Market Integration between Cooking Oil and Olein Prices in Indonesia

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ABSTRACT— Many analysis related to the market integration between international crude palm oil and cooking oil prices in Indonesia have been carried out, but no one has included the olein price variable. This research used monthly data for the period of January 2016 - April 2022 from the Ministry of Trade, Republic Indonesia and the Commodity Futures Trading Regulatory Agency of the Ministry of Trade. The method utilized is Johansen cointegration, Granger Causality, Vector Error Correction Model (VECM), impulse response and variance decomposition. The results show that there is a long-term integration between variables. In the short term, cooking oil prices are influenced by international olein prices, domestic CPO prices, international CPO prices and cooking oil prices one month earlier. Impulse response analysis shows that shocks to international and domestic olein prices have had a major impact on cooking oil prices. This study also found that the effect of international olein prices is greater than international CPO prices and domestic CPO prices. It is advisable to make a policy related to the price of cooking oil by considering domestic and international price of olein.

KEYWORDS: Agricultural policy, price, crude palm oil.

1. INTRODUCTION

Crude palm oil (CPO) is an important product from Indonesia and used for daily activities [1]. Cooking oil is one of the nine staple goods needed by Indonesian people (Ministry of Trade Regulation No 115/MPP/Kep/2/1998). At the beginning of January 2022 there was an increase in the price of cooking oil ranging from IDR 19,000 to IDR 24,000 per liter (depending on the type of packaging used). Furthermore, on February 1, 2022 the government sets the highest retail price for bulk cooking oil of IDR 11,500 per liter, simple packaged cooking oil IDR 13,500 per liter and premium packaged cooking oil IDR 14,000 per liter [2]. The high price of cooking oil in Indonesia has been in the spotlight from the fourth quarter of 2021 to the beginning of the first quarter of [3].

The Director General of Domestic Trade at the Ministry of Trade said that the increase in cooking oil prices occurred due to a sharp increase in international CPO prices [4]. In addition, the increase in world demand for biofuels (biofuels) from palm oil has also contributed to a decrease in the supply of crude palm oil (CPO) for cooking oil production [5]. The government was trying to stabilize cooking oil prices since cooking oil prices fluctuatin will have an impact on people's welfare.

The government issued several policy instruments to control rising cooking oil prices at the consumer level. These policies include cooking oil subsidies, the domestic market obligation (DMO) and the domestic price obligation (DPO) which require CPO exporters to sell 20% of their export volume for domestic consumption at a price of Rp 9,300/kg. The DPO is also applied to olein-type CPO derivatives, namely Refined, Bleached and Deodorized (RBD) palm olein, which is a raw material for cooking oil, at IDR 10,300/kg. In addition, the government has also set the highest retail price at IDR 11,500/liter for bulk cooking oil and IDR 14,000/liter for premium packaged cooking oil based on Minister of Trade Regulation No. 6 of 2022. During the implementation of the 'one price' policy or cooking oil subsidy in mid-January 2021, there was a shortage of supply at several retailers.

The most consumed cooking oil in Indonesia is produced from crude palm oil (CPO). On the other hand, CPO is one of Indonesia's main export commodities. Palm oil from Malaysia and Indonesia dominate the world palm oil market [6]. On April 28, 2022, the government issued Regulation of the Minister of Trade Number 22 of 2022 concerning temporary prohibition on the export of crude palm oil, refined, bleached and deodorized palm oil, refined, bleached and deodorized (RBD) palm olein and used cooking oil. This policy is expected to overcome the scarcity and reduce the price of cooking oil in the country.

The purpose of this study is to analyze the market integration between cooking oil and olein prices. Market integration is a concept where prices in markets that are separated spatially or at different levels of the market chain are linked by supply and demand mechanisms [7]. Market integration is one indicator of marketing efficiency, especially price efficiency. Market integration in different locations refers to the existence of long-term price relationships. If trade occurs in two different areas and the price in the importing area is proportional to the price in the exporting area plus the necessary costs, then the two markets can be integrated [8]. In addition, an integrated market if changes at one market level are channeled or transferred to other markets. An efficiently integrated market system will have a positive relationship between prices in different market areas [9].

