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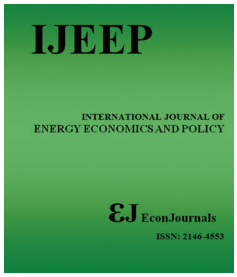

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Competitiveness, Market Structure, and Energy Policies: A Case Study of the World's Largest Crude Palm Oil Exporter

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ABSTRACT

Crude palm oil (CPO) is the mainstay of Indonesian agricultural products which is the largest CPO producing country in the world. The high market share of Indonesian CPO exports reflects the high competitiveness of Indonesian CPO in the global market. The purpose of this study is to determine the competitiveness of Indonesian CPO, the concentration of the Indonesian CPO industry, and analyze the factors that are suspected to affect the competitiveness of the CPO industry in Indonesia. The data used in this study are secondary data with a five-digit International Standard Industrial Classification (10432) using time series data for 2001–2020 and the analytical techniques used in this study include revealed comparative advantage, Gini coefficient, and error correction model. The results showed that Indonesian CPO has high competitiveness in the international market, the Indonesian CPO industry is not concentrated, in the short term the variables that affect competitiveness are CPO prices, subsidized solar prices policy, and industrial concentrations, while in the long term the influential variables are biodiesel policy, subsidized diesel oil policy and industrial concentration.

Keywords: Crude Palm Oil, Competitiveness, Biodiesel Policy, Subsidized Fuel Oil
JEL Classifications: D24, F62, L11, O13

1. INTRODUCTION

The crude palm oil (CPO) industry is one of the plantation commodities that has a strategic role in economic development, generates domestic income and foreign exchange (Nurfatriani et al., 2022). CPO is also known as a critical component for food security in Indonesia and other countries (Goh and Lee, 2010). CPO is one of the flexible commodities because of its benefits that can be utilized for daily activities, such as human food consumption, with 80% to 90% of users (Shimizu and Desrochers, 2012).

Based on Figure 1, Indonesia as the largest producer CPO in the world controls 56% of total global exports with an export capacity of 73.5% of total production in 2020 (Purba, 2020). Even though in 2020 Indonesia and the world were hit by the Covid-19 pandemic, the export value of these palm oil products still showed a positive figure of around US$ 35 billion in 2021, up 9.32% due to rising prices. In terms of CPO demand due to the Covid-19 pandemic, only import demand from the Netherlands and Italy has decreased (Jamilah et al., 2022). This shows the high competitiveness of Indonesian CPO in the global market even though the world economy is experiencing a decline.

Price elasticity has become an important element in controversy among empirical studies of commodity competitiveness (Ismail et al., 2022). The nature of markets and their role in price determination are central to economics (Kharin, 2019). The significant increase in global CPO prices since the end of 2019 has resulted in an increase in the prices of CPO derivative products such as cooking oil, butter and other derivative products that have put great pressure on the Indonesian economy (Rosyadi et al., 2021). This also has an impact on unrest in Indonesia's CPO export destination countries such as India, China, Pakistan and as well as Bangladesh where most of the world's population is located (Figure 2) (Ali, 2019).

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The existence of the Indonesian government's policy regarding biodiesel production for sustainable energy utilization will reduce Indonesia's dependence on fuel oil imports. Furthermore, the implementation of the B30 policy has an impact on increasing domestic demand for CPO and also causes a multiplier effect in the form of added value in the downstream palm oil industry (CPO to biodiesel) and employment (Zulqarnain et al., 2020).

The biodiesel policy in Indonesia has several objectives including, increasing the export value of the country's palm oil by encouraging its use in domestic transportation, reducing the country's dependence on imported fossil fuels, which can significantly drain the country's foreign exchange reserves, encouraging the domestic agricultural industry by providing new markets for domestic crops such as palm oil, which is used as the main raw material for biodiesel production in Indonesia, promoting energy security and reducing the country's vulnerability to fluctuations in world oil prices, the use of biodiesel can result in significant reductions in greenhouse gas emissions, and creating new jobs in agriculture and biofuel production ((Naylor and Higgins, 2017; Manik et al., 2013; Kharina et al., 2016; Halimatussadiah et al., 2021).

In Indonesia, the government still uses subsidized fuel policies, including solar is a type of fuel oil which is still massively used for transportation in the plantation and mining sectors, including the CPO industry. The purpose of the subsidized diesel oil policy in Indonesia is to support the country's industrial competitiveness by providing cheap and affordable fuel for the transportation and manufacturing sectors Dartanto (2013), which are the main drivers of economic growth in the country. In addition, the policy also aims to encourage the development of the country's manufacturing sector and support the growth of other industries, such as agriculture, by providing a reliable source of affordable fuel (Kumar et al., 2013).

