

Article

Price Competition and Shifting Demand: The Relation between Palm and Coconut Oil Exports

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Abstract: Despite having a strong production capacity for fresh coconut, Indonesia has a certain deficiency in coconut processing, particularly coconut oil products, which is reflected in the declining market demand rates. The skyrocketing price of palm kernel oil (PKO) had been observed to impact the shifting demand for coconut oil. The cross-price competition with PKO was estimated to uncover the potential market demand for Indonesian coconut oils, especially during the periods of price discrepancies between 2020 and 2022. Thus, our study aimed to analyze the Indonesian coconut oil and palm kernel oil (PKO) market relationship as the markets reacted during the period of price volatility. This study is essential for Indonesian market evaluation, as both commodities are considered to be perfect substitute goods and are similar substances that contain high levels of lauric acid called “lauric oils”. We deployed an ARDL analysis utilizing secondary data from 1964 to 2022, focusing on the cross-price elasticity between coconut oil and PKO prices with the addition of prominent concerned variables. In the long-term estimations, the observational results indicated that the coconut oil and PKO prices had distinctive impacts on Indonesian coconut oil exports of -1.85% and 1.88% , respectively. In the short-term estimations, we found inverse values: the coconut oil price had positive impacts in the short-term period of 1.29% (D1.) and 2.35% (LD.), while the PKO had a negative impact on Indonesian coconut oil exports of -2.17% . This indicated that a PKO price reduction would increase the demand for Indonesian coconut oil exports due to the PKO price volatility and uncertainty perceived by the buyers in the short term. Our study also observed that rival producers, such as the Philippines, had a negative impact (-1.80%), representing the intense competition between Indonesia and the Philippines. Therefore, the Indonesian government has to elevate its coconut oil competitiveness to acquire the potential to expand the market and compete with other major coconut-producing countries.

Keywords: coconut oil; palm kernel oil; price competition; demand-shifting behavior; ARDL



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1. Introduction

Among the ASEAN countries, Indonesia and the Philippines play roles as the world’s main coconut exporters, producing approximately 17 million tons and 15 million tons, respectively [1], and sharing about 73% of the total world coconut production. The coconut markets have accelerated, due to not only the raw material but also the processing needs, thanks to its versatility, which makes it appealing to various exporters. The two most promising coconut-processing derivatives are coconut oil and copra, which dominate the coconut-processing sector [2]. In fact, coconut production is a major economic driver in Indonesia through its annual export contributions. Based on Indonesian statistics, the export value of all coconut products accounted for as much as USD 1.6 billion in 2021 through the export of 2 million coconut products [2].

Despite having a strong fresh-coconut production capacity, Indonesia has seen a declining rate of coconut oil processing exports, from 831 tons in 2011 to only 650 tons in 2022 [3].

This downward export trend is due to the cross-price competitive relationship with other substitute lauric oils, like palm kernel oil (PKO). Confidentially, buyers have a profit-seeking orientation and commonly purchase lower-priced goods, and it is estimated that PKO has better price competitiveness. Thus, the cross-price competition with PKO has been identified as a challenge for Indonesian coconut oil producers. Moreover, in addition to the market access, the production has a similar weakness. Compared to the Philippines, with a higher competitive advantage in coconut oil processing, Indonesia has been facing a lack of production capacity as well as productivity. The Philippines produced almost 1 million tons of coconut oil for export, compared to only 600 thousand tons produced in Indonesia [2].

The authors of Darusman [4] observed the fluctuations in Indonesian coconut oil exports, due to reasons such as the coconut oil export price, GDPs of importing countries, real exchange rate, and, in particular, its international demand. A report from the International Coconut Community (ICC) assessed the relation between coconut and palm oil prices [5], demonstrating that the skyrocketing PKO prices not only put pressure on its own price but also impacted the shift in demand from palm kernel oil to coconut oil (Figure 1). The US market, which is becoming a major world oil importer, has had an intense demand shift to coconut oil (CO) from 5% to an upsurge of 35% growth in the most recent year. In contrast, there was a decrease in the demand for palm kernel oil (PKO) from 1% to $-20%$ from 2020 to 2021. An identical result is being experienced by the Indonesian government, which relishes the increase in coconut oil exports. The skyrocketing PKO prices have increased the trade volume of Indonesian coconut oil to two major importers: China and the US, from USD 309 million and USD 472 million in 2020 to USD 583 million and USD 747 million in 2021, respectively (Observatory of Economic Complexity (OEC)) [6].

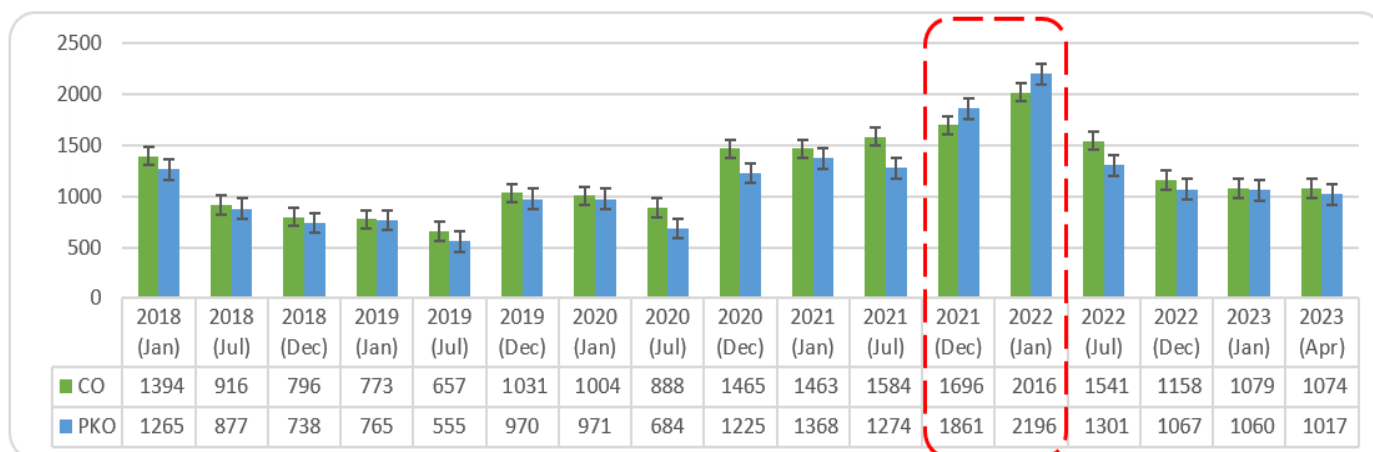


Figure 1. Price trend of international lauric oil market (source: World Bank [7]). Note: PKO price (USD/ton) volatility during 2021–2022 over CO price in short-run period (red line).

As in Figure 1, we assumed that both price relationships could become market distinctions for Indonesian coconut oil producers to capture the demand potential in international markets. The price relationship, interestingly, induces a market demand shift, as well as a potential market opportunity for Indonesian coconut oil. As both commodities typically could perform as substitutions regardless of the functions, the price instrument is the key factor influencing the demand, in addition to the health value of coconut oil. The fundamental theory of the price elasticity of substitute goods might be the motive behind the demand shift in a particular good [8], and these price elasticity characteristics are essential to understanding the impact of policy interventions on agricultural market demands [9].

Generally, various studies have elucidated the competitiveness of palm oil prices over other vegetable oils, as confirmed in Schmidt [10]. The authors of Tandra [11] note that palm oil is essentially used in the manufacture of a variety of daily products and is highly competitive over vegetable oils. In another study [12], the authors note that palm oil has a unique selling point (USP) advantage, whereby buyers in emerging markets,

such as China, India, and Nigeria, generally do not buy palm oil for the flavor but for the cheap price instead. However, several challenges in the palm industry have hampered the potential of producing countries, such as Indonesia, to exploit higher export values, including price fluctuations, as well as the environmental “black campaign”. A vast majority of environmental organizations and economic unions, such as the European Union (EU), have expressed concern about the environmental degradation due to palm production and deforestation, resulting in several cases of the banning of exports from producing countries [13,14]. As a consequence, the market supply has dropped, which has impacted the prices in the international palm oil markets, shifting to a downward demand. Therefore, the complexity of the recent palm kernel oil situation might present the Indonesian government with the opportunity to maximize coconut oil market expansion, especially during periods of price discrepancies between the two commodities, given the international price fluctuations. Substitutions among vegetable oils could be reflected by the calculation of the cross-price elasticity. An extensive study [15] examined the cross-price elasticity between palm and soy oil, which resulted in a positive relation, indicating that an increase in the soy oil price could lead to a proportional rise in the palm oil supply.

In [16–18], the authors reviewed the relation between the cross-price elasticities among vegetable oils, which could intervene in the demand shift for respected oil goods; however, none of them estimated a clear relation between coconut oil and palm kernel oil (PKO). In this study, we aimed to analyze the market relationship between the PKO and coconut oil prices to assess the potential effect of Indonesian producers on the coconut oil demand. The substitution selection between palm kernel oil (PKO) and coconut oil was due to their close substitution relationship, as both have been categorized as “lauric oils”, which are commonly used in similar market segments: (1) food and beverage industries, (2) pharmaceuticals, and (3) personal care and cosmetics. Thus, due to the continuous acceleration of these particular industries, the market demand for lauric oils is ascending, of which coconut and PKO oils are the main substances.

