Volatility and Transmission of Palm Oil Price in the Province of North Sumatra and Bengkulu Province

Yulia Herdiyanti, Ketut Sukiyono[*], Andi Irawan

University of Bengkulu, Bengkulu 38371, Indonesia

ABSTRACT

This study aims to analyze the level of volatility and transmission of palm oil prices in the Rotterdam and Belawan markets as well as the price of palm FFB in the markets of North Sumatra and Bengkulu Provinces. This study uses time series data for 120 months from January 2012 to December 2021. In this study, the data analysis method used to analyze the level of price volatility is Autoregressive Conditional Heteroscedasticity-Generalized Autoregressive Conditional Heteroscedasticity (ARCH-GARCH) and to analyze the level of price transmission is Autoregressive Distributed Lag (ARDL). The results showed that: (1) the price volatility level in the Rotterdam and Belawan palm oil markets was high; and (2) palm oil price transmission which is perfectly transmitted both in the short term and in the long term only occurs between the Rotterdam palm oil market and the Belawan palm oil market.

Keywords: ARCH-GARCH, ARDL, oil palm, transmission, volatility

INTRODUCTION

In trading palm oil, price is a matter of concern for the relevant economic actors. In trading activities between palm oil market players, there are 2 types of markets, namely the physical market (spot) and the futures market. Usually price developments on the futures palm oil market are followed by prices on the physical (spot) palm oil market. In line with the findings of Gandhi *et al.* (2022) stated that price volatility in the palm oil futures market was transmitted to prices on the spot palm oil market. In this study, the reference price of palm oil is the Rotterdam forward market price and the Belawan spot market price. Based on the Figure 1, prices on the Rotterdam palm oil market fluctuate every year. The coefficient of price variation on the Rotterdam palm oil market is 27.19% which indicates that the price on the

*Corresponding author:
Department of Agricultural Social-Economics, Faculty of Agriculture, University of Bengkulu, Indonesia
Jl. WR. Supratman, Kandang Limun, Kec. Muara Bangka Hulu, Sumatra, Bengkulu 38371
E-mail: ksukiyono@unib.ac.id

Rotterdam palm oil market varies widely and has a risk level of 27.19%. Price volatility on the Rotterdam palm oil market was not only followed by prices on the Belawan palm oil market but also followed by prices on the fresh fruit bunches (FFB) market.
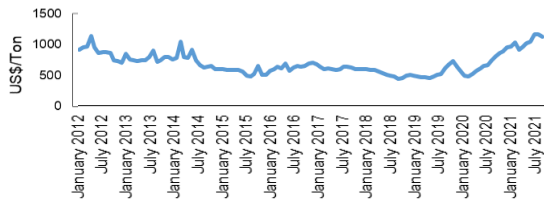

Figure 1 Development of Palm Oil Prices in the Rotterdam Market in 2012–2021.

The Figure 2 shows that prices on the Belawan palm oil market and prices on the Palm Oil FFB market in the Provinces of North Sumatra and Bengkulu Province fluctuate every year. The price variation coefficient on the Belawan palm oil market was 29.82% and the price variation coefficient on the FFB market for North Sumatra Province was 32.73% and Bengkulu Province was 16.70% which indicated that the price on the palm oil market varies greatly and has a risk level of 29.82% in the Belawan market, 32.73% in the North Sumatra Province market and 16.70% in the Bengkulu Province market.
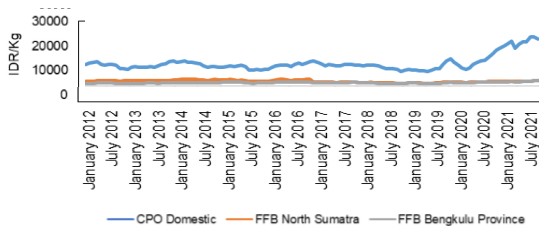

Figure 2 The Development of Palm Oil Prices in the Belawan Market and the FFB Prices for Palm Oil Markets in North Sumatra and Bengkulu Provinces in 2012–2021.

The problem that often occurs in the marketing process of palm oil and palm FFB products is that the prices of palm oil and palm FFB often experience high price fluctuations. Fluctuations in the price of palm oil may be caused by an imbalance in the supply of goods from producers (Iskandar 2015). If consumer demand is higher than the goods supplied, the price of palm oil will rise and if the supply from producers is higher than the amount of consumer demand, the price of palm oil will fall.

