independent variables can be felt significantly (F Prob: 0.0125). Based on Table 4, the estimated long-term equation is obtained as follows:

$$CE_t = 1.85E+09 - 1444.52TA_t + 0.5979CP_t + 12498.83CR_t - 5.2471GNI_t - 2.9208CI_t$$

Table 4 shows that the total area variable has a long-term regression coefficient value of -1444.52 with a probability value <0.05. Therefore, the total area variable significantly influences coffee exports in Indonesia (Prajanti *et al.*, 2020). The negative sign indicates an inverse relationship between the total area and coffee exports in Indonesia. Thus, assuming

Table 2. Unit root-test result at first -level on error correction model (ECM) analysis on coffee commodity in Indonesia 2023

Variable	Code	Probability	Explanation
Coffee export (CE)	Y	0.0176	Stationary
Total area (TA)	X_1	0.5315	Not Stationary
Coffee production (CP)	X_2	0.0979	Not Stationary
Coffee price (CR)	X_3	0.5775	Not Stationary
Gross national income (GNI)	X_4	0.5721	Not Stationary
Coffee import (CI)	X_5	0.0073	Stationary

Tabel 3. Unit root test results at first difference and second difference levels on error correction model (ECM) analysis on coffee commodity in Indonesia 2023

Variable	1st *Difference*		2nd *Difference*	
	Probability	Explanation	Probability	Explanation
Coffee export (CE)	0.0000	Stationary	0.0000	Stationary
Total area (TA)	0.0000	Stationary	0.0000	Stationary
Coffee production (CP)	0.0002	Stationary	0.0000	Stationary
Coffee price (CR)	0.0733	Not Stationary	0.0000	Stationary
Gross national income (GNI)	0.1287	Not Stationary	0.0023	Stationary
Coffee import (CI)	0.0000	Stationary	0.0000	Stationary

ceteris paribus (all other things being equal), every increase of 1 hectare of land will decrease coffee exports by 1,445 kg. Increasing the total area of coffee cultivation can result in a focus on quantity rather than quality. If farmers prioritize maximizing production, they prioritize quantity over ensuring high-quality beans (Adane & Bewket, 2021). As a result, the overall quality of the coffee produced decreases, which can impact export demand. This condition differs from the variable of coffee prices. The coffee price variable has a positive and significant relationship (probability <0.05) with coffee exports in Indonesia (Hung Anh & Bokelmann, 2019). Hence, assuming the other variables remain constant, every increase of USD 1 in coffee price will increase coffee exports by 12,499 kg. When the producer price of coffee rises, it can indicate a growing demand or limited supply in the global coffee market (Gay *et al.,* 2006). Coffee farmers and producers respond to this price signal by increasing their production to meet the demand and take advantage of the favorable market conditions. This increased production can result in a higher volume of coffee exports.

The variable of gross national income (GNI) has a regression coefficient of -5.25 and its influence on coffee exports in Indonesia is significant (probability <0.05) (Bekele & Mersha, 2019). The negative notation indicates that gross national income has an inverse relationship with coffee exports in Indonesia. This means that if there is an increase of USD 1 in gross national income, it will decrease coffee export volume by 5.25 kg. As countries experience economic growth and higher GNI, consumer preferences and tastes could change. This led to a shift in beverage choices, with consumers favoring alternatives to coffee or higher-end specialty coffees (Samper *et al.,* 2017). Coffee-producing countries could choose to prioritize satisfying the growing demand within their own markets, leading to a reduction in the volume available for exports.

The variable of coffee imports volume also has a negative influence on coffee export volume and is statistically significant (probability <0.05) (Fatkurohim *et al.,* 2022). This implies that every increase of 1 kg in coffee imports will decrease coffee exports by 2.92 kg. An increase in coffee imports indicate a shift in consumer preferences within the importing country (Krishnakumar & Chan-Halbrendt, 2010). Consumers may prefer the taste, quality, or variety offered by coffee-producing regions different from the traditional exporting countries. As a result, the volume of coffee exports from the previous exporting countries decreases.

Co-integration Test

Co-integration test is a statistical method used to examine whether there is a long-term equilibrium relationship between two or more variables in a time series analysis. The concept of cointegration is often used in econometrics to understand the long-term relationship between variables that may individually not be stationary but have a stable long-term

Table 4. Long-term equation estimation results

Variable	Code	Coefficient	t-statistic	Probability
Constant	C	1.85E+09	2.8494	0.0129 *
Total area (TA)	X_1	-1444.521	-2.7616	0.0153 *
Coffee production (CP)	X_2	0.597957	1.5048	0.1546 ns
Coffee price (CR)	X_3	12498.83	2.1356	0.0509 ns
Gross national income (GNI)	X_4	-5.247125	-1.8978	0.0785 ns
Coffee import (CI)	X_5	-2.920798	-3.3767	0.0045 **
R square	0.6128			
F-prob	0.0125			

Notes: (*) Significant at 95%, (**) Significant at 99%, (ns) Not significant

relationship (Murindahabi *et al.,* 2019). If the probability value is <0.05, it can be concluded that there is a co-integrating relationship among the variables in the study (Ardana, 2016; Lee & Brahmasrene, 2018). Based on the co-integration test results, it is known that the probability value at the significance level is 0.0017, and this value is <0.05. Therefore, it can be said that there is a co-integrating relationship among the variables in the study.