2. Previous Studies

2.1. Effect of Cross-Price Elasticity on the International Vegetable Oil Trade

It has been asserted that price elasticity is a prominent factor that affects trade both nationally and internationally. Vegetable oil exports and imports could be determined via the international price elasticity, including its relation to substitute goods, making the cross-price elasticity a potential motive for a shift in demand. Studies have revealed this relationship in the cross-price elasticities among vegetable oils, including [15], who exposed a positive cross-price elasticity relationship between the soy and palm cross-price elasticity using the ARDL analysis, suggesting that an increase in the soy oil price would have a considerable impact on palm oil imports in the US. Rifin [19] asserts that the palm and soybean oil in the world market are substitutable only in the long term, which was the same result as that in another Rifin’s study [20], in which it was found that the cointegration among soybean, rapeseed, and palm oil existed in a long-term relation. The majority of scholars have focused on the price relation of soybean and palm oil, as these depict the common substitution effects for the vegetable oils, and have found similar results for the cross-price elasticity [21,22]. Taheripour states that cross-price elasticity could occur due to national policy (i.e., the US palm oil imports as a consequence of national soy oil biodiesel expansion) [23]. Another extensive study on Malaysian palm oil prices [24] concerned several factors that impact Malaysian palm oil exports pertaining to the price of substitute products, along with other factors, such as the local palm price and the exchange rate.

In the aforementioned studies, scholars mostly explored estimations of the palm and soy oil relation, as these commodities represent the majority of the world vegetable oil demand, dominating around 50% of the world vegetable oils, with 76 and 60 million tons of total consumption worldwide for palm and soy oil, respectively [25]. However, the rising trends among countries in health care and certain chemical industries, such as cosmetics and personal care (as depicted in Figure 2) have initiated changes in consumer preferences

towards organic and essential oils; thus, the escalation in the use of coconut oil cannot be confined. These industrial escalations require particular lauric acid oil substances, normally contained in PKO and coconut oil, or alternative vegetable oils, such as soy and crude palm oil (CPO); there are different raw material substances for different market segments.

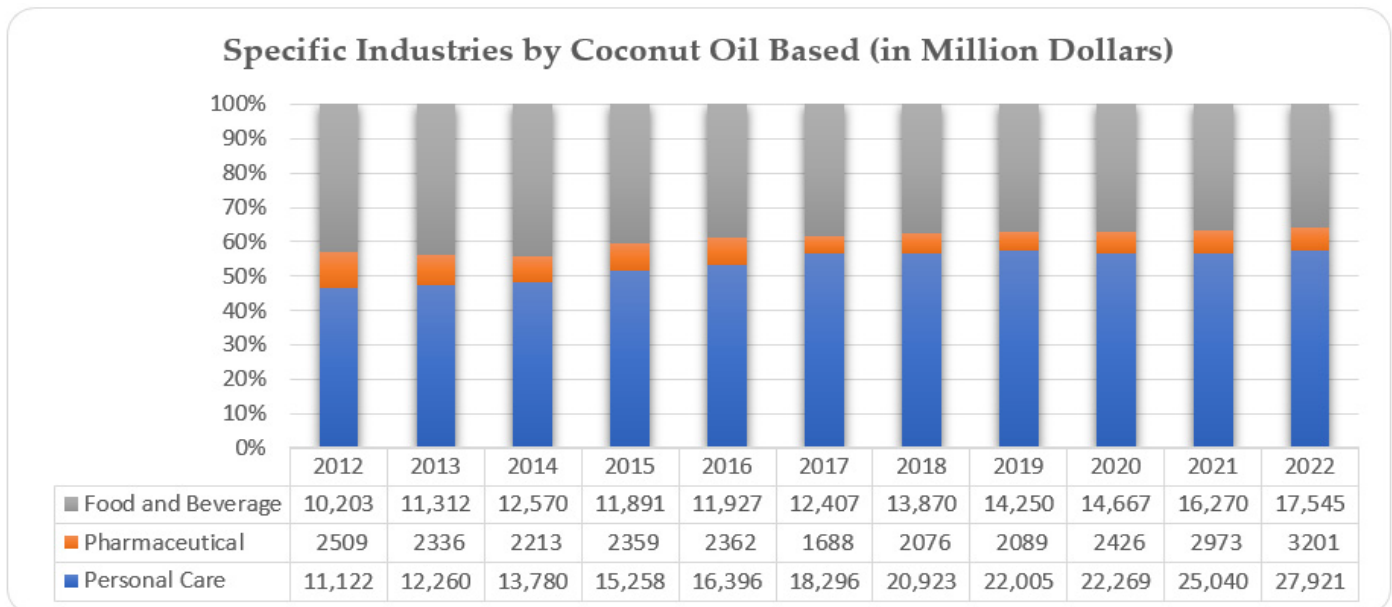


Figure 2. Rising industries that require coconut-oil-based substances (OEC source: [6]).

Therefore, a study on the coconut oil price competition with other lauric acid oil substitutions, in this case, palm kernel oil (PKO), could have policy implications for the Indonesian government as the major producer of both commodities. Especially amid the price spiking of palm oil, the government could potentially generate additional export earnings through coconut oil exports instead of relying so heavily on the palm oil industry. Accordingly, we attempted to measure the cross-price elasticity between both commodities, as coconut oil (CO) and palm kernel oil (PKO) are considerably suitable substitutions, and as they are similar substances that contain high levels of lauric acid [26], named “lauric oils”, and are used in food and non-food industries, including in cosmetics, lubricants, and others.

2.2. Determinant of Coconut Oil Export Markets

Indonesia has a profound comparative advantage in terms of coconut production, ranking first for fresh coconut (in-shell) production. Moreover, it is second in coconut oil processing after the Philippines, producing around 599 thousand tons of coconut oil, compared to 965 thousand tons in the Philippines [27]. Anggrasari [28] explains that Indonesia is a frequent exporter and a country that specializes in selling coconut oil. Indonesian coconut oil competitiveness is mainly supported by the national copra production volume; however, new market producers could be the barrier to extracting more export value [29]. Based on empirical studies, the determinant factors that influence Indonesian coconut oil exports are as follows: (1) the price of coconut oil; (2) the real exchange rate; (3) the total import value of accomplice nations; (4) the populations of the importing partners; (5) the GDP; (6) the availability of substituted goods; (7) the oil price; and (8) the economic crisis situation [30]. In addition, Darusman [4] recognizes the Indonesian palm oil (CPO) export price and the Philippine coconut oil export price as significant factors that affect coconut oil exports. Turukay observed soybean oil, [31] elucidating the identical factors, sharpened by the soybean oil price and RCA index (which revealed a comparative advantage) as the influential determinants. According to Tanago et al. [32], the factors could vary across countries; they found several distinct outcomes between Indonesian and Philippine coconut oil exports, such as the nation’s GDP leading to higher Indonesian export values; however,

it had no impact on the rival country. Moreover, the finding by Rosyidi [33] indicates that the partner-country GDP could lead to positive export increases in Indonesian agricultural commodities, along with their commodity prices; however, the exchange rate has an adverse impact. In contrast, the price of coconut oil would inversely affect the demand side in the partner country, as studied by Ximenes [34,35]. Therefore, in order to intensify the export performance of a specific targeted country, the role of the government has to cover its demand behavior related to the trade openness of the importing countries [36].

Accordingly, based on these studies, such variables could be significantly estimated to determine Indonesian coconut oil exports depending on the supply-and-demand perspective, as well as on the entrance of rival-country exporters into the market. Therefore, given the development of the world lauric acid oil demand, we attempted to evaluate the export performance of Indonesian coconut oil by analyzing the price relationship between PKO and coconut oil in the markets, with the addition of the impact of the rival-country factor, which, in this case, was the coconut oil production in the Philippines, as a major world coconut oil exporter. Finally, this study aimed to depict the potential position of Indonesian coconut oil exports by estimating the cross-price elasticity between coconut oil and PKO oil amid the price fluctuation in palm kernel oil (PKO) as a source of the coconut oil export potential.

3. Materials and Methods

3.1. Data Types and Sources

ARDL Data Source Model: Price Relation Model of Coconut Oil Exports

This study aimed to explore the demand-shifting potential during a period of price discrepancies between palm kernel oil (PKO) and coconut oil (CO), particularly between 2021 and 2022. Indonesia, as a main producer of both palm and coconut, has to examine the market behavior towards these oils, where palm has frequently encountered massive market volatility due to drastically skyrocketing prices in the short term. Hence, as a producer, the Indonesian government is encouraged to evaluate the market-seeking potential for coconut oil, especially during periods of high palm oil market volatility, as it is an alternative to export earnings. We expected that the sensitive palm oil market behavior could potentially uncover the extensive demand for coconut oil in international markets, as PKO and CO are relatively substituted goods, given that they are “lauric oil” acid substances for specific goods. Thus, we attempted to estimate this relationship, particularly in the context of skyrocketing palm oil prices during the short period of 2021 and 2022. In addition, the rise of specific industries (e.g., personal care and cosmetic brands (depicted in Figure 2)) could notably increase the coconut oil market demand during the market decline in the PKO commodity.