Industrial competitiveness has always been an interesting study in empirical studies, one of which is due to market structure (Worley et al., 2008). Market structure is a market component that will affect the nature of competition (Wilden et al., 2013). The CPO industry in Indonesia continues to grow every year, of course, it has an impact on the competitive nature of the CPO industry in Indonesia. The lower concentration of an industry makes competition high, thus suppressing price levels and affecting competitiveness. In addition to market structure, global influences such as the Covid-19 pandemic, the war between Russia and Ukraine which has an impact on world CPO prices, are expected to affect the competitiveness of Indonesian CPO in the global market. We, therefore, answer the following questions:

- What is the structure of the Indonesian CPO Industry?
- How is the competitiveness of the Indonesian CPO Industry in the international market?
- Do market structures, CPO prices, subsidized fuel oil prices, and Biodiesel policies affect the competitiveness of the Indonesian CPO industry?

Several empirical studies support the arguments in this research objective. Othman et al. (2022) studied the competitiveness of the Malaysian CPO industry and other major producing countries, showing that Indonesia is a strong competitor to Malaysia. The level of continuity of trade continues to increase from time to time, reflecting the increasing competitiveness of Indonesian CPO Industry companies in the global market, and in terms of competitiveness is heavily influenced by government policies and taxes. Harahap et al. (2019) concluded that dependence on the use of subsidized fuel oil affects the competitiveness of the CPO industry. Rifin et al. (2020) found that CPO prices also affect competitiveness in international trade.

2. LITERATURE REVIEW

According to Lipczynski et al. (2017) industry concentration refers to the number and size distribution of companies. In this case, the fewer the number of companies that exist in the market and the larger the size of those companies relative to the size of the entire company in the industry is usually indicated by a higher sales share. This is based on the argument that as the level of industry concentration increases, the ability of existing companies in the market to suppress competition and coordinate price policies among such companies tends to get higher.

According to Rostow (1960) in Cho and Moon (2003) competitiveness is the ability to produce goods or services that meet the test of international competition while our citizens enjoy sustainable standards. Krugman et al. (2012) explain that the country's competitiveness depends on the country's industrial capacity to continue to innovate and develop.

Cho and Moon (2003) explains the nine-factor model for assessing international competitiveness. According to him, there are four physical determinants of international competitiveness, namely the resources conferred, the business environment, related industries and supporting domestic demand; there are also four human factors namely workers, government policies, entrepreneurs and professional managers and engineers. External opportunities are listed as the ninth factor. Political factors and bureaucrats that can increase international competitiveness are through the application of efficient and non-corrupt bureaucracies to implement state policies and politicians who have a commitment to growth and success. Regulation can change demand factors (e.g. regulations related to fuel subsidies), a country's government has an important role in shaping the extensibility of factors that determine a country's level of competitive advantage in the industry. Porter (1990) also explained that the company's strategy, structure, and level of competition can affect competitiveness. Furthermore, factors in the condition of resource availability in a country, namely human resources, raw materials, knowledge, capital, and infrastructure that affect the price of these commodities so that they affect competitiveness.

3. METHODOLOGY

The scope of this study is the CPO industry. The industry category in this study is from the 2020 Indonesian Business Field Standard Classification (KBLI) with code 10432, which is included in the production of the processing industry sub-industrial vegetable and animal oils and fats (Central Bureau of Statistics Indonesia, 2022).

Annual data from 2001 to 2020. The data used in this study are secondary data related to the Indonesian CPO industry, the total number of Indonesian CPO companies officially registered with the government, Indonesia's biodiesel policy, subsidized fuel oil (diesel) price. In this study, data were obtained from the Indonesian Central Bureau of Statistics (BPS), UN Comtrade, Ministry of Trade of the Republic of Indonesia.

3.1. Revealed Comparative Advantage (RCA)

The most popularly used measurement of competitiveness is the RCA which measures comparative advantage. Introduced by Ballasam (1965), the rationale underlying this method is that a country's export performance is determined by its relative level of competitiveness against related products made by other countries. Mathematically to calculate the RCA index is as follows:

$$RCA = \left(\frac{X_{IK}}{X_{IM}}\right) / \left(\frac{X_{WK}}{X_{WM}}\right) \quad \text{(i)}$$

Where:
X_{IK} = Export value of products I country K
X_{IM} = Total export value of country k
X_{WK} = Export value of world product I

The RCA method is used to measure a country's comparative advantage over a product by comparing its share or ratio of exports to the ratio of that product to world exports. If the RCA values >1, it means that a country has a comparative advantage over the world average, so the product is of high power.

3.2. Lorenz Curve and Gini Coefficient

Lipczynski et al. (2017) the Lorenz curve shows a variation in the cumulative size of n largest companies in an industry, since n varies from 1 to N (where N is the total number of companies) (Figure 3).