Research on price integration in the CPO and palm cooking oil markets in Indonesia has been cunducted by [10], [11] and [12]. [11] used three variables (cooking oil price, domestic CPO price and international CPO price). While [10] used similar variables but different model. In addition [12] used cooking oil price and international CPO price variables to test the existence of long run relationship.

In contrast to previous studies, this study used olein price variable which is a CPO derivative product to produce cooking oil. This research also conducted an impulse response analysis as well as variance decompositions which can estimate the effect of cooking oil, CPO and olein price shocks on cooking oil prices for the next 10 months. In addition, The results of this study will be useful to determine the determinants that affect changes in cooking oil prices in Indonesia.

2. METHODS

This study utilized monthly data from January 2016 - April 2022. The cooking oil price data was taken from the Indonesian Ministry of Trade. The cooking oil referred to in this study is bulk cooking oil. Prices for international crude palm oil (CPO) and olein were collected by the Commodity Futures Trading Supervisory Agency (Bappebti) of the Ministry of Trade. Domestic CPO and olein prices refer to spot prices at Belawan Port, while international CPO and olein prices refer to Rotterdam prices. The model used is the Vector Error Correction Model (VECM). The steps taken include:

1. Stationarity Test
   Time series data are generally not stationary, even though the econometric method used is based on stationary assumptions. If a time series data is not stationary, statistical analysis tests on the data will be imprecise and can produce spurious results [13]. The stationarity test in this study used the Augmented Dickey Fuller (ADF) unit root test and was estimated according to what was suggested [14].
2. Cointegration Test.
   This test was conducted to determine the integration between variables. Cointegration test in this study uses the Johansen cointegration test, where this test can be used to see the number of cointegration (cointegration rank) between variables [15]. Whether cointegration exists is based on the likelihood ratio (LR) test. If the calculated value of LR is greater than the critical value then there is cointegration of a number of variables and vice versa if the calculated value of LR is less than the critical value then there is no cointegration.
3. Vector Error Correction Model (VECM)
   VECM is used when the variable is not stationary at the level but is stationary at the same level of differentiation and is cointegrated. VECM measures how price deviations can return to a state of equilibrium [16]. The VECM model used in this study is as follows:

$$\Delta \ln PMG_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \ln PMG_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta \ln PDCPO_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta \ln PWCPO_{t-i} + \sum_{i=1}^{n} \alpha_{4i} PDOLE_{t-i} + \sum_{i=1}^{n} \alpha_{5i} PWOLE_{t-i} + \alpha_6 ECT_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta \ln PDCPO_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln PMG_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta \ln PDCPO_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta \ln PWCPO_{t-i} + \sum_{i=1}^{n} \beta_{4i} PDOLE_{t-i} + \sum_{i=1}^{n} \beta_{5i} PWOLE_{t-i} + \beta_6 ECT_{t-1} + \omega_t \quad (2)$$

$$\Delta \ln PWCPO_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta \ln PMG_{t-i} + \sum_{i=1}^{n} \delta_{2i} \Delta \ln PDCPO_{t-i} + \sum_{i=1}^{n} \delta_{3i} \Delta \ln PWCPO_{t-i} + \sum_{i=1}^{n} \delta_{4i} PDOLE_{t-i} + \sum_{i=1}^{n} \delta_{5i} PWOLE_{t-i} + \delta_6 ECT_{t-1} + \gamma_t \quad (3)$$

$$\Delta \ln PDOLE_t = \sigma_0 + \sum_{i=1}^{n} \sigma_{1i} \Delta \ln PMG_{t-i} + \sum_{i=1}^{n} \sigma_{2i} \Delta \ln PDCPO_{t-i} + \sum_{i=1}^{n} \sigma_{3i} \Delta \ln PWCPO_{t-i} + \sum_{i=1}^{n} \sigma_{4i} PDOLE_{t-i} + \sum_{i=1}^{n} \sigma_{5i} PWOLE_{t-i} + \sigma_6 ECT_{t-1} + \omega_t \quad (4)$$