With regard to the situation in Figures 3 and 4, we estimated both oil relationships using the ARDL analysis and secondary time series data from 1964 to 2022, focusing on the cross-price elasticity factors of the relationship between the prices of (1) coconut oil and (2) palm kernel oil (PKO), and whether the decreased price discrepancies and fluctuations encouraged the shift in the demand for both goods in the international markets. Along with the prices, we added several variables that have been estimated to have enormous impacts on Indonesian coconut oil exports, such as (3) the coconut oil production, (4) the real GDP of Indonesia, and (5) the real exchange rate between the Indonesian Rupiah (IDR) and the US Dollar (USD). In the previous studies mentioned above, some scholars focused on the GDP of the export nation, while others focused on the exchange rate, which is fundamental to the determination of the purchasing decisions of partner countries. However, there is a lack of studies with estimations on the cross-price elasticity variable for specific coconut oil and PKO products; instead, most scholars generally estimate the comparison between saturated oils (for instance, palm oil (CPO)) and other vegetable oils, like soybean oil. Therefore, this study covers new insights into the relationship between two specific “lauric oils”, which are especially linked in the recent growth of particular industries, such as the personal care, food and beverage, and pharmaceutical industries, and which could elevate the position

of the Indonesian coconut oil export potential. Moreover, to consistently calculate the export value, this study entailed the provision of the rival-country export supply; thus, we involved (6) the coconut oil export volume of a rival country, in this case, the Philippines, ranked first among world coconut oil exporters. We attempted to estimate whether the magnitude of the Indonesian rival-country performance could also essentially determine Indonesian coconut oil exports, as both countries have relatively similar coconut cultivation practices to support coconut oil processing.

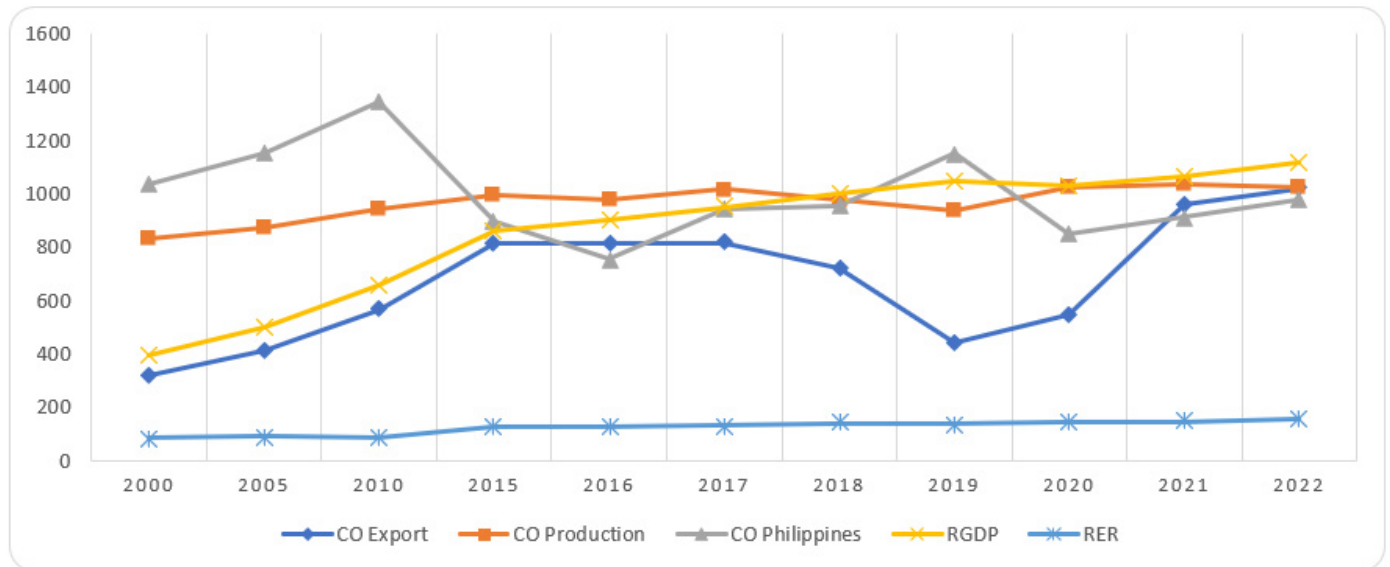


Figure 3. Observed data trend (sources: FAO [27,37,38]). Note: CO Export: coconut oil export (USD million); CO Production: coconut oil production (1000 tons); CO Philippines: coconut oil production in the Philippines (1000 tons); RGDP: Indonesian real GDP (USD trillion); RER: real exchange rate (IDR/USD divided by 100 points).

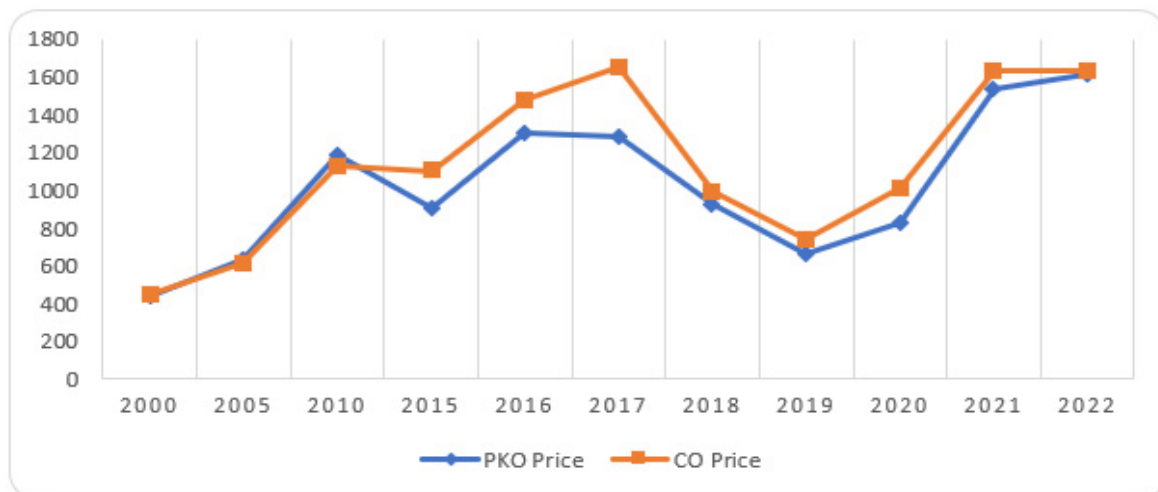


Figure 4. Price competition trend of PKO and coconut oil (USD/ton) (source: World Bank [39]).

The data to estimate the short- and long-term dynamic impacts among the variables varied from 1964 to 2022. The data were collected from the World Bank (pink-sheet data) [39] for the coconut oil and PKO prices, and the coconut oil export value was generated from FAOStat statistics FAO [27]. The real GDP [37] and real exchange rate [38] were collected from World Economics and World Bank data, respectively, as explained in Table 1.

Table 1. Variable definitions for the ARDL model of Indonesian coconut oil exports.

No.	Exogenous Variables	Description	Source	Expected Result	Studies
1.	Coconut Oil Price	The annual price of coconut oil, 1964–2022	World Bank [39]	(+/-)	[28–30,34,35]
2.	PKO Price	The price of palm kernel oil (PKO) on an annual basis from 1964 to 2022	World Bank [39]	(+)	[4,15,19–24]
3.	Coconut Oil Production	The total coconut oil production of Indonesia on an annual basis	FAOStat [27]	(+)	[29,30]
4.	Indonesian Real GDP	The real GDP value of Indonesia on an annual basis	World Economics [37]	(+)	[30,32]
5.	Real Exchange Rate	The real exchange rate between IDR and USD	World Bank [38]	(+/-)	[30]
6.	Coconut Oil Exports of the Philippines	The total coconut oil exports (volume) of the rival country, the Philippines, as an indicator of international supply	FAOStat [27]	(-)	[29,32]

3.2. Methods

3.2.1. ARDL Model: Price Relation Model of Indonesian Coconut Oil Exports

In this study, we referred to the pioneering work of Kuwornu et al. [40], who assessed the export determinants of coconut products, and to that of Abdulrahman [41], who expanded the analytical method perspective by using the autoregressive distributed lag (ARDL) analysis to estimate the time-series phenomenon in agricultural export cases. In addition, the work of Ghimire et al. [42] introduces a desirable modeling approach to estimating the short- and long-term economic growth relationships via the ARDL model. The ARDL model fits the investigation of such phenomenon over time. Pesaran and Shin (1998), as reported by Kripfganz et al. [43], emphasize that ARDL can accommodate a mixture of stationarity variables, stationer or non-stationer, without any required need for pretesting the order of integration, in addition to its robustness in terms of the consistent estimation of the short- and long-term coefficients in such a simple way.

3.2.2. ARDL Cointegration Testing in the Model

The ARDL model for testing cointegration (the ARDL bounds test) was employed to examine the model [44], whether the variables were stationer at level or the first difference (I(0) or I(1)) or mutually cointegrated (I(0) and I(1)), allowing for the simultaneous testing of the long-term and short-term relationships among them. The application of the ARDL bounds tests involved testing for the presence of a long-term relationship, in this study, based on the log linear form, by using the dynamic unrestricted error correction model (UECM) to integrate the short-term relationship with the long-term equilibrium [44,45]. To determine the long-term relationship, we referred to the extensive work of the authors of Nagawa [46], who elucidated the existence of cointegration in the UECM model by checking the null hypothesis of no cointegration ($H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$), which was tested against the alternative cointegration ($H_a: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$). Moreover, to determine whether a cointegration relation existed in the model, we then checked the F-statistics compared to the critical F-value provided in the ARDL model. The null of no cointegration is rejected if the values of the F-statistics are above the upper critical value (F-Statistics > I(1) value), which indicates the existence of cointegration among the variables and represents a long-term relationship in the model. In contrast, if the F-statistics are less than the critical value of the lower bound I(0), this depicts the null hypothesis of the absence of a long-term relationship [45]. Hjazeen et al. [47] estimated the UECM ARDL model for economic growth, stating that once the cointegration relationship was established, one can proceed to the ARDL ECM (error correction terms) model calculations to investigate

the relationship among the variables and determine which influential variables affect the dependent variable in the short- and long-term estimations [48]. In conclusion, based on Pesaran [49], the ARDL model has numerous advantages over other model estimations as follows: (1) it accommodates different orders of integration among the variables (i.e., whether $I(0)$ as a level or $I(1)$ as the first difference and mixture); (2) it can perform long-term and short-term estimations at the same time; and (3) it allows for the inclusion of specific individual differences across countries as well as regions.

