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Causality of Robusta Coffee Prices in the North Tapanuli Regency of North Sumatra Province

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ABSTRACT

The North Tapanuli Regency cultivates two types of coffee: Robusta and Arabica; Robusta is the most significant amount of production. Robusta coffee is a commodity with strategic value in efforts to empower the people's economy. The more competition opens up in the Robusta coffee trade in domestic and international markets, the more farmers are required to produce highly competitive products. Should this situation be imbalanced by an increase in producer prices, it is expected to result in a decline in production and farmers' interest in cultivating Robusta coffee. It implies that price movements from consumers to producers are closely related to production performance. This research aims to analyze the causal relationship between the Robusta coffee prices among farmers, wholesalers, and retailers or consumers in North Tapanuli Regency. The analytical model used is the Granger Causality Test to analyze the cause-and-effect relationship between Robusta coffee prices in North Tapanuli Regency. The data used are secondary; the monthly data from 2016 to 2022 obtained 84. The results show no causal (reciprocal) relationship between Robusta coffee prices for wholesalers and retailers or consumers. However, there is a one-way relationship, i.e., Robusta coffee prices for retailers or consumers influence its price for wholesalers in North Tapanuli Regency.

Keywords: Robusta coffee, Price, Granger Causality
Article type: Research Article.

INTRODUCTION

Coffee is one of the most popular drinks in various groups of the community, ranging from low to high-income people (Gomes *et al*. 2023). They have been accustomed to consuming coffee since long ago (Becquer Frauberth *et al*. 2023). Besides consumption, coffee is also part of traditional rituals, as is done in the Solo Palace every Tuesday and Thursday, where coffee is used as an offering for the drinks of the gods (Gumulya & Helmi 2017; Harahap 2018). Coffee commodities increase the number of job vacancies in Indonesia, especially in North Sumatra Province, through several activities, such as processing, marketing, and trade like exports as well as imports, and other activities (Chandra *et al*. 2013). The existence of coffee in Indonesia cannot be separated from the contributions of the colonialists who brought it to Indonesia. The taste of coffee planted in Indonesia is superior to coffee from other countries (Rahardjo 2020). There are two types of coffee that grow in Indonesia, Robusta and Arabica, with the largest total production reaching 73% of the total Indonesian coffee production is Robusta. Indonesia has an area of coffee plantations owned by three groups of plantations, i.e., community, large state, and large private plantations. The largest belongs to community plantation, with a total production of 742 thousand tons in 2019, and about 98.6% of production with more than 1,215 hectares (Central Statistics Agency 2020). All coffee production in Indonesia will be distributed to domestic and international markets (Reza 2021). In the domestic market, household consumption in the form of powder coffee tends to decrease, however, consumption in the form of instant coffee tends to elevate to 9.6% per year. According to Utami (2020), there are several factors that influence domestic consumption, including social, psychological, and personal factors. Robusta coffee is one of the commodities with strategic values that contributes to empowering the people's economy (Azmi &

Handriatni 2018) and plays an important role in rural development (Sahat *et al*. 2018). The high potential of Robusta coffee is expected to improve the welfare of coffee farmers by increasing their income. Farmers become risk-takers in utilizing their limited land, so they have to be able to allocate it optimally (Fitriani *et al*. 2020). The exchange of goods through trade pays attention to good prices at the producer and consumers. Prices become a factor that determines the volume of exports. The price for coffee farmers is one of the important aspects, especially in North Tapanuli Regency, given the high proportion of land ownership owned by the community coffee plantation. In addition to the prices that apply to farmers as producers, other considerations are price fluctuations in the market as recipients of this commodity. Prices can be one indicator in reviewing the efficiency of product marketing (Khumaira *et al*. 2016). Price difference between the country receiving goods and the producing countries is very closely related to export performance. The price transmission of the importing country to the exporter country shows the influence of prices on the amount of goods to be exported. Price transmission from the importing country also shows the existence of market power that controls the exporting country (Arfah *et al*. 2020; Izaati *et al*. 2020; Rahmanta *et al*. 2020). Determining price aims to balance the supply of products and resources of the raw material, which can maintain the stability of its production prospects. Balance is achieved when prices provide opportunities for fulfilling product demands since the supply is neither lacking nor excessive, which results in effective product absorption by consumers (Rusdarti 2015). Research conducted by Alfiana (2021) shows that the increasing price of Robusta coffee commodities every year is included in a low category. However, it should still be noted that the price of Robusta coffee has increased in the following years, especially in South Sulawesi, due to several factors, including uncertain weather conditions that result in reduced production and high consumer demand that is not met. A decrease in Robusta coffee production in coffee production centers in South Sulawesi Province due to those factors will possibly result in an elevation in the price of Robusta coffee. Prices become an important factor that will affect the profit or potential risk due to price decline. Price integration between producers and consumers is one indicator of the response of producers to changes among consumers. Integrated markets occur if price changes in one party can impact or transmit to the other one (Zahara *et al*. 2020). Therefore, this study aims to analyze the reciprocal relationship of Robusta coffee prices among the marketing agencies in North Tapanuli.