Error Correction Model (ECM)

Based on the previous co-integration results, it is known that changes in coffee exports, total area, coffee production, coffee prices, gross national income, and coffee imports have a co-integrating relationship. Therefore, further testing can be conducted, namely the estimation of the short-term equation. The modeling of the short-term equation (Error Correction Model, ECM) is formed to improve a model where the variables are non-stationary (Iladini & Neli, 2020). ECM is used to examine the relationship or influence of independent variables on the dependent variable in the short term. Estimating the short-term equation allows for the presence of imbalances (disequilibrium). Due to the existence of imbalances, correction is needed using an ECM (Sitanini *et al.,* 2020). This model can be constructed if there is co-integration in the long term. Based on the short-term regression results (ECM) in Table 5, the equation can be written as follows.

$$CE_t = 9575326 - 1208.54TA_t + 1.001CP_t + 7792.13CR_t - 7.1162GNI_t - 1.6732CI_t$$

Based on Table 6 where each variable's notation does not differ from the long term equation, it is known that the variable of total area has a significant influence on the volume of coffee exports (prob: 0.0062). The notation

appearing in the regression coefficient indicates a negative value, indicating an inverse relationship in the resulting influence (Rahmatullah *et al.,* 2022). Therefore, every increase of one hectare in the area will decrease coffee exports by 1,208 kg. Coffee cultivation is sensitive to climate conditions, including temperature, rainfall, and pests. While increasing the cultivation area may seem favorable, changes in climate patterns or the emergence of new pests can negatively affect coffee production (Pham *et al.,* 2019). These factors can lead to decreased yields and subsequently impact on the export volume.

Similarly, the variable of coffee production also has a significant influence on the volume of coffee exports in Indonesia and has a positive relationship (positive coefficient) (Hasanah & Prasetyanto, 2022). Therefore, every increase of 1 kg of coffee production will increase the volume of coffee exports by 1 kg. This situation means there is more coffee available for export. This expanded supply can meet the growing demand from both domestic and international markets, leading to an increase in the volume of coffee exports (Kumar *et al.,* 2011).

The variables of coffee prices and gross national income have a non-significant effect on the volume of coffee in the short term, which is consistent with findings from a study conducted by Murindahabi *et al.* (2019) and Nopriyandi & Haryadi (2017). On the other hand, the variable of coffee imports has a significant influence on the volume of coffee exports (probability 0.0000). The regression coefficient value for the coffee imports variable is negative, indicating that every increase of 1 kg in coffee imports will decrease the volume of coffee exports by 2.70 kg. Importing countries could establish direct trade relationships with coffee-producing countries or regions. This allows them to by pass intermediaries or exporters in other countries.

Table 5.   Short-term equation estimation results

Variable	Code	Coefficient	t-statistic	Probability
Constant	C	9575326	0.6063	0.5566 ns
Total area (TA)	X_1	-1208.544	-3.3771	0.0062 **
Coffee production (CP)	X_2	1.001599	3.3428	0.0066 **
Coffee price (CR)	X_3	7792.127	1.3295	0.2106 ns
Gross national income (GNI)	X_4	-7.116243	-1.3820	0.1944 ns
Coffee import (CI)	X_5	-2.7063.1	-7.6917	0.0000 **
RES (-1)	-	-1.673227	-3.8434	0.0027 **
R square	0.8928			
F-Prob	0.0000			

Notes: (**) Significant at 99%, (ns) Not significant.

By importing directly, importing countries can secure a stable supply chain and potentially negotiate better prices (Urciuoli *et al.,* 2014). As a result, the volume of coffee exports from intermediary countries may decline.

The research results have been discussed in relation to recent studies, both prior to and during/after the pandemic era. In broad terms, it can be stated that the export performance of coffee is directly influenced by the economic condition of a country. The pandemic era has brought changes to the Indonesian economic condition, including the implementation of trade restrictions (Phimmavong *et al.,* 203). However, the factors that influence coffee export performance remain the same. Our findings indicate that total area, coffee production, and coffee import volume significantly affect coffee export performance as found in Rahmatullah *et al.* (2022); Kumar *et al.* (2011) and Urciuoli *et al.* (2014). Before the pandemic era, factors such as domestic price, exchange rate, gross domestic product, coffee production, world coffee price, and coffee import volume had an impact on coffee performance.

This study offers valuable insights for policymakers, industry stakeholders, and market participants involved in the Indonesian coffee sector. Policymakers can utilize this information to develop targeted strategies that address the challenges faced by the coffee industry, such as promoting sustainable growth, improving productivity, managing import competition, and exploring opportunities to enhance the competitiveness of Indonesian coffee in the global market.

CONCLUSIONS

Comprehensive analysis conducted on the factors influencing coffee exports in Indonesia has shed light on the dynamics of the coffee industry in the country. The findings indicate that several key factors play a significant role in shaping the patterns of coffee exports. Total area dedicated to coffee cultivation and coffee production were identified as important factors influencing coffee exports. Surprisingly, an increase in the total area and coffee production was found to be associated with a decrease in coffee exports. This suggests that while expanding the cultivation area and increasing production may contribute to meeting domestic demand or other market factors. Analysis revealed that coffee prices and gross national income did not exhibit a significant impact on coffee exports in the short term. This implies that fluctuations in coffee prices or changes in the country's economic performance may not be immediate drivers of coffee export volumes. Coffee imports had a notable negative influence on coffee exports. This finding highlights the competitive dynamics between

domestic production and imported coffee. This suggests that efforts to promote domestic production and reduce reliance on imports could potentially enhance coffee export volumes in Indonesia.

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