Therefore, in this study, the application of the ARDL bounds testing approach included testing for the presence of a long-term relationship based on the specifications of coconut oil export value equation models. It utilized a dynamic, unrestricted error correction model (unrestricted ECM/UECM) framework that integrated the short-term dynamics with the long-term equilibrium without omitting any long-term information. We attempted to estimate the cointegration testing to assess the long-term relationship among the variables, before testing the ECM model, to show how the short-term and long-term relationships between the exogenous variables impact Indonesian coconut oil exports. Both our ARDL model and ECM models are expressed below.

3.2.3. ARDL Model: Price Elasticity Model of Coconut Oil Exports

Our models were constructed based on the export performance of Indonesian coconut oil (the export value), with the aim of representing the relationship between the variables, and particularly, the cross-price elasticity, during a period of price discrepancies between coconut oil and PKO over several years. The empirical formulations of the ARDL bounds testing approach to cointegration are given in the equations below.

1. ARDL model for coconut oil export value in USD terms:

$$\Delta \log \text{COexp}_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta \log \text{COexp}(\text{value})_{t-i} + \sum_{i=1}^q \alpha_2 \Delta \log \text{COPrice}_{t-i} + \sum_{i=1}^q \alpha_3 \Delta \log \text{PKOPrice}_{t-i} + \sum_{i=1}^q \alpha_4 \Delta \log \text{COPhil}_{t-i} + \sum_{i=1}^q \alpha_5 \Delta \log \text{CocoProd}_{t-i} + \sum_{i=1}^q \alpha_6 \Delta \log \text{RER}_{t-i} + \sum_{i=1}^q \alpha_7 \Delta \log \text{RGDP}_{t-i} + \beta_1 \log \text{COexp}(\text{value})_{t-1} + \beta_2 \log \text{COPrice}_{t-1} + \beta_3 \log \text{PKOPrice}_{t-1} + \beta_4 \log \text{COPhil}_{t-1} + \beta_5 \log \text{CocoProd}_{t-1} + \beta_6 \log \text{RER}_{t-1} + \beta_7 \log \text{RGDP}_{t-1} + \mu_t \quad (1)$$

Note: COexp: coconut export on USD value basis; COPrice: coconut oil export price (USD) per metric ton; PKOPrice: palm kernel oil export price (USD) per metric ton; COPhil: coconut oil export from rival country, the Philippines, per metric ton; CocoProd: coconut oil production of Indonesia per metric ton; RER: real exchange rate between IDR (Indonesian Rupiah) and USD; RGDP: real GDP of Indonesian economy; Δ : difference between years; α : short-term coefficient; β : long-term coefficient; p : optimal lag length of dependent variable; q : lag of independent variables; log: variables are log-transformed.

We estimated the model via the coconut export performance in value (USD), which depicts the total export value generated by Indonesia during the price fluctuations for both coconut oil (CO) and palm kernel oil (PKO). In this model, the short-term and long-term coefficients of the variables were estimated if the result of the null hypothesis of no cointegration was rejected ($H_1 = \beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq 0$), indicating that the cointegration among the variables was established, which is the value of the cointegration above $I(1)$. Once we found the cointegration, we proceeded to estimate the long-term dynamics model based on the error correction term (ECT) value, as specified below in the error correction model (ECM):

2. The Error Correction Model (ECM) Term in Coconut Export (Value) Long-Term Dynamics Estimation:

$$\Delta \log \text{COexp}_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta \log \text{COexp}(\text{value})_{t-i} + \sum_{i=1}^q \alpha_2 \Delta \log \text{COPrice}_{t-i} + \sum_{i=1}^q \alpha_3 \Delta \log \text{PKOPrice}_{t-i} + \sum_{i=1}^q \alpha_4 \Delta \log \text{COPhil}_{t-i} + \sum_{i=1}^q \alpha_5 \Delta \log \text{CocoProd}_{t-i} + \sum_{i=1}^q \alpha_6 \Delta \log \text{RER}_{t-i} + \sum_{i=1}^q \alpha_7 \Delta \log \text{RGDP}_{t-i} + \lambda \text{ECT}_{t-1} + \mu_t \quad (2)$$

Note: ECT_{t-1} is the error correction term resulting from the long-term cointegration equilibrium relationship, and λ is a parameter indicating the speed of adjustment after the shock, which depicts how long it takes to restore the same equilibrium (indicated with the negative sign).

Based on the above models, a negative and significant ECT coefficient implies that any short-term movement between the dependent and explanatory variables converges back to the long-term relationship, which is cointegrated.

4. Results and Discussion

Our results estimate the price relationship between PKO and coconut oils, which are the fundamental estimations for the market potential orientation for Indonesian producers and the government, especially during periods when PKO prices skyrocket. This study gave the government policy consideration to seek the potential competitiveness of Indonesian coconut oil during periods of the price volatility of other oil products, like palm kernel oil (PKO). Understanding the cross-price elasticity gives producers an important baseline to maintain the motivation orientation of coconut oil production, as there is a coconut oil reduction trend due to land conversion to other commodities, including palm oil, by large-scale firms. Moreover, our study provides the Indonesian government with fundamental market data on the relation between both commodities, which are relatively tied to each other and affected by cross-price elasticity. Based on our study, under the condition of market price volatility, we expect that both the government and producers will activate their responses through production as well as quality assurance, like the coconut certification procedure for the product guarantee and diversification of coconut oils.

We decided to select the model based on the value measurement (USD), as the price volatility could affect the export value, given the similar characteristics (substituted) between coconut oil and palm kernel oil, and influence the international market demand.

Table 2 contains descriptive statistics of all the variables. We defined the highest standard deviation among the variables as the coconut oil exports of Indonesia, which indicates that it had more fluctuations during certain estimation years, which rendered basic information on how other factors could become demand-shifting factors for Indonesian coconut oil exports. Following our concern with the cross-price elasticity relationship between the coconut oil (CO) price and PKO price, the PKO price showed more unstable trends by 0.563, which was more than the CO price (0.502). We expected that the palm industries, and the PKO oil markets, would attract more market fluctuations. Basically, PKO has high price volatility due to several factors, such as its production trend, its productivity, and especially its high environmental threat, influencing the market supply of major producers, which finally affects the international market price. Thus, we proceeded to analyze the relationship between the cross-price elasticity of the PKO and CO prices to assess its impact on the Indonesian coconut oil export value in international oil markets.

Table 2. Descriptive statistics.

Variable	log COExp	log COPrice	log PKOPrice	log COPhil	log Coco Prod	log RER	log RGDP
Mean	11.38	6.45	6.25	13.53	13.46	7.59	12.52
Std. Deviation	2.35	0.51	0.56	0.49	0.38	1.68	0.95
Min.	5.61	5.46	5.31	12.27	12.47	3.00	10.35
Max.	13.60	7.46	7.41	14.17	13.97	9.64	13.93
Observations	59.00	59.00	59.00	59.00	59.00	59.00	59.00

4.1. Diagnostic Tests

The diagnostic tests intentionally aimed to measure whether the models were free from bias, accompanied by stationarity checking and optimum lag selection for the ARDL analysis. Therefore, we checked for all diagnostics in the model prior to our work to estimate the ARDL ECM models. The main required diagnostic tests are depicted in Table 3.

Table 3. Diagnostic tests for all models.

Diagnostic Test	Chi2	p-Value
Durbin Watson	-	R2 < 1.93
BG LM test	0.110	0.74 (Prob > Chi2)
White's test	57.00	0.44 (Prob > Chi2)
Heteroskedasticity	57.00	0.44

Our main coconut export value model was articulated free from bias, with no heteroskedasticity problem. The model reflected the goodness of fit to deliver responsible results in the model. Here, we obtained the value of the Durbin Watson, which was above the R-squared value, indicating that the model was stationer. Our model had no autocorrelation, as the value of the BG LM test was above the significance level of 5%, which was 0.740, reflecting the acceptance of H0: no serial correlation. Meanwhile, White's test indicated that the model was not affected by the heteroskedasticity problem; the value for the coconut oil export model was at a higher point than the significant level of 5%, which was 0.438. Additionally, to check the short- and long-term stability, the coefficient cumulative sum (CUSUM) test was deployed (see Figure 5 below). In Gessesse [50], the CUSUM test was particularly essential in terms of the structural changes in nations' macro-economic time-series data that may have been subject to one or more structural breaks. Thus, we estimated that the models were stable during the estimation periods, and therefore, that the coefficients of the given results were stable. However, only the CUSUM-squared stability was slightly over the 5% boundary in short periods of time, especially during the monetary crisis, impacting broad industrial sectors as well as prices. However, we still considered the CUSUM-squared value as the stable model, as the coefficients resulted in estimations that were logically represented as influential estimators for Indonesian coconut oil exports with proportional coefficient values.