Excessive price volatility in the price of palm oil and palm FFB can result in higher price uncertainty for market participants. To reduce the risk of price uncertainty, an understanding of price volatility is important for market participants to know. According to Haron and Salami (2015) through the results of a study on the volatility of Malaysian CPO prices stated that an under-standing of the level of volatility needs to be understood in order to provide useful information to policy makers in order to reduce price uncertainty. The impact of price fluctuations in the Rotterdam market should be passed on to the Belawan market and North Sumatra Province and Bengkulu Province through a transmission mechanism so that the Belawan market and North Sumatra Province and Bengkulu Province will also experience price volatility. As a result, an analysis of volatility in the market is not sufficient for business actors, so it is necessary to conduct research on price transmission.

From the explanation above, until now fluctuations in the price of palm oil still occur, making researchers interes-ted in conducting research on the volatility and transmission of palm oil prices. The results of this study are expected to be useful in making decisions to avoid uncertainty in the price of palm oil.

MATERIALS AND METHODS

Locations were chosen purposively, namely North Sumatra Province and Bengkulu Province with the consideration

that North Sumatra Province is an area that has the largest land area and produces the second largest palm oil production and Bengkulu Province is area the sixth largest palm oil in Indonesia. Data collection techniques in this study were collected using secondary data. Secondary data was obtained from previously available data such as data from the Central Statistics Agency (BPS) and the Commodity Futures Trading Regulatory Agency (BAPPEBTI). The data needed is monthly data (10 years, namely January 2012-December 2021) on the price of palm oil on the Rotterdam market (CIF) and the price of Belawan palm oil (FOB spot port of Belawan) and the price of palm FFB on the market for North Sumatra Province and the Province of Bengkulu.

This study used two models, namely the Autoregressive Conditional Heteroscadasticity - Generalized Autoregressive Conditional Heteroscadasticity (ARCH-GARCH) model and the Autoregressive Distributed Lag (ARDL) model. The ARCH-GARCH model is used to determine the level of volatility in the price of palm oil in the Rotterdam and Belawan markets and the price of FFB in the markets of North Sumatra and Bengkulu Provinces. This model was also used in a study conducted by Mubarokah *et al.* (2022) on soybean commodities, Khoiruddin *et al.* (2021) on the CPO commodity, Puspitasari *et al.* (2019) on the shallot commodity, Pipit *et al.* (2019) on the beef commodity, and Miftahuljanah *et al.* (2020) on the red chili commodity.

ARCH-GARCH model testing is carried out at prices at the Rotterdam, Belawan, North Sumatra Province, and Bengkulu Province levels with the following equation:

$$\sigma^2 HRC_t = \alpha_0 + \alpha_1 \varepsilon^2 HRCPO_{t-1} + \alpha_p \varepsilon^2 HRCPO_{t-p} + \beta_1 \sigma^2 HRCPO_{t-1} + \beta_q \sigma^2 HRCPO_{t-q}$$

$$\sigma^2 HMC_t = \alpha_0 + \alpha_1 \varepsilon^2 HMCPO_{t-1} + \alpha_p \varepsilon^2 HMCPO_{t-p} + \beta_1 \sigma^2 HMCPO_{t-1} + \beta_q \sigma^2 HMCPO_{t-q}$$

$$\sigma^2 PSTB_t = \alpha_0 + \alpha_1 \varepsilon^2 PSTBS_{t-1} + \alpha_p \varepsilon^2 PSTBS_{t-p} + \beta_1 \sigma^2 PSTBS_{t-1} + \beta_q \sigma^2 PSTBS_{t-q}$$

$$\sigma^2 PBTBS_t = \alpha_0 + \alpha_1 \varepsilon^2 PBTBS_{t-1} + \alpha_p \varepsilon^2 PBTBS_{t-p} + \beta_1 \sigma^2 PBTBS_{t-1} + \beta_q \sigma^2 PBTBS_{t-q}$$

Description:

$\sigma^2 HRCPO_t$= The price variance of Rotterdam palm oil t period.