$$\Delta \ln PWOLE_t = \varepsilon_0 + \sum_{i=1}^{n} \varepsilon_{1i} \Delta \ln PMG_{t-i} + \sum_{i=1}^{n} \varepsilon_{2i} \Delta \ln PDCPO_{t-i} + \sum_{i=1}^{n} \varepsilon_{3i} \Delta \ln PWCPO_{t-i} + \sum_{i=1}^{n} \varepsilon_{4i} PDOLE_{t-i} + \sum_{i=1}^{n} \varepsilon_{5i} PWOLE_{t-i} + \varepsilon_6 ECT_{t-1} + \eta_t \quad (5)$$

where
PMG_t = cooking oil price in period t
$PDCPO_t$= domestic CPO price in period t
$PWCPO_t$= international CPO price in period t
$PDOLE_t$ = domestic olein price in period t
$PWOLE_t$ = international olein price in period t

4. Granger Causality Test
   Granger causality test was conducted to determine the reciprocal relationship between the two variables. In other words, this test looks at the causal relationship between one variable and another. This is done because each variable in the study has the opportunity to become an endogenous or exogenous variable
5. Impulse Response Function Analysis
   This analysis was conducted to estimate the effect of exogenous variable price shocks on cooking oil prices. Impulse response analysis is required in the estimation of VAR/VECM because individually the coefficients in the VAR/VECM model are difficult to interpret. The use of impulse responses can help researchers to track shocks for several future periods [17].
6. Analysis of Variance Decompositions
   Variance decomposition is used to predict the percentage contribution of the variance of each variable due to changes in certain variables in the VAR/VECM system [17].

3. RESULTS AND DISCUSSIONS

The stationarity test was carried out on all variables using the Augmented Dickey Fuller (ADF) unit root test and the results can be seen in Table 1. The table shows that all variables are stationary at the first level or I(1).

Table 1. Augmented Dickey Fuller (ADF) Test Results

Variable	*Level*		*Fist Difference*	
	ADF test	Prob	ADF test	Prob
Ln domestic cooking oil price (LPMG)	-0.404	0.902	-11.097	0.000
Ln domestic CPO price (LPDCPO)	-0.298	0.920	-8.170	0.000
Ln international CPO price (LPWCPO)	-0.460	0.892	-7.745	0.000
Ln domestic olein price (LPDOLE)	-0.805	0.812	-10.152	0.000
Ln international olein price (LPWOLE)	-0.569	0.871	-7.806	0.000

The next stage is to test whether there is a long-term relationship or cointegration between variables. The method used is Johansen Cointegration by calculating trace statistics and Max Eigen. The results show that there is a long-term relationship (cointegration) between variables (Table 2). This is in line [11] which states that in the long run the price of cooking oil is influenced by international CPO prices as well as by domestic CPO prices. On the contrary [10] found that there was no long run relationship between international and domestic prices of CPO.

The integration of CPO and cooking oil occurs because most of the companies in the cooking oil industry are related to CPO processing companies. [18] concluded that as much as 68% of the palm cooking oil industry is integrated with the upstream industry and CPO processing. The strong link

between cooking oil prices and international CPO prices indirectly indicates the behavior of the CPO processing industry which prioritizes CPO exports rather than meeting the needs of the palm cooking oil industry.

Table 2. Cointegration Test Result

H_0	Eigen Value	Trace Statistik	Prob	Max-Eigen Statistic	Prob
r=0	0.521	92.296	0.002	56.733	0.000
r=1	0.214	35.563	0.696	18.504	0.533
r=2	0.134	17.059	0.884	11.039	0.746
r=3	0.048	6.019	0.949	3.810	0.966
r=4	0.028	2.209	0.736	2.209	0.736

The short-run relationship is shown in Table 3. In the short run, cooking oil prices are influenced by international olein prices, domestic CPO prices, international CPO prices and cooking oil prices one month earlier. [11] states that international CPO price influenced directly the domestic CPO price and also indirectly influenced the cooking oil price through CPO domestic price. Nonetheless, the R^2 obtained shows that 73.7 percent of the price of cooking oil is influenced by variables other than these variables. In the short term, the price of domestic olein does not affect the price of cooking oil.