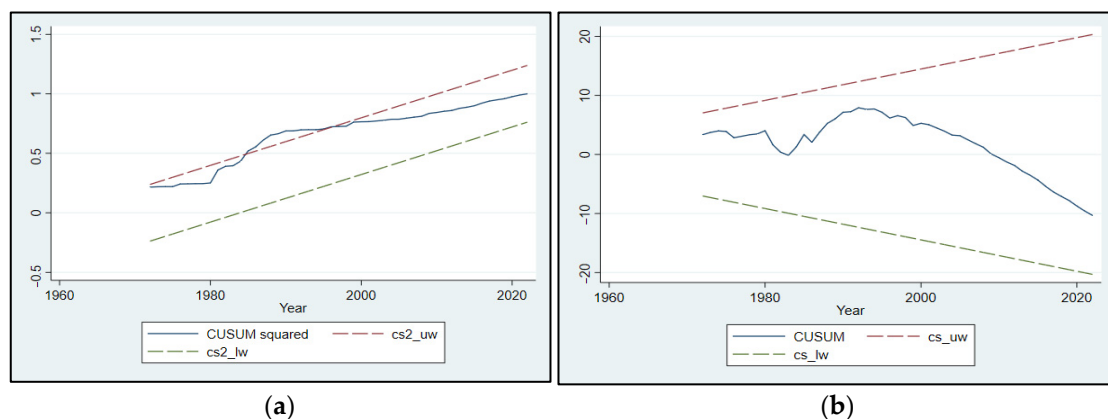


Figure 5. Stability test for each ARDL model: price relation. Note: (a) CUSUM square; (b) CUSUM residuals. Note: CUSUM is cumulative sum of recursive residuals, CUSUM square is cumulative sum of square, cs_lw is cusum lower bound line, cs_uw is cusum upper bound line.

4.1.1. Stationarity Test and Optimum Lag Selection

The ARDL model bounds test is applicable irrespective of whether the model follows underlying exogenous factors in the degree of I(0) or the I(1) order. Therefore, it is essential to test the univariate stationary within the variables, for which the unit root test is weighted by the ADF test, as in Table 4 below.

The ADF unit root test results in Table 4 show that the variables are stationary to estimate the model in terms of the short- and long-term dynamics. The ADF unit root tests for four variables show that the probability values are less than the significant value (5%), under the stationarity in level, while the other remaining variables (coconut oil production of Philippines, coconut oil production in Indonesia, and real exchange rate) are stationary in the first difference. We estimated that our data could confidently endorse the utilization of

ARDL bounds test estimation for short- and long-term cointegration analysis. Hjazeen [47] determined that, in cases in which the variables are joined under different orders, there is the possibility of a cointegration relationship among the variables.

Table 4. ADF unit root test for stationarity.

ADF Unit Root Test	p-Value < 5%	t-Value	Critical Value (1%)	Critical Value (5%)	Critical Value (10%)
Unit Root at Level					
log CO Export Value	0.0496	−3.414	−4.135	−3.493	−3.176
log CO Price	0.0007	−4.708	−4.135	−3.493	−3.176
log PKO Price	0.0003	−4.908	−4.135	−3.493	−3.176
log Coconut Philippines	0.2042	−2.781	−4.135	−3.493	−3.176
log CO Production	0.1963	−2.802	−4.135	−3.493	−3.176
log RER	0.2386	−2.694	−4.135	−3.493	−3.176
log Real GDP	0.0423	−3.474	−4.135	−3.493	−3.176
Unit Root at First Difference					
log Coconut Philippines	0.0000	−9.723	−4.137	−3.494	−3.176
log CO Production	0.0000	−9.005	−4.137	−3.494	−3.176
log RER	0.0000	−8.289	−4.137	−3.494	−3.176

Furthermore, prior to estimating the ARDL model, the optimum lag selection was essential to determine the appropriate lag order (Table 5), as the ECM specifications assumed that the disturbances were serially uncorrelated. We depicted the optimum lag selection by employing valid lag criterion selections: the AIC, SBIC, HQIC, and FPE.

Table 5. Optimum lag selection: a model of coconut oil export value.

Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	−106.043				1.4×10^{-7}	4.11067	4.20946	4.36615
1	188.649	589.38	49	0.000	1.9×10^{-11}	−4.82359	−4.03322	−2.77976 *
2	273.161	169.03	49	0.000	5.8×10^{-12}	−6.11496	−4.63302	−2.28278
3	357.38	168.44	49	0.000	2.0×10^{-12} *	−7.39564 *	−5.22213 *	−1.77511
4	398.505	82.251 *	49	0.002	4.4×10^{-12}	−7.10929	−4.24422	0.299594

Note: * Indicates lag order selected by the criterion; AIC: Akaike information criterion; LR: sequentially modified LR test statistic (at 5%); SC: Schwarz information criterion; FPE: final prediction error; HQ: Hannan–Quinn criterion.

4.1.2. ARDL Bounds Cointegration Test

We ran the bounds cointegration test (in Table 6) in F-Statistics to confirm the existence of cointegration among the variables [50]. As seen in the bounds test (Table 6), our models have long-term dynamics cointegration, revealing the relation among the long-term estimations within the expected variables that impact the export performance of Indonesian coconut oil in the international markets. The bounds test represented the value of the coconut oil exports, accounting for an F-statistics value of 14.277, which was greater than the upper-bound critical value at the 5% significance level by 3.61 value. This showed that the null hypothesis of no cointegration was rejected and confirmed the evidence of cointegration between the estimated variables, depicting long-term estimations of the impact among the exogenous variables on coconut oil exports.

Table 6. Bounds cointegration tests on ARDL models.

H0: No Levels or Relationship			F = 14.277
Critical Value Bounds			t = −8.942
			k = 6
Significant Level	I(0) Bound		I(1) Bound
10%	2.12		3.23
5%	2.45		3.61
2.5%	2.75		3.99
1%	3.15		4.43

4.2. ARDL Model Result

4.2.1. Generalized ARDL Result: Estimation of the Models

Based on our estimation results in Table 7, the ARDL model shows that the explanatory variables affect the Indonesian coconut oil export value; however, this depends on the lag order of each variable. Such log coconut oil price only has an influential impact on the second-lag order with a negative effect (−2.35%), indicating that the intense increase in coconut oil prices would decrease the Indonesian coconut oil export value proportionally by −2.35%. This follows the law of market demand in relation to the own-price elasticity function. Thus, major partner countries' demands would intentionally reduce the demand for Indonesian coconut oil during periods of skyrocketing coconut oil market prices. Otherwise, we found divergent results for the cross-price elasticity. Under the perfect substitute goods, like PKO oil, we found that the PKO price had positive impacts of 1.35% and 2.17% in recent time periods of the no-lag order and second-lag order, respectively. Based on this finding, the perfect substitute goods relationships have to be considered by the Indonesian government in order to increase the coconut oil export value. This is a distinctive opportunity for the Indonesian government to capture an additional market opportunity for the export of coconut oil, especially during periods of immediate market price volatility of other goods. Thus, subsidy policies for coconut oil exports are essential during PKO-price-spiking periods. In the results below, we present all the details of the variable impacts on the Indonesian coconut oil export value. The coconut oil production of the rival country mainly has a negative impact, while the real exchange rate (RER) generally has a positive impact on coconut oil exports but an inverse impact in the second lag. Thus, we evaluated, in general, the IDR currency depreciation, which leads to more market demand, as buyers have more purchasing power parity (PPP) over Indonesian coconut oil products. Meanwhile, the real GDP has a negative influence on the position of Indonesia's GDP, as the coconut oil sector has not yet been fully promoted by Indonesia government. Furthermore, only the log coconut oil production has all positive influences, as coconut yields produced by Indonesian farmers directly support Indonesian coconut oil exports to international coconut oil markets.

Table 7. Generalized ARDL estimation of the model coconut oil export value.

ARDL Model: Value		
Variable	Coefficient	p-Value
<i>logCOExp</i>		
L1.	0.036	0.742
<i>logCOPrice</i>		
-	−0.484	0.391
L1.	1.053	0.110
L2.	−2.350	0.000 ***
<i>logPKOPrice</i>		
-	1.350	0.075 *
L1.	−1.704	0.049 **
L2.	2.174	0.002 ***
<i>logCOPhil</i>		
-	−1.570	0.011 **
L1.	−0.777	0.137
L2.	0.608	0.194
<i>logCocoProd</i>		
-	1.363	0.217
L1.	3.422	0.009 ***
L2.	3.627	0.044 **
<i>logRER</i>		
-	0.434	0.216
L1.	1.686	0.000 ***
L2.	−1.361	0.000 ***

Table 7. Cont.

ARDL Model: Value		
Variable	Coefficient	p-Value
<i>logRGDP</i>		
-	4.591	0.247
L1.	4.041	0.505
L2.	-9.619	0.008 ***
constant	-73.574	0.000

Note: L indicates the lag time of the variable. (-) indicated no lag on each variable measured. *, ** and *** indicated the level of significant at level 10%, 5%, and 1% respectively.