MATERIALS AND METHODS

Data

The data used in this research are secondary data, with time series for 7 years from 2016 to 2022 or 84 months. The data include the prices of Robusta coffee for farmers or producers, wholesalers, and retail traders or consumers in North Tapanuli. The data were obtained from the Indonesia Statistics, the Agriculture Office of North Tapanuli, and other sources.

Granger causality analysis method

Granger causality is a test used to examine the causal or reciprocal relationship between two research variables to determine whether the two variables statistically influence each other (two-way or reciprocal relationship), have a unidirectional relationship, or have no relationship at all (do not influence each other; Gujarati 2013).

The mathematical equation for the Granger causality test can be written as follows:

1. HPR = f (HGR)
2. HPR = f (HER)
3. HGR = f (HER)

where:

HPR : Robusta coffee price for producers or farmers
HGR : Robusta coffee price for wholesalers
HER : Robusta coffee price for retailers or consumers

Stages of Granger Causality Test

Determining optimal lag values

The number of lags to include in the model is usually selected using an information criterion, such as the Akaike information criterion (AIC) or the Schwarz information criterion. The lagged value is selected if it has the smallest AIC value based on the estimated results of multiple linear regression analysis (Juanda 2012).

Through multiple linear regression analysis:

a) HPR HPR (-1) HGR (-1) HER (-1) C
b) HPR HPR (-1) HPR (-2) HGR (-1) HGR (-2) HER (-1) HER (-2) C
c) HPR HPR (-1) HPR (-2) HPR (-3) HGR (-1) HGR (-2) HGR (-3) HER (-1) HER (-2) HER (-3) C

RESULTS AND DISCUSSION

The increase in Robusta coffee prices in North Tapanuli Regency

In the current development of the regional economy, it is clear how the economy of one region can influence the economy of other regions. This can also be examined from the very close interplay of the price of Robusta coffee among farmers and consumers. The development of Robusta coffee prices among various economic actors in North Tapanuli can be seen in the figure below.

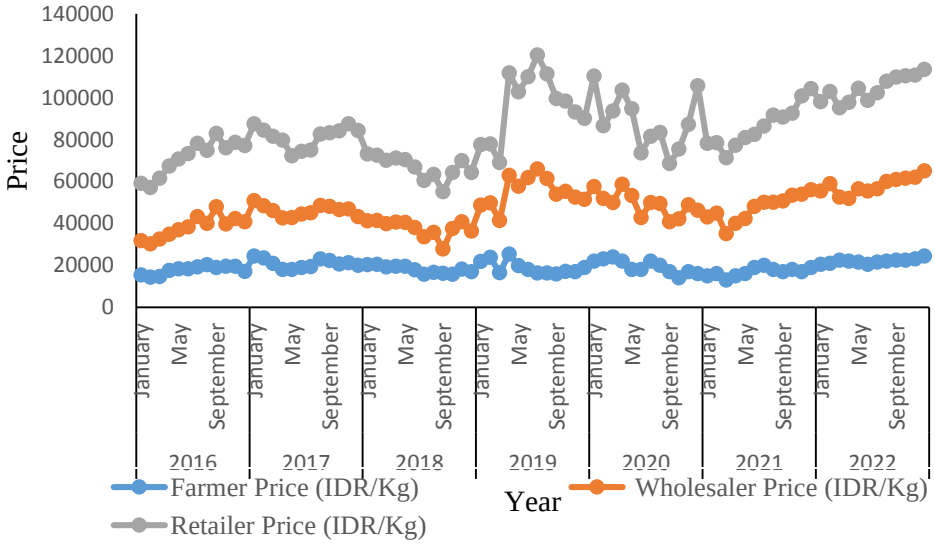

Fig. 1. Distribution of Robusta coffee prices in North Tapanuli Regency from 2016 to 2022.

Fig. 1 shows that the retail price of Robusta coffee is always higher than the price of Robusta coffee of farmers with a positive trend. This is normal since production and marketing costs for farmers are lower than for retailers or consumers.