$\sigma^2 HMCPO_t$= The price variance of Belawan palm oil t period.

$\sigma^2 PSTBS_t$ = The price variance of FFB in North Sumatra Province t period.

$\sigma^2 PBTBS_t$ = The price variance of FFB in Bengkulu Province t period.

$\varepsilon^2 HRCPO_{t-p}$, $\varepsilon^2 HMCPO_{t-p}$ = The price of palm oil in Rotterdam and Belawan in the previous period (ARCH element).

$\varepsilon^2 PSTBS_{t-p}$, $\varepsilon^2 PBTBS_{t-p}$ = The price of FFB in North Sumatra Province and the Province Bengkulu in the previous period (ARCH Elements).

$\sigma^2 HRCPO_{t-q}$, $\sigma^2 HMCPO_{t-q}$= Price of palm oil Rotterdam and Belawan previous period (Elements of GARCH).

$\sigma^2 PSTBS_{t-q}$, $\sigma^2 PBTBS_{t-q}$ = Price of FFB North Sumatra Province previous period (Elements of GARCH).

The criterion for the ARCH-GARCH model that must be owned is that the coefficient value in the model must be significant, the sum of the coefficients α and β is less than 1 (α + β < 1). Volatility is said to be low when it shows a value of α + β < 1, it is said to be high when it shows a value of α + β = 1, and it is said to be very high when it shows a value of α + β > 1.

In addition, the ARDL model is used to determine the level of transmission of palm oil prices between the Rotterdam and Belawan markets as well as the price of palm oil FFB in the markets of North Sumatra and Bengkulu. The gene-

ral form of the ARDL model is as follow:

$$HMCPO_t = \beta_0 + \beta_1 HRCPO_t + \beta_2 HRCPO_{t-1} + \beta_3 HMCPO_{t-1} + \varepsilon_t$$

a. ARDL equation from the Rotterdam palm oil market to the FFB market in North Sumatra Province.

$$PSTBS_t = \beta_0 + \beta_1 HRCPO_t + \beta_2 HRCPO_{t-1} + \beta_3 PSTBS_{t-1} + \varepsilon_t$$

b. ARDL equation from the Rotterdam palm oil market to the FFB market in Bengkulu Province.

$$PBTBS_t = \beta_0 + \beta_1 HRCPO_t + \beta_2 HRCPO_{t-1} + \beta_3 PBTBS_{t-1} + \varepsilon_t$$

c. ARDL equation from the Belawan palm oil market to the FFB market in North Sumatra Province.

$$PSTBS_t = \beta_0 + \beta_1 HMCPO_t + \beta_2 HMCPO_{t-1} + \beta_3 PSTBS_{t-1} + \varepsilon_t$$

d. ARDL equation from the Belawan palm oil market to the FFB market in Bengkulu Province.

$$PBTBS_t = \beta_0 + \beta_1 HMCPO_t + \beta_2 HMCPO_{t-1} + \beta_3 PBTBS_{t-1} + \varepsilon_t$$

e. ARDL equation from the North Sumatra FFB market to the FFB market in Bengkulu Province.

$$PBTBS_t = \beta_0 + \beta_1 PSTBS_t + \beta_2 PSTBS_{t-1} + \beta_3 PBTBS_{t-1} + \varepsilon_t$$

Description:
$HRCPO_t$ = Price of Rotterdam Palm Oil t period.
$HRCPO_{t-1}$= Price of Rotterdam Palm Oil in the previous period.
$HMCPO_t$ = Price of Belawan Palm Oil t period.
$HMCPO_{t-1}$= Price of Belawan Palm Oil in the previous period.
$PSTBS_t$ = Price of FFB in North Sumatra Province t period.
$PSTBS_{t-1}$ = Price of FFB in North Sumatra Province in the previous period.
$PBTBS_t$ = Price of FFB Bengkulu Province t period.
$PBTBS_{t-1}$= Price of FFB in Bengkulu Province in the previous period.

RESULT AND DISCUSSION

Analysis of Palm Oil Price Volatility

Table 1 shows the price of palm oil at four market levels which are presented as stationary at the first difference levels.

Table 1 DF test results, best ARIMA model and best ARCH-GARCH model at 4 market levels.