4.2.2. Error Correction Model (ECM) Long-Term Dynamics Estimation

Based on our bounds testing results, we expected there to be a long-term relationship among the variables, reflected in the value of the error correction term (ECT) in the models. As shown below in Table 8, the ECT term has a negative sign, indicating the speed of adjustment within the short term to convergence in the long-term equilibrium by the negative value (-0.964 coefficient value). This indicated that our notable factors have responses that impact Indonesian coconut oil exports over long-term estimation periods. Nevertheless, as our main factors were the relationships between the coconut oil price (CO) and palm kernel oil (PKO) price in the model, we ensured that these factors were eminent to establish the long-term impacts of the essential values: the CO Price (-1.847%) and PKO Price (1.888%). Based on these results, we estimated that the CO price has a negative influence, on which the higher price of coconut oil in the international markets, possibly hindering the expansion of the export of Indonesian coconut oil. The PKO price renders more potential market cover for the Indonesian coconut oil export value, showing the potential of the price elasticity across products to impact the international demand behavior, particularly during periods of skyrocketing PKO prices. A positive price relation of PKO could possibly intensify the market exposure of Indonesian coconut oil by 1.888%, as both products are practically substituted goods in the lauric oil market. These findings could eventually sharpen an essential export policy baseline for the Indonesian government during periods of price discrepancies between the two commodities. Furthermore, we found several paramount factors that impact the export of Indonesian coconut oil, especially the rival-country factor, which suppresses the Indonesian coconut oil export performance. As Indonesia's rival-country producer, Philippine coconut oil negatively impacts the coconut oil exports of Indonesia by -1.803%, which indicates that the Indonesian government has to create a more competitive advantage than its rival-country producer. Recently, the Philippines has come to dominate the world's coconut oil production; thus, it might have more market power than Indonesia in terms of its production efficiency to lead to intensive market price competition for the international lauric oil demand. This will eventually require substantial market intervention by the Indonesian government to compete at the productivity level of the Philippines. We present the relations among the variables in the ECM model for the short- and long-term estimations in Table 8.

Table 8. ARDL ECM model: long-term dynamics estimations of coconut oil model.

ARDL Model: Coconut Oil Export Value			
	Variable	Coefficient	p-Value
ADJ.	<i>logCOExp</i>	-0.964	0.000 ***
	L1.		
LR.	<i>logCOPrice</i>	-1.847	0.026 **
	<i>logPKOPrice</i>	1.888	0.079 *
	<i>logCOPhil</i>	-1.803	0.071 *
	<i>logCocoProd</i>	8.724	0.000 ***
	<i>logRER</i>	0.788	0.028 **
	<i>logRGDP</i>	-1.022	0.269

Table 8. Cont.

ARDL Model: Coconut Oil Export Value			
	Variable	Coefficient	p-Value
SR.	<i>logCOPrice</i>		
	D1.	1.298	0.065 *
	LD.	2.350	0.000 ***
	<i>logPKOPrice</i>		
	D1.	−0.470	0.589
	LD.	−2.174	0.002 ***
	<i>logCOPhil</i>		
	D1.	0.169	0.801
	LD.	−0.608	0.194
	<i>logCocoProd</i>		
	D1.	−7.049	0.001 ***
	LD.	−3.627	0.044 **
	<i>logRER</i>		
	D1.	−0.325	0.357
	LD.	1.361	0.000 ***
	<i>logRGDP</i>		
	D1.	5.578	0.185
	LD.	9.619	0.008 ***
Cons.		−73.574	0.000

ADJ: speed of adjustment from short-term to long-term equilibrium; LR: long-term estimations. SR: short-term estimations. *, ** and *** indicated the level of significant at level 10%, 5%, and 1% respectively. D1 indicated first difference, and LD indicated one value lagged.

4.3. Discussion

4.3.1. Long-Term Relationship Impact on Indonesian Coconut Oil Exports

Our outcome stresses the cointegration in the model to reveal the long-term relationship between the explanatory and dependent variables. The speed of adjustment (ECM_{t-1}) is about -0.964 , which suggests that approximately 96% of the adjustment period towards the long-term equilibrium is required per year. If disequilibrium occurs, it will take approximately more than 1 year for Indonesian coconut oil exports to adjust to their long-term equilibrium.

Therefore, our study found the long-term impacts generated by the explanatory variables that affect the Indonesian coconut oil export value. In the long term, our main variables are (1) the coconut oil price and (2) the palm kernel oil (PKO) price, generating different adverse impacts. The coconut oil own-price confidentially had a negative impact on the export of coconut oil in the long-term estimation, with a 1% price increase in coconut oil, which could potentially reduce the proportion of Indonesian coconut oil exports by -1.85% . Meanwhile, the PKO price had a positive impact, proportionally increasing the coconut oil exports by 1.89% for international markets. This distinctive two-price behavior refers to the condition of the own-price and cross-price elasticity between the two commodities. Under the own-price elasticity, the coconut oil price is relatively inclined to give a negative relation to the export. An own-price elasticity greater than 1 means that the coconut oil markets are sensitive to price change [34]. This follows the law of demand, whereby consumer purchasing behaviors towards price sensitivity impact the quantity demand, especially in markets in which the buyers have more market power with various alternative substitute goods. Thus, the markets would be more price-sensitive, affecting the quantity of the coconut oil demand of Indonesia's partner countries. This is indeed reflected in our outcomes, in which the own-price elasticity of coconut oil reached as much as -1.85% , categorizing it as elastic-price-sensitive for market demands.

The own-price elasticity is essential as a prominent factor for government policy implications, especially in determining international market demand behaviors. Devi [51] observed the price elasticity and used it to determine the number of changes in the quantity demands proportional to the own-price changes. A considerable number of scholars have been working on price elasticity and have found that the own-price elasticity has a negative impact on the demanded products [51–54]. Kojima [55] emphasized the own-price

elasticity among vegetable oils for US oil markets, indicating that the own-price elasticities were elastic in negative patterns for canola oil (−1.58) and palm oil (−1.24%) but rather inelastic for soybean oil (−0.19%), affecting the demand for US domestic vegetable oils. Ximenes et al. [35] explored the specific market demand for the export of coconut crude oil (CCO) from Indonesia to the Netherlands, which again showed that the own-price elasticity had a negative sign, implying that when the price of CCO increased by 1%, the demand in the Netherlands decreased by −0.82%. However, they found that the demand for CCO from the Netherlands market was less than 1, which indicated that the markets were not price-sensitive (inelastic). We conclude that this inelastic demand was mainly due to the essential needs for CCO in the oil markets of the Netherlands, in which the price was overwhelmed by the essential need value of the consumer demand. Thus, major price changes might only cause slightly downward shifts in consumer demands. A similar finding was emphasized by Mufteeth [56], who showed that the coconut price elasticity was inelastic in Sri Lanka. This was important because coconut is considered a basic-need good in Sri Lankan markets, as it is the second most important food and a highly demanded commodity. According to the level of consumer importance, a vast majority of consumers value quality over price, while others are willing to sacrifice quality for a cheaper price Ximenes [34], thereby creating the distinctive elasticity of coconut oil demands, which depends on the market behavior of specific consumers.

In the wider markets, the coconut oil demand corresponds to a negative elasticity sign, such as estimated by Sugiyanto [57], who highlighted that world coconut oil consumers were price-sensitive in terms of their demands, by −1.23%. Therefore, as our findings depict the negative elastic pattern for the own-price coconut oil elasticity (−1.85%) in international market demands, we expect that, in the long-term markets, Indonesian coconut oil products are price-sensitive and can potentially be substituted by alternative goods. In cases of dramatic price changes in the market, consumers would prefer to change their demands to other oil products. In addition, in the long-term markets, consumers are predictably blessed with more market power potential to determine the market due to the fact that they have various alternative oil product options, which finally affects the export quantities of coconut-oil-producing countries. This is a sign that the Indonesian government should implement proper measures with the aim of stabilizing the price volatility of coconut oil through both cost efficiency and price subsidies for local farmers and producers.

Reflected in our results, we assumed that the export of Indonesian coconut oil relies on the positions of other goods in the market, as noted by the oil trade trend [5] during the spiking of the PKO prices in 2021–2022 when the market demand shifted to coconut oil (CO) by a significant number of tradable oils. We stress that the cross-price elasticity with the PKO oil market demand could determine the lauric oil markets, as we found that both commodities had a positive relationship under an elasticity of 1.89% in the long-term estimations. It was indicated that a 1% increase in the PKO oil price would increase the coconut oil market demand by 1.89%. This result could be a welcome relief for the Indonesian government, allowing it to obtain alternative export earnings from the coconut oil market potential during periods of decreases in the palm oil market demand. Moreover, our result reflects similar findings of Dewanti et al. [30], who revealed that the positions of substituted goods have a positive influence on international coconut oil markets. They observed the three main coconut oil importers and found all relations among the substituted goods prices were positive. This is in line with the study of Kojima et al. [55], which estimated the share of the US domestic soybean oil market that relied on other vegetable oil supplies. Among vegetable oils, the cross-price elasticities commonly represent a positive impact on the soybean oil markets, such that a 1% change in the prices of canola oil (0.59%), palm oil (0.34%), corn oil (0.14%), and sunflower oil (0.69%) would determine the price of soybean oil in the US markets in a positive relation. This was followed by a study conducted by Destiarni et al. [58], who observed, among vegetable oils, that the price elasticity relationship has a strong substitution effect on determining the oil market demands.