Table 3. VECM results

Independent Variables	Dependent Variables				
	D(LPWOLE)	D(LPDOLE)	D(LPDCPO)	D(LPWCPO)	D(LPMG)
CointEq1	-0.011	-0.000	-0.105***	-0.041*	-0.038***
	[-0.461]	[-0.004]	[-3.392]	[-1.508]	[-3.609]
D(LPWOLE(-1))	-0.327	0.611	0.427	-0.016	0.338**
	[-0.858]	[1.219]	[0.886]	[-0.038]	[2.055]
D(LPDOLE(-1))	-0.233	-0.790***	-0.717***	-0.288	-0.086
	[-1.374]	[-3.543]	[-3.343]	[-1.529]	[-1.179]
D(LPDCPO(-1))	0.189	0.551***	0.215	0.356*	0.201***
	[0.982]	[2.181]	[0.883]	[1.667]	[2.426]
D(LPWCPO(-1))	0.378	-0.226	-0.009	-0.132	0.465***
	[1.056]	[-0.480]	[-0.019]	[-0.333]	[3.009]
D(LPMG(-1))	0.216	0.211	0.282	0.196	0.172*
	[0.904]	[0.671]	[0.933]	[0.739]	[1.667]
R^2	0.078	0.216	0.208	0.054	0.263

Number in parenthles indicates t-statistic

To see the relationship between variables used the Granger Causality test. The results show that there is a reciprocal relationship between domestic olein prices and domestic CPO prices (Table 4). This means that the two prices mutually influence each other. This finding is in line with research by [19] which suggests that domestic CPO price fluctuations are heavily influenced by international CPO prices.

The cooking oil price is influenced by international CPO price, domestik CPO price international olein price. This is appropiate with [20] which suggests that cooking oil prices in Indonesia are influenced by international CPO prices. An increase in international CPO prices can spur Indonesian CPO exports and result in reduced domestic CPO supply. If the supply of domestic CPO decreases, the cooking oil processing industry will experience a shortage of raw materials and cause the cooking oil price, which is a CPO derivative product, to become expensive. The availability of palm cooking oil in the market must

be guaranteed, therefore, the government must implement policies related to the supply of domestic CPO for the palm cooking oil industry [21]. The step taken by the Indonesian government is to implement an export policy to anticipate a shortage of domestic CPO. Despite the fact that [22] shows that the implementation of export taxes by Indonesia had a more positive impact on increasing government revenues than reducing the price of Indonesian palm cooking oil.

Table 4. Granger Causality Test Results

Independent Variable	Dependent Variable				
	D(LPWOLE)	D(LPDOLE)	D(LPDCPO)	D(LPWCPO)	D(LPMG)
D(LPWOLE)		1.486	0.785	0.001	4.223**
D(LPDOLE)	1.887		11.174***	2.336	1.390
D(LPDCPO)	0.965	4.756***		2.778*	5.884**
D(LPWCPO)	1.116	0.230	0.000		9.057***
D(LPMG)	0.817	0.450	0.870	0.545	

Impulse response analysis is used to estimate the effect of exogenous variable price shocks on cooking oil prices. [12] suggests that there is price transmission between international CPO price and cooking oil price in Indonesia. Price changes on the international CPO market will be fully transmitted to the cooking oil market in Indonesia in the long term, and takes 4.8 months in the short term.

In cooking oil, shocks to world and domestic olein prices have had a major impact. The same thing is found in the short term where domestic and international olein prices affect changes in cooking oil prices in Indonesia. The effect of international olein price shocks is greater than that of domestic olein prices (Figure 1 and 2).