Determining Optimal Lag Values

By carrying out regression estimates on the HPR equation HPR (-1) HGR (-1) HER (-1) C, the results of the multiple linear regression analysis are as follows:

Table 1. Estimated results of Robusta coffee price for farmers with Lag 1

Dependent Variable: HPR				
Method: Least Squares				
Sample (adjusted): 2 84				
Included observations: 83 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
HPR (-1)	0.640859	0.091445	7.008141	0.0000
HGR (-1)	0.013660	0.056260	0.242795	0.8088
HER (-1)	-0.011109	0.056315	-0.197265	0.8441
C	6991.628	1868.223	3.742394	0.0003
R-squared	0.401793	Mean dependent var		19182.93
Adjusted R-squared	0.379077	S.D. dependent var		2763.010
S.E. of regression	2177.216	Akaike info criterion		18.25647
Sum squared resid	3.74E+08	Schwarz criterion		18.37304

Log likelihood	-753.6437	Hannan-Quinn criter.	18.30331
F-statistic	17.68714	Durbin-Watson stat	2.108697
Prob (F-statistic)	0.000000		

Based on the results of the estimation of the regression equation above, an AIC value of 18.25647 is obtained. By estimating multiple linear regression analysis on the HPR equation HPR (-1) HPR (-2) HGR (1) HGR (-2) HER (-1) HER (-2) C, the following estimation results are obtained:

Table 2. Results of estimated prices for Robusta coffee for farmers with Lag 2

Dependent Variable: HPR

Method: Least Squares
Sample (adjusted): 3 84
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HPR (-1)	0.601632	0.118797	5.064378	0.0000
HGR (-1)	-0.034335	0.074572	-0.460425	0.6465
HER (-1)	-0.029691	0.058475	-0.507762	0.6131
HPR (-2)	0.060256	0.118221	0.509690	0.6118
HGR (-2)	0.021225	0.075565	0.280884	0.7796
HER (-2)	0.051850	0.058188	0.891069	0.3757
C	6149.554	2125.802	2.892816	0.0050

R-squared	0.406873	Mean dependent var	19241.56
Adjusted R-squared	0.359422	S.D. dependent var	2727.565
S.E. of regression	2183.037	Akaike info criterion	18.29632
Sum squared resid	3.57E+08	Schwarz criterion	18.50177
Log likelihood	-743.1492	Hannan-Quinn criter.	18.37881
F-statistic	8.574730	Durbin-Watson stat	2.019758
Prob (F-statistic)	0.000000		

Based on the results of the estimation of the multiple regression equation above, an AIC value of 18.29632 is obtained. By estimating multiple linear regression on the HPR equation HPR (-1) HPR (-2) HPR (-3) HGR (1) HGR (-2) HGR (-3) HER (-1) HER (-2) HER (-3) C, the following estimation results are obtained:

Table 3. Estimated results of Robusta coffee prices for farmers with Lag 3

Dependent Variable: HPR

Method: Least Squares
Sample (adjusted): 4 81
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HPR (-1)	0.539504	0.118716	4.544514	0.0000
HGR (-1)	-0.107124	0.078876	-1.358138	0.1789
HER (-1)	-0.026652	0.057488	-0.463598	0.6444
HPR (-2)	0.031842	0.137975	0.230779	0.8182
HGR (-2)	-0.054556	0.085109	-0.641016	0.5237
HER (-2)	0.064517	0.059008	1.093358	0.2781
HPR (-3)	0.057804	0.122294	0.472666	0.6380
HGR (-3)	0.071231	0.064266	1.108386	0.2716
HER (3)	0.093253	0.040395	2.308540	0.0240
C	4779.060	2675.459	1.786258	0.0785

R-squared	0.412670	Mean dependent var	19143.69
Adjusted R-squared	0.334935	S.D. dependent var	2618.423
S.E. of regression	2135.364	Akaike info criterion	18.28987
Sum squared resid	3.10E+08	Schwarz criterion	18.59201
Log likelihood	-703.3050	Hannan-Quinn criter.	18.41082

F-statistic	5.308683	Durbin-Watson stat	1.944451
Prob(F-statistic)	0.000018		

Based on the results of the estimation of the multiple regression equation above, an AIC value of 18.28987 is obtained. Based on the results of the multiple linear regression analysis, the overall AIC value is:

Table 4. AIC values based on estimation with Lags 1, 2, and 3.

No	Lag	Equation	AIC Value	Conclusion
1	1	HPR HPR (-1) HGR (-1) HER (-1) C	18.25647	Smallest
2	2	HPR HPR (-1) HPR (-2) HGR (1) HGR (-2) HER (-1) HER (-2) C	18.29632	
3	3	HPR HPR (-1) HPR (-2) HPR (-3) HGR (-1) HGR (-2) HGR (-3) HER (-1) HER (-2) HGR (-3) C	18.28987	

Causality test of Robusta coffee prices applied for farmers and wholesalers

The causal (reciprocal) relationship between the price of Robusta coffee at farmers and wholesalers can be tested using the Granger causality method.

Table 5. Causality of Robusta Coffee Prices among Farmers and Wholesalers.