Variable	ADF test First Difference (1)	Best ARIMA Models	Best ARCH-GARCH Models
Rotterdam	0.0000	ARIMA (7,1,2)	GARCH (1)
Belawan	0.0000	ARIMA (8,1,1)	GARCH (1)
North Sumatra	0.0000	ARIMA (12,1,5)	-
Bengkulu	0.0000	ARIMA (1,1,12)	-

The ARCH-GARCH model can be tested if the data contains heteroscedasticity in the best ARIMA model. The ARCH-GARCH model that can be analyzed only on Rotterdam and Belawan palm oil prices. Where the Rotterdam and Belawan palm oil prices have a prob F-statistic value of less than 0.05. The results of the analysis provide the ARCH (1) GARCH (1) model, which is the best ARCH-GARCH model for estimating price volatility in the palm oil market in Rotterdam. The following is a comparison of the ARCH-GARCH model for price data on the palm oil market in Rotterdam.

$$\sigma^2 HRCPO_t = \alpha_0 + \alpha_1 \varepsilon^2 HRCPO_{t-p} + \beta_1 \sigma^2 HRCPO_{t-1} + \beta_q \sigma^2 HRCPO_{t-q}$$
$$\sigma^2 HRCPO_t = 116.8769 + 0.168407 \varepsilon^2 HRCPO_{t-1} + 0.822481 \sigma^2 HRCPO_{t-1}$$

The results of the equation above provide information about the effect of price volatility in the previous period on price movement patterns in the palm oil market in Rotterdam. The high or low volatility of the Rotterdam price variable

is shown by the result of the sum of the ARCH-GARCH coefficient values. Where the total value of the estimated coefficient α-1 + β-1 is 0.990888, meaning that the coefficient value is close to 1. The high price volatility in the palm oil market in Rotterdam is caused by a shortage of palm oil production in various supplying countries, including Indonesia. In September 2021, Indonesia's palm oil production reached 4,176,000 tons, down around 1 percent from August 2021.

The ARCH-GARCH estimation results show the GARCH model (1), which is the best model for estimating price volatility in the palm oil market in Belawan with the following model equation:

$$\sigma^2 HMCPO_t = \alpha_0 + \alpha_p \varepsilon^2 HMCPO_{t-p} +$$
$$\beta_1 \sigma^2 HMCPO_{t-1} + \beta_q \sigma^2 HMCPO_{t-q}$$
$$\sigma^2 HMCPO_t = -21441.79 + 1.072592 \sigma^2 HMCPO_{t-1}$$

From the results of the GARCH model equation (1) on the market price of palm oil in Belawan with a coefficient value of 1.072592, this indicates that the level of volatility in the market price of palm oil in Belawan is relatively high. The high price volatility in the palm oil market in Belawan is caused by a lack of supplies of raw materials for making palm oil. The lack of production of raw material for palm oil is caused by the amount of fertilizer used, the experience of farmers, and the use of seeds. This causes the supply of palm oil FFB to decrease and causes the price of palm oil to increase (Alamsyah *et al.* 2019).

Analysis of Palm Oil Price Transmission Rotterdam Palm Oil Prices – Belawan Palm Oil Prices

The results of the price trans-mission analysis can be seen in Table 2 as follows. Short-term significance test results in the current period and in the

previous period (1 month). The test results obtained the coefficient value at the Rotterdam market level with the Belawan market in the current period of 6.08 > 1. This means that when there is an increase in the price of the Rotterdam palm oil market in the current period of Rp100 it will increase the price on the Belawan palm oil market by Rp608 in the current period. It also indicates that the transmission of the price of palm oil that was formed between the Rotterdam market and the Belawan market in the current period continues perfectly.

Table 2 Analysis results of the palm oil price model in the Rotterdam market with palm oil prices in the Belawan market.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	81.89033	51.69315	0.1160
HRCPO$_t$	6.084461	0.705212	0.0000
HRCPO$_{t-1}$	-2.172687	0.887836	0.0160
HMCPO$_{t-1}$	0.137779	0.096601	0.1566
Long-term			
Constant	66.693064	41.22682	0.1086
HRCPO$_t$	9.197285	1.074794	0.0000

Prices on the Rotterdam palm oil market with prices on the Belawan palm oil market in the previous period obtained a coefficient value of -2.17 < 1, meaning that price changes on the Rotterdam palm oil market in the previous period had a negative effect on prices on the oil market Belawan oil palm. When there was a price increase on the Rotterdam palm oil market in the pre-vious period of Rp100 it will lower the price on the Belawan palm oil market by Rp217. These results also show that the increase in the price of palm oil between the two markets has been imperfectly transmitted.