To deal with the consequences of price elasticity, the Indonesian government needs to respond by either regulating the price through market subsidies or enhancing the capacity of local producers by achieving production efficiency to gain better market competitiveness ahead of price fluctuations and rivalry competition with other oil products, as well as other rival-country producers, in light of the fact that the Indonesian coconut oil industries have yet to improve their production capacities. The authors of Alouw [59] explored the low productivity in Indonesia due to the high proportion of aging coconut palms, producing 1.1 metric tons/Ha/year, which is far below other world coconut-producing countries, such as Brazil, which reached an average of 11.22 tons, followed by Vietnam and Malaysia, which produced 9.57 and 6.57 tons per year, respectively [60]. This forced the Indonesian government to start its new-coconut-variety-replanting program (Genjah Palm Variety) in 2022 [61]. The seed component was a major issue to be tackled by the government, aimed at achieving higher productivity. Wulandary et al. [62] forecasted a strategy for accelerating the coconut-replanting program that mainly consisted of the development of the seed system through nursery establishment, seed distribution, and planting and cultivation management. This instrument could be a fundamental policy for strengthening the coconut oil position amid international market competition with other oil commodities.

The spiking PKO prices in the last several years definitely reveal the potential export demand for Indonesian coconut oil. However, the Indonesian government has to create more competitiveness value; otherwise, the market opportunities will be captured by other rival coconut oil producers, especially the Philippines, as the world's number one coconut oil exporter. Our study found a relation with the export of Philippine coconut oil that resulted in a negative impact of -1.80% , in which a 1% improvement in Philippine exports would lead to a significant reduction in Indonesian coconut oil exports by 1.80% in the long-term export market. The market power of the Philippine coconut oil production over Indonesia was established due to the government's coconut levy fund stimulus, which was then strengthened by the Coconut Farmer Trust Fund in 2011. The fund was proposed for the development of the Philippine coconut industry through financing and assistance programs for coconut farmers to increase productivity as well as coconut-based enterprises [63]. Under the Coconut Industry Development Council (CIDC), the Philippines coconut levy funds are managed to facilitate a return to the small coconut farmers, and especially to pursue a coconut farmer-led program aimed at higher productivity on the part of coconut farmers, as well as the integrated development of the coconut industries. Therefore, it is mandatory that the Indonesian government intensifies the integrated policy instrument for coconut production, particularly, the allocation of a consistent fund mechanism for local coconut farmers, similar to the Philippines, to maintain the quality of production as well as cost efficiency for better market price competitiveness.

Furthermore, we found other factors that influence long-term coconut oil export markets, including coconut oil production, with a high positive impact (8.72%), and the real exchange rate, with a slightly positive-fractional effect (0.79%), while the Indonesian real GDP had no influence on the export performance of Indonesian coconut oil. We derived the same perspective as Girsang [64], where the exchange rate (IDR/USD) has a positive influence on the commodity export from the perspective of the export demand via currency depreciation. However, the study by Dincer [65] warns of the consequences of continuous depreciation, which could stimulate the lost momentum over time, as producers lose the confidence to keep producing under the lower price exchange. Dincer indicated that exchange rate fluctuations have a net effect on a nation's export growth.

In the long-term markets, the GDP of Indonesia is not robust enough to support the development of the coconut industry. Based on the coefficient value, the GDP rendered a negative value of -1.02% ; nevertheless, the GDP does not significantly affect the nation's coconut oil exports under the 95% confidential level, which only obtained a p -value of 0.269. Based on the fiscal support of the national government, palm oil exploited more government assistance than that of fractional support for the coconut oil industries. Palm oil, due to its massive economic contribution, is supported by generous government subsidies and

the ease of expansive land development in recent years. Based on the data, the Indonesian government is more likely to support the palm oil industry than the coconut oil industry, as the palm oil industry receives more multiplier income effects. Indonesia could earn notable palm oil export value over coconut oil by an elasticity of 2.46% in the GDP Setyowati [66]. Thus, every 1% increase in palm oil's economic value leads to an additional 2.46% increase in the Indonesian GDP by over IDR 300 billion; coconut oil does not produce the same value. This result could extend the government principality task in the long term, whereby the national government has undertaken enormous works to relieve and support the coconut oil sectors as the fundamental cultivation land for coconut continues to decline, in contrast to the palm oil industry, which is spoiled by more land concessions for its expansion.

4.3.2. Short-Term Impacts on Indonesian Coconut Oil Exports

In the short-term estimations, we found interesting results concerning our main variables, the coconut oil price, and PKO price, with an inverse correspondence with our long-term estimations. In the short-term period, the coconut oil market price positively impacted the Indonesia coconut oil export value by 1.29% and 2.35%, while the PKO price induced a negative impact of -2.17% . These two distinctive results between the coconut and PKO prices are likely due to the behavior and perspective of consumers in the markets during short-term fluctuated periods. These results show that, in the short term, consumers tended to consume coconut oil by 1.29% and 2.35%, though the price of coconut oil increased by 1%. In the short-term period, any drastic changes in price would create a sudden shock to the market demand. However, consumers require time to alter their buying decisions, while making adjustments to allocate their budgets for other commodities or suppliers. Therefore, we assume that consumers still consume coconut oil while confirming other alternative oils as possible choices, like PKO. Nevertheless, our short-term estimations revealed that the increase in the coconut oil price was at the level of normal price fluctuation, as compared to the world palm oil price during the short-term period, which is categorized as one of the highest and most impactful instances of the price spiking of palm oil. Thus, as consumers face price differences between palm and coconut oil, we presume that this would prompt them to consume coconut oil in the short term while waiting on other substituted goods at a reasonable price. As of this result, we recommend that the government react by supporting coconut oil producers through an export facility instrument (i.e., export tax allowance during the short-run momentum), which might result in a crucial leap ahead in the price competition with palm kernel oil.

Our results regarding the price elasticity of coconut oil prices are categorized as distinct findings compared to other scholarly observations with other commodities, such as observed by Hughes et al. [67], who evaluated the shift in the short-term price elasticity of the gasoline demand to reflect that the short-run price elasticity of gasoline will reduce the market demand from -0.034 to -0.077 , while the income elasticity will have a positive effect on consumer behavior. Meanwhile, Shariff et al. [68] identified clear price elasticity for Malaysia palm oil exports, in which its own price negatively generated elastic demands (-1.16). In contrast, they observed that substitute goods like soybean oil had a positive impact on exports.

Based on standard economic notation, the own-price elasticity naturally attaches a negative influence on the demand; however, our study found contrasting results. In addition to our above explanations regarding price competition, we have yet to assume that market behaviors might consider coconut oil as a non-traditional good, as it contains a high concentration of lauric acid. It is being marketed as a luxury good, given the health advantages of coconut, with abnormally higher prices compared to other substitute oils, while products like palm oil are generally consumed by emerging markets not for its flavor but rather for its cheap price [12]. Therefore, the positive price elasticity for the coconut oil demand in the short-term period could reflect luxury-good market behavior, where higher coconut oil prices could increase the proportion of the coconut oil export demand by 1.29% and 2.35% in the short-term period of export markets. Thus, as the markets grow

in a positive way, it is the government's responsibility to maintain the level of Indonesian coconut oil quality by implementing policies aimed at targeting local farmers' extensive production and productivity. In addition to the production capacity, the Indonesian government needs to deploy coconut oil certification procedures to strengthen quality assurance. The certification referred to in Otsuki's extensive work [69] was found to increase the export share of the company sales by 44.9% over the average increase. He evaluated that the company needed to apply international standards to mitigate trade losses by controlling the safety and quality criteria, which, later on, could create a favorable perception of the company brand and attract buyers. Furthermore, in the specific certification for coconut products, the government could provide a voluntary sustainability standard (VSS) to meet the sustainability goals, including health, safety, and environmental aspects [70]. This certification could be varied, such as Rainforest Alliance (RA) certification, Fair Trade, UTZ, and others, to increasingly promote economic concerns not only via farm diversification but also through price premiums for healthy and safe products for consumers. In the market for coconut oil exports, especially in Europe, buyers are concerned about the oil quality and identify (1) the moisture content, which should not exceed 0.5%, and (2) the lauric acid content, which should range from 45 to 50%. Therefore, determining quality through certification standards and labeling is clearly a distinctive factor for the consumption of coconut oil [71].

Regarding our findings on the PKO price impact during the short-term export markets, it had a negative impact on Indonesian coconut oil exports by an elasticity of -2.17% . This indicated that a 1% PKO price reduction would lead to an increase of 2.17% for Indonesian coconut oil exports. This would essentially benefit the Indonesian government, particularly in terms of short-term trades, due to the fact that buyers tend to consume coconut oil at the exact time that the PKO price is slowly decreasing to the normal price trend. We estimated this trading behavior due to the uncertainty perceived by international buyers, prompting them to make the decision to continue consuming coconut oil for a certain time while waiting for the PKO price to stabilize during the spiking PKO price volatility in the short-term export period. This finding relates to prior work of Suzuki [72], in which the authors observed that, under price uncertainty, consumers make their purchasing decisions by considering the option value of postponing the purchase. Price uncertainty results in the ambiguousness of the purchasing decision, as consumers make their purchasing decisions by comparing the utility of purchasing versus not purchasing the goods. Hence, in this market situation, coconut oil could lead the market potential in terms of the short-term demand for lauric acid oils over PKO oils due to uncertainty about the PKO price in the short term.