Pairwise Granger Causality Tests

Sample: 1 84

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
HGR does not Granger Cause HPR	83	0.02028	0.8871
HPR does not Granger Cause HGR		0.04104	0.8400

The hypothesis is as follows:

H_0 = The coffee price for farmers or producers does not affect the price for wholesalers

H_1 = The coffee price for farmers or producers affects the price for wholesalers

Table 5 indicates that if the probability is above 5%, then accept H_0; conversely, if the probability is below 5%, then H_1 is accepted. Based on the results of data processing using the E-views software program, the Granger causality test does not show a reciprocal relationship (causality) between the price of Robusta coffee for farmers and wholesalers. In other words, the price of Robusta coffee for farmers does not affect its price for wholesalers, and vice versa in North Tapanuli Regency.

This supports the results obtained by Pratita (2022), who stated that the price of Robusta coffee for farmers in Indonesia and USA market, as the main target of the Indonesian coffee export market, do not have a causal relationship. In addition, Nasution & Rahmanta (2022) pointed out that there was no reciprocal (causal) relationship between the price of Arabica coffee for farmers and wholesalers. In other words, the price of Arabica coffee for farmers does not affect it for wholesalers, and vice versa in North Tapanuli Regency.

Causality test of Robusta coffee prices applied for farmers and retail traders

The causal (reciprocal) relationship between the price of Robusta coffee for farmers and for retailers can be tested using the Granger causality method.

The hypothesis are as follows:

H_0 = The coffee price for farmers or producers does not affect the price for retailers

H_1 = The coffee price for farmers or producers affects the price for retailers

Table 6 shows that the results of the Granger causality test do not reveal a reciprocal relationship (causality) between the price of Robusta coffee for farmers and for retailers or consumers. In other words, the price of Robusta coffee for farmers does not affect the price of Robusta coffee for retailers or consumers, and vice versa in North Tapanuli Regency. This supports results obtained by Zahara *et al.* (2020), who reported that the price of Robusta coffee for exporters in the short term is not influenced by changes in its price for farmers in the previous month period. Likewise, changes in its price on the London Stock Exchange market in the previous month did not affect

the price for the Lampung exporter. This is because exporters need more time to adjust to changes in Robusta coffee prices that occur on the London Stock Exchange market.

Table 6. Causality of Robusta coffee prices among farmers and retail traders.

Pairwise Granger Causality Tests		
Sample: 1 84		
Lags: 1		
Null Hypothesis:	ObsF-Statistic	Prob.
HER does not Granger Cause HPR 83	7.9E-10	1.0000
HPR does not Granger Cause HER	0.23159	0.6317

Causality test of Robusta Coffee prices for wholesalers and retail traders

To examine the causal (reciprocal) relationship between the price of Robusta coffee for wholesalers and retailers or consumers, a test can be carried out using the Granger causality method.

Table 7. Causality of Robusta Coffee prices among wholesalers and retail traders.

Pairwise Granger Causality Tests		
Sample: 1 84		
Lags: 1		
Null Hypothesis:	ObsF-Statistic	Prob.
HER does not Granger Cause HGR 83	0.61440	0.4355
HGR does not Granger Cause HER	16.2419	0.0001

The hypothesis is as follows:

H_0 = The coffee price for wholesalers does not affect the price for retailers

H_1 = The coffee price for wholesalers affects the price for retailers

Table 7 shows that the results of the Granger causality test do not reveal a reciprocal relationship (causality) between the price of Robusta coffee for wholesalers and its price for retail traders or consumers. However, it exhibited a one-way relationship, i.e., the price of Robusta coffee for retail traders or consumers affect its price for wholesalers, while the price for wholesalers does not affect the price for retailers in North Tapanuli Regency. This supports research by Amadea (2019), who stated that the price of Japanese coffee does not significantly affect the price of Indonesian coffee, so we accept the null hypothesis. Meanwhile, the price of Indonesian coffee significantly affects the price of Japanese one, so we reject the null hypothesis. Thus, it can be concluded that there is a unidirectional causality between the prices of Japanese and Indonesian coffee; i.e., the price of Indonesian coffee has a statistically significant effect on the price of Japanese one and does not apply to vice versa. Nasution & Rahmanta (2022) reported that the price transmission patterns between Arabica coffee marketing agencies in North Tapanuli Regency are asymmetrical in wholesale-producer and wholesaler-consumer relationships in the short and long term.

CONCLUSION

The results of the Granger causality analysis show that there is no causal (reciprocal) relationship between the price of Robusta coffee for wholesalers and its price for retail traders or consumers. However, there is a one-way relationship, i.e., the price of Robusta coffee for retail traders or consumers affects its price for wholesalers in North Tapanuli Regency.

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