The long-term estimation results between the price of palm oil at the Rotterdam market level and at the Belawan market level in the current period obtained a coefficient value of

9.20 > 1. These results indicate that when there is an increase in the Rotterdam market palm oil price in the current period of Rp100 it will increase the price of palm oil in the Belawan market by Rp920. The estimation results between the price of palm oil at the Rotterdam market level and the price at the Belawan market level in the long run show a coefficient value of greater than 1, so the process of transmitting the price of palm oil between the two markets continues perfectly.

The transmission of palm oil prices between the Rotterdam market and the Belawan market in the previous period, in the short term, did not continue perfectly. This is probably due to adjustment costs. In line with the research by Sitepu *et al.* (2018) explains that prices are not transmitted imperfectly because there are several additional costs incurred to adjust prices by business actors in accordance with changes in costs, such as costs due to storage in ware-houses.

Rotterdam Palm Oil Prices – North Sumatra Province Palm Oil FFB Prices

The results of the price transmission analysis between the Rotterdam market and the North Sumatra Province market can be seen in Table 3 as follows. Referring to the test results above, price transmission between the Rotterdam market and the North Sumatra Province market in the short term obtained a significance value of 0.0220 with a coefficient value of 0.38 in the current period. A coefficient value of 0.38 indi-cates that the price on the Rotterdam palm oil market has a positive effect on the price on the FFB market for oil palm in North Sumatra Province. That is, in the current period when there was an increase in prices on the Rotterdam palm oil market of Rp100, there will be an increase in the price on the oil palm

FFB market in North Sumatra Province of Rp38. In the long run the price transmission between the Rotterdam market and the North Sumatra Province market has a significance of 0.0219 with a coefficient value of 0.41 in the current period. These results indicate that price changes in the Rotterdam palm oil market have a positive effect on prices on the oil palm FFB market in North Sumatra Province. This means that when the price on the Rotterdam palm oil market increases by Rp100 it will increase the price on the oil palm FFB market in North Sumatra Province by Rp41 in the current period.

Table 3 Results of analysis of the Rotterdam palm oil price model with the FFB price of palm oil in North Sumatra Province.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	0.536674	13.60297	0.9686
HRCPO$_t$	0.379525	0.163470	0.0220
Long-term			
Constant	0.169276	ǀ4.331518	0.9906
HRCPO$_t$	0.408568	0.175767	0.0219

The coefficient value between the price on the Rotterdam palm oil market and the price on the palm oil FFB market in North Sumatra Province in the short and long term shows a coefficient value < 1. So, it can be concluded that the price on the Rotterdam palm oil market both in the short and long term not fully forwarded to the price on the oil palm FFB market in North Sumatra Province. Although the price increases continued, they were carried out slowly and imperfectly. The main problem for some farmers today is the weak negotiation of their production prices. In general, the bargaining power of farmers is weak, so that it becomes one of the obstacles in efforts to increase farmers' income. The weak bargaining position of farmers is

usually caused by farmers' lack of access to markets and limited time, distance, location and market information. Farmers have difficulty selling their products because they do not have their own marketing channels, so farmers prefer to sell their products directly to middlemen (Firmanda *et al.* 2022).

Rotterdam Palm Oil Prices – Bengkulu Province Palm Oil FFB Prices

The estimation results using the ARDL model on price transmission between the Rotterdam market and the Bengkulu Province market are shown in Table 4 below.