Furthermore, as coconut oil was classified as a luxury good, the good's quality value is the main priority for buyers, rather than the volatile price in the short-term export market. Bocha [73] investigated consumer behaviors regarding luxury goods and found that they have different characteristics, depending on their lifestyle, desire, and purchasing behaviors, which follow their perception of the uniqueness, social value, emotional value, and quality value of the good. We classified coconut oil products as a "luxury-type good", as they deliver the perception of an organic product created from a premium perspective, which is in contrast to palm oils. Thus, following the organic product trend in recent years, coconut oil-based products have been achieving enormous attention, particularly in the pharmaceutical and personal care industries, as depicted in Figure 2. According to Chauvin study, the organic market size is expected to increase from USD 11.07 billion in 2021 to USD 18.25 billion dollars by 2028 [74]. The EU attributes the organic bio-based cosmetic and personal care product trend due to (1) the promotional benefits of marketing cosmetics as "natural" and (2) the growing market demand due to an increase in consumer income [75]. Thus, as the second largest coconut oil producer, the Indonesian government needs to elevate the branding of natural and organic coconut oil products in the international markets, as the market has readily started to shift towards the demand for organic products.

Finally, our results show that the other influential factors that generate impacts on Indonesian coconut oil exports in the short-term markets include (1) the Indonesian coconut oil production by negative effects of -7.05% and -3.63% . Based on these results, we could identify that, during the short-term period of Indonesian coconut oil markets, coconut oil production interestingly has a negative impact due to several government policies, including the replanting programs, which might have consequences on the production of domestic coconut oil. Moreover, this finding is also an essential sign for the government, in which the productions of domestic coconut oil are not always distributed for coconut oils' export markets. As experienced by the domestic cooking oil consumers, due to the high volatility of palm oil price as well as its shortage in the markets, Indonesia consumers have raised their demand for coconut oil in particular short-run period. Therefore, Indonesia government has to expect that the additional capacity of coconut oil production is required to fulfill the growing demand both in international market and domestic market, which needs acceleration on the production of green coconut as well as the processing plants for the oil producers.

In response to that, starting in 2022, the government has intensively undertaken the replanting program by cultivating a new variety of coconut seeds: the genjah coconut seed variety [61]. This new seed variety has the distinct advantage of shorter harvesting years compared to normal coconut seeds, from the previous 6–7 years for the initial harvesting time to only 3–4 years for farmers to earn yields. Therefore, during the short-term period, Indonesian coconut oil producers experience relatively declining rates of fresh green coconut yields, which impacts coconut oil production. However, we note that the Indonesian government works collectively with the farmers and coconut agencies to significantly improve the total quantity of coconut oil production. Thus, in the forthcoming years, it is expected that the production of coconut oil will increase, especially as a result of the intense market support driven by particular industries (shown in Figure 2), which have increased the potential surge in coconut oils to capture more extensive market exposure, seeking continuous market opportunities during PKO price spiking to reveal further Indonesian coconut oil exports in international markets demands.

According to international trade, the function of the real exchange rate between countries could crucially stipulate trade behavior. Our results indicate that (2) the real exchange rate reflected both negative and positive support for Indonesian coconut oil exports by -0.33% at first difference lag (D1.) and 1.36% at one value lagged (LD.); however, only the result of one value lagged (LD) significantly affected Indonesian coconut oil exports by a positive relation of 1.36% . This envisages the market behavior between Indonesia and its counterpart market demands. It shows that, in the short-term period, the depreciation of the Indonesian exchange rate could potentially accelerate the export of Indonesian coconut oils to international markets. We found this result counter to the original theory of producer behavior, which suggests that they would be less motivated during periods of the depreciation of the rate. However, our results estimate that the depreciated exchange rate has less impact on the proportional demand shifting due to the dramatic price volatility of palm kernel oil. In turn, this could be potentially exploited by the coconut oil producers in the short term as an opportunity to make export earnings. The increasing export coconut oil market trajectory during the short term is massively and indirectly affected by the dramatic volatility of the palm kernel oil (PKO) price. It then consequentially hinders the market demand for palm kernel oil and promulgates the shifting demand for coconut oil. Especially in high-lauric-oil-demand countries (i.e., the US and China), skyrocketing palm kernel oil prices and volatility during the short term have caused them to establish myriad market adjustments, including consideration of the coconut oil demand shift as their alternative market choice, given its prominent organic moisture substances and relative inexpensiveness. Thus, as consumers find different prices for both products, they decide to consume coconut oil in the short term. This motive was the main consideration of our result on the exchange rate that contrasts with the law of the producer supply, which only works for specific market behavior, especially during

short-term periods of the high volatility of palm kernel oil prices that affect the international demand shift towards coconut oil markets.

Our results are similar to those of Dincer [65], who detected that the anticipated exchange rate appreciations had significant adverse effects that contracted export growth across multiple sectors. In contrast, the effect of depreciation could have a positive impact; however, in stimulating export growth, it has lost momentum over time. This reflects that, as time goes on, the export will decline under continuous depreciation during long-term conjectures. Our long-term estimations also reveal the same perspective, in which the depreciation of the exchange rate only induced a fractional impact of less than 1%, compared to our short-term estimation of 1.36% during periods of skyrocketing PKO price transitions. Another scholar found that the currency appreciation had a negative effect on the export [76], followed by its volatility, dampening the export shares. However, we conclude that these effects depend on the market behaviors, either elastic or inelastic markets, which could determine the market power of producers and consumers. Roberts and Tybout [77], and Campa [78], indicate that the characteristics of firms are utilized in exploring export behaviors, such as the inelastic market demand, and the producers spur the supply during the appreciation of the exchange rate, when consumers have limited market choices to alter their decisions, and vice versa.

Furthermore, we found the contribution of the Indonesian economic growth to the improvement in short-term coconut oil exports, as it depicted that the (3) real Indonesian GDP rendered a positive impact by 9.61% in the short-term markets. Normally, the GDP impact takes time, requiring myriad technological transfers, including the development and widespread planting of a new seed variety. However, our results show that Indonesia's GDP contributed positively to coconut oil exports in the short term. We forecast that this finding is related to the immense response of the central government, allocating more funding for coconut projects in recent years, including a central coconut plantation in the Central Java Province [61], via massive planting areas and the establishment of new seed productions since 2022. We predict that the Indonesian government will allocate more of its fiscal budget as the GDP increases in response to the market potential of short-term coconut oil exports. During the short term, the nation experienced both domestic and international oil market turbulence, given the so-called "skyrocketing" prices of palm oils, causing palm oil shortages for the year, thereby exposing the options to forage for alternative oils, like coconut oil. Given this market demand spillover, the government has implemented a coconut oil export tax allowance since 2020–2021, for producers to export, depending on the amount of investment [79]. Nevertheless, we believe that the growth ratio of the coconut oil industries cannot compete with the palm oil industries in the long term due to the massive palm oil firm expansions. As a consequence, the Indonesian government will endow the palm oil industries with a more generous response in the long term, rather than the coconut oil industries, given the prevailing palm contribution to the GDP. Therefore, in the long-term estimation, Indonesia's GDP is more likely to exert a negative pressure value on coconut oil market expansion by -1.02% , whereas in the short term, it gives a positive value (9.62%), as a spillover response to the sudden shift in market demand behaviors. Thus, based on our results, we suggest that the government facilitate the strengthening of the production capacity of coconut oil producers, including providing incentives for labeling and certification for international export markets, in addition to the export tax allowance, to recognize the local coconuts have been cultivated and processed under sustainable approaches and practices. This might become a distinctive approach to addressing the international "organic label" oil demand, and particularly the EU nation demands.

5. Conclusions

Indonesia's coconut oil export had been estimated to experience potential export earnings, due to the cross-price elasticity relationship with palm kernel oil (PKO). This study found a cointegration value of 14.277, which indicated the long-term relationship among the

variables. The ECT term had a negative sign (-0.964), indicating the speed of adjustment within the short term to convergence in the long term. As our main factors, the coconut oil and PKO prices had distinctive impacts on Indonesian coconut oil exports of -1.85% and 1.88% , respectively, in the long-term estimations. Based on these facts, it is recommended that the Indonesian government sharpens an essential export policy, especially during periods of lessened price discrepancies, during which we found a prominent demand shift from PKO to coconut oils, as both share similar values of lauric acid substances. In the long-term estimation, we observed the potentially massive impact generated by rival oil producers, like the Philippines, rendering a -1.80 negative impact on Indonesian coconut oil exports. This was estimated due to such persistent political strategies by its government (i.e., coconut farmer trust fund) to increase small farmer productivity, as well as the integrated development of coconut industry producers. Nevertheless, in the short-term estimations, we found inverse values both for the coconut oil and PKO oil prices. Unlike the long-term estimations, the coconut oil price had positive impacts in the short-term period of 1.29 (D1.) and 2.35 (LD.), while the PKO seemed to have a negative impact on Indonesian coconut oil exports (-2.17), which indicated that a PKO price reduction would increase the demand for Indonesian coconut oil exports. This was projected due to the PKO price uncertainty during the short-term periods of price volatility, resulting in the ambiguity of consumer purchasing decisions, as consumers make their decisions by comparing the utility of purchasing versus not purchasing the goods. Based on our findings, we suggest that the Indonesian government issues a coconut support policy, especially to capture the market potential during the price competition between coconut and PKO oils. These recommendations could (1) increase production support during the short-term periods of skyrocketing PKO prices through production subsidies and, especially, farmer capacity management training, in order to increase the productivity level of coconut oil, like the Philippines, and (2) elevate the marketing level through labels and voluntary certifications for oil producers aiming for long-term notable recognition among international organic-oriented buyers.

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