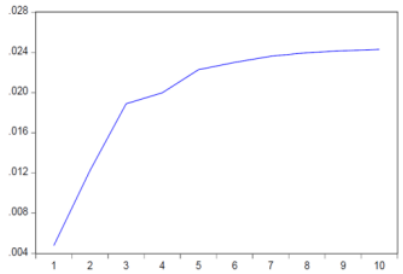

Figure 1. The Effect of International Olein Price Shocks on Domestic Cooking Oil Prices

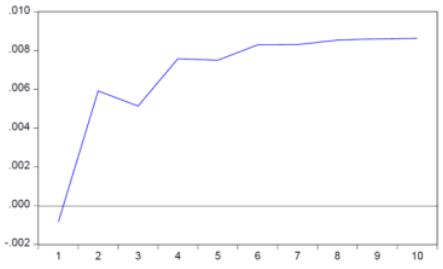

Figure 2. Effect of Domestic Olein Price Shocks on Domestic Cooking Oil Prices

Analysis of variance decompositions shows that fluctuations in the price of cooking oil are mostly due to the price of the cooking oil itself (Figure 3. This happened until the tenth month. Apart from the price of cooking oil itself, the price of domestic CPO made a big contribution in the first month. The international CPO price has a big effect in the second month but this influence gets smaller in the following months. This is in line with the research results of [10] which stated that in the first month after the international CPO price shock occurred, a new response emerged from the international CPO price itself, while the domestic cooking oil price did not respond immediately. The new cooking oil price response will appear after the second month and reach its peak after the third month. The impact of the shocks gradually disappeared and stabilized after the tenth month.

The impact of these shocks on the price of cooking oil was not as big as the impact that appeared on the international CPO price itself [10]. When there is a shock to the international CPO price of 1 standard deviation, the biggest impact on cooking oil prices is 0.03 standard deviation. This figure is much smaller than the impact on the price itself, which is 0.07 standard deviation.

An increase in the international CPO price will be responded more quickly, namely with a correction of 0.20% each month, while a decrease in the international CPO price will be responded to more slowly, namely with a correction of 0.14% each month. As a result, cooking oil prices will increase faster when there is an increase in international CPO prices, but tend to fall more slowly when international CPO prices fall [10].

In the third month there was a change. International olein prices occupy the second position which influences cooking oil price fluctuations. This continues until the tenth month. The government's policy of banning the export of CPO and olein as raw materials for cooking oil will cause the international supply of CPO and olein to decrease considering that Indonesia is the world's main exporter of CPO and olein. The decrease in supply will increase the international CPO price. Based on the results of this study, an increase in international CPO prices will result in an increase in the price of cooking oil in Indonesia. In other words, the policy of banning the export of CPO and olein will further increase the price of cooking oil in Indonesia.

This study also found that the effect of international olein prices is greater than international CPO prices and domestic CPO prices. An alternative effort that can be made by the government is to increase olein exports so that olein supply increases and international olein prices can decrease. The government needs to divert exports from CPO to olein. This will also provide more added value from processing CPO into olein.

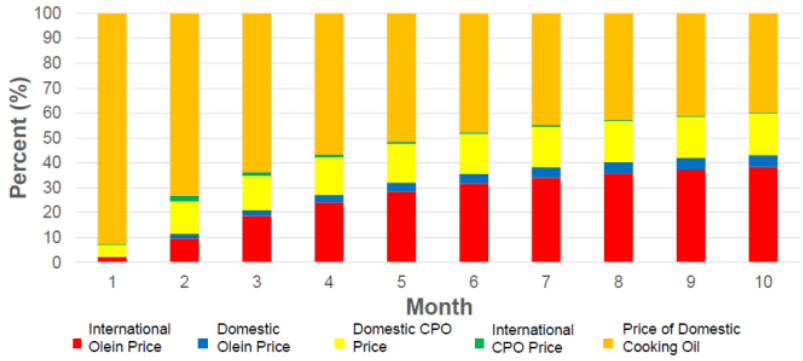

Figure 3. Variance Decompositions Results

4. CONCLUSION

There is long-term integration between cooking oil price variables, domestic olein prices, international olein prices, domestic CPO prices, and international CPO prices. In the short term, cooking oil prices are influenced by international olein prices, domestic CPO prices, international CPO prices and cooking oil prices one month earlier. Impulse response analysis shows that shocks to world and domestic olein prices have had a major impact on cooking oil prices. The influence of international olein prices is greater than international CPO prices and domestic CPO prices. It is advisable to make a policy related to the price of cooking oil by considering domestic and international olein prices.

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