Table 4 Results of analysis of the Rotterdam palm oil price model with the FFB price of Bengkulu Province.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	5.640769	5.640204	0.3194
HRCPO$_t$	0.265722	0.070282	0.0003
Long-term			
Constant	6.703143	6.661113	0.3164
HRCPO$_t$	0.513318	0.127790	0.0001

The short-run relationship equation above shows that in the current period the price on the Rotterdam market has a positive effect on the price on the Bengkulu Province market. The value of the price coefficient on the Rotterdam market with the Bengkulu Province market was obtained at 0.27. This shows that when the price on the Rotterdam palm oil market increased by Rp100 then the price on the oil palm FFB market in Bengkulu Province has also increased by Rp27 in the current period. Based on the long-term relationship equation, the value of the price coefficient on the Rotterdam market with prices on the Bengkulu Province market is 0.51. The results of this estimation indicate that the price on the Rotterdam market has a positive influence on the price on the Bengkulu Province market. This means that when

the price on the palm oil market in the Rotterdam market increases by Rp100 in the current period, the price on the Bengkulu Province palm FFB market will increase by Rp51. The coefficient value in both the short and long term has a coefficient value of <1, indicating that the price transmission formed between the Rotterdam market and the Bengkulu Province market is weak. As a result, the weak bargaining position of oil palm FFB farmers in the Bengkulu Province market is related to the various obstacles they face. The price transmission process between the two markets is asymmetric. When the price on the Rotterdam palm oil market increases, it will be passed on to the oil palm FFB farmers in the Bengkulu Province market in a slow and imperfect way. As a result, farmers often face price pressures and uncertainty over relatively high farmer incomes resulting from high price volatility.

This result is in line with the research of Sinaga (2017) which shows that prices in the International Market have no effect and are not perfectly transmitted to palm oil at the Local Farmer Level. One of the reasons is because the international market is more oriented towards the price of palm oil based on quality to be able to compete competitively at the international level for industry and consumption of the people of importer countries rather than the price of palm oil as the main basic ingredient for making palm oil. However, it is undeniable that when the price of palm oil in the International Market rises, this becomes an intensive for palm oil entrepreneurs in increasing exports, or in other words increasing the volume of palm oil exports. This will of course be passed vertically to the palm oil processing plant and eventually to the farm level. This fact strengthens the assumption that the international price of palm oil is an exogenous variable in influencing the price of palm oil commodities, especially at the farm

level in Bengkulu Province.

The Price of Belawan Palm Oil – The FFB Price of Palm Oil in North Sumatra Province

The results of the price transmission analysis can be seen in Table 5 as follows.

Table 5 Results of analysis of the Belawan palm oil price model with the FFB price of palm oil in North Sumatra Province.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	-2.111744	13.61328	0.8770
$HMCPO_t$	0.057701	0.019045	0.0030
Long-term			
Constant	-4.233166	13.684879	0.7576
$HMCPO_t$	0.059815	0.019304	0.0024

The short-term estimation results for the Belawan market price variable with the market price for North Sumatra Province in the current period have a probability value of 0.0030 <0.05. This shows that in the current period the price in the Belawan market has affectted the market price in North Sumatra Province. The value of the price coefficient on the Belawan market with the price on the North Sumatra Province market in the current period is 0.06, indicating that the price in the North Sumatra Province oil palm FFB market in the current period has increased by Rp6, in line with the increase in prices on the Belawan palm oil market of Rp100 in the current period. The estimation results in the long term, the price on the Belawan market with the price on the North Sumatra Province market in the current period has a probability value of 0.0024 <0.05. This means that the price at the Belawan market has an influence on the price on the market in North Sumatra Province. The value of the price coefficient on the Belawan market with the price on the North Sumatera Province

market is 0.06, indicating when the price on the Belawan palm oil market increases the price by Rp100 then the price on the oil palm FFB market in North Sumatra Province will increase the price by Rp6 in the period.

The coefficient value between the price on the Belawan market and the price on the market for North Sumatra Province in the short and long term shows a coefficient value <1. So, it can be concluded that the price on the Belawan palm oil market both in the short and long term is not fully transferred to the price in the oil palm FFB market in North Sumatra Province. Although the price increases continued, they were carried out slowly and imperfectly. The delay in adjusting the price increase between the Belawan market and the North Sumatra Province market was due to the low quality of the FFB produced by the farmers. Oversupply of palm oil FFB is the main reason why many small-holder FFBs are rejected by factories. As a result, oil palm FFB that is stored for a long time causes a decrease in the quality of oil palm FFB and even damages if it is not processed immediately (Nesti *et al.* 2018).

The Price of Belawan Palm Oil – The FFB Price of Palm Oil in Bengkulu Province

The estimation results with the ARDL model in this study can be seen in Table 6 as follows. The test results in the shortterm show that the Belawan market price variable in the current period has a positive influence on the Bengkulu Province market price with a coefficient value of 0.04. This means that when there is a price increase in the Belawan palm oil market in the current period of Rp100 it will increase the price on the oil palm FFB market in Bengkulu Province by Rp4 in the period. In the long run the Belawan market price in the current period has a positive influence on the

market price of Bengkulu Province with a coefficient value of 0.06. This means that when there is a price increase in the Belawan palm oil market in the current period of Rp100 it will increase the price on the oil palm FFB market in Bengkulu Province by Rp6 in the current period. Judging from the coefficient value between the two markets, both in the short and long term, the coefficient value is less than 1. So, it can be concluded that the price on the Rotterdam palm oil market was not fully continued, even though the price increase was continued, but it was done slowly and not perfect. The price increase in the oil palm FFB market in Bengkulu Province occurred because this market acted as a price taker, so that the price of palm FFB formed was determined from the Belawan market (FOB Belawan port). Research results Dewi *et al.* (2017) said that farmers as producers are price takers, where farmers as producers get smaller price changes compared to traders as consumers.

Table 6 Results of analysis of the Belawan palm oil price model with the FFB price of Bengkulu Province.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	2.354225	5.243048	0.6543
$HMCPO_t$	0.040567	0.007466	0.0000
$HMCPO_{t-1}$	0.011860	0.007833	0.1328
Long-term			
Constant	2.769766	6.166435	0.6542
$HMCPO_t$	0.057355	0.012969	0.0000

The Price of FFB for Oil Palm in North Sumatra Province – FFB for Oil Palm in Bengkulu Province

The results of the price transmission analysis can be seen in Table 7 as follows. In Table 7 the short-term relationship shows that in the current period the market price of North Sumatra Province has a positive impact on the market price of Bengkulu

Province. The value of the price coefficient on the market in North Sumatra Province with prices on the market in Bengkulu Province was 0.27.

Table 7 Results of analysis of the FFB price model for oil palm in North Sumatra Province and the FFB price for oil palm in Bengkulu Province.

Variable	Coefficient	Std. Error	Probability
Short-term			
Constant	6.330866	5.995118	0.2932
$PSTBS_t$	0.272859	0.031766	0.0000
Long-term			
Constant	7.405540	5.972370	0.2175
$PSTBS_t$	0.350029	0.050404	0.0000

This means that when there was a price increase on the oil palm FFB market in North Sumatra Province in the current period of Rp100 it will increase the price on the oil palm FFB market in Bengkulu Province by Rp27 in the current period. Based on the results of a long-term relationship, the market price of North Sumatra Province in the current period has a positive impact on the market price of Bengkulu Province with a coefficient value of 0.35. This means that when there was a price increase on the oil palm FFB market in North Sumatra Province in the current period of Rp100 it will increase the price on the oil palm FFB market in Bengkulu Province by Rp35 in the current period. Judging from the coefficient value between the two markets, both in the short term and in the long term, the coefficient value is less than 1. So, it can be concluded that the price in the oil palm FFB market in North Sumatra Province was not fully continued, even though the price increase was continued, but carried out in full. slow and imperfect. One of the factors that caused the price transmission of oil palm FFB between the North Sumatra Provincial market and the Bengkulu Province market was not carried on

perfectly because the products related to price transmission at the market level observed were of the same type. The findings of Mulyani (2021) explain that the fluctuations in the price of palm oil fresh fruit bunches (FFB) are more influenced by the fluctuations in the price of palm oil.

CONCLUSION

Based on the results of the analysis and discussion above, it can be concluded that: (1) The level of price volatility in the Rotterdam and Belawan palm oil markets is high, while the price volatility level in the oil palm FFB markets in North Sumatra and Bengkulu Provinces cannot be analyzed because the data does not contain heteros-cedasticity; (2) The transmission of palm oil prices between the Rotterdam market and the Belawan market both in the short and long term continues perfectly, but the prices on the Rotterdam palm oil market are the same as the FFB market for oil palm in North Sumatra Province.

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