- If all companies are the same size, the Lorenz curve is a 45° line OCA. At point C, for example, exactly half of the industry member companies make up exactly half of the total industry size, represented by the OD distance.
- If the company size distribution is skewed, the Lorenz curve is an OBA concave curve. At point B, exactly half of the industry member companies make up three-quarters of the total industry size, represented by OD. The Gini coefficient is defined as follows:

$$G = \frac{\text{The crescent area between OBA and OCA}}{\text{Area of triangle ODA}}$$

- The maximum possible value of G = 1 corresponds to the case of one dominant company with a market share close to one, and N-1 small companies each with a negligible market share. In this case the Lorenz curve approaches the OD line.
- The minimum value of G = 0 corresponds to the case of N the same sized company. In this case the Lorenz curve is the OCA of the 45-degree line, so the numerator in the formula for G is zero.

The definition of the formula for the Gini coefficient is as follows:

$$G = \left\{\frac{\sum_{n=1}^{N} \cdot \sum_{i=1}^{n} Xi}{0.5(N+1)\sum_{i=1}^{N} Xi}\right\} - 1 \quad \text{(ii)}$$

Where xi is the size of company i (as before, measured using sales, assets, jobs, or some other appropriate size indicator) when the company is ranked in descending order of size.

3.3. Error Correction Model (ECM)

The ECM regression aims to explain whether an independent variable affects the dependent variable in the short and long term. This study analyzes the effect of CPO Price, Indonesian Biodiesel Policy, Subsidized Fuel Oil (Diesel) Price, and Structure used as independent variables (X) and Competitiveness as bound variables (Y). The equation in the short term is as follows:

$$\Delta Y = \beta_0 + \beta_1 \Delta_X1_t + \beta_2 \Delta_X2_t + \beta_3 \Delta_X3_t + \beta_4 \Delta X4_t + \beta_5 ECTe_t \quad \text{(iii)}$$

$$\Delta RCA = \beta_0 + \beta_1 \Delta_PCPO_t + \beta_2 \Delta_BD_t + \beta_3 \Delta_PBBM_t + \beta_4 \Delta Gini_t + \beta_5 ECTe_t \quad \text{(iv)}$$

While the equation in the long term is as follows:

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + e \quad \text{(v)}$$

$$RCA = \beta_0 + \beta_1 PCPO + \beta_2 BD + \beta_3 PBBM + \beta_4 GINI + e \quad \text{(vi)}$$

Where, Y is the dependent variable, β_0, 1, 2, 3, 4 is the coefficient of the 1st, 2, 3, 4th variable, RCA is competitiveness, PCPO is International CPO Price, BD is Indonesia's Biodiesel Policy, PBBM is Subsidized fuel prices, and Gini Coefficient is Industry concentration, e is the error term.

4. ANALYSIS AND DISCUSSION

The following is the analysis of the data and the trend of the variables used in the research:

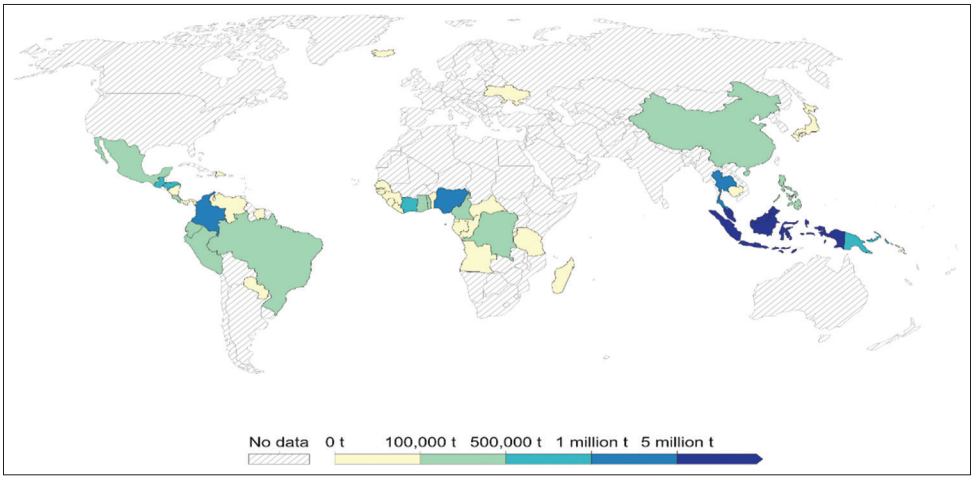
4.1. Competitiveness Calculation Results using Revealed Competitive Advantage (RCA)

A country or region will have competitiveness in the form of a comparative advantage if the country or region is able to produce and export goods or services at relatively lower costs than the country or region imports goods and services from other countries (Nesti and Tan, 2017). Higher specialization can lead to higher productivity and competitiveness (and vice versa) (Zdráhal et al., 2020).

Based on Table 1, the value of processed RCA products, the results are obtained annually from 2000-2020, the value of RCA > 1, then CPO commodities in Indonesia have a comparative advantage above the world average so that CPO commodities have strong competitiveness in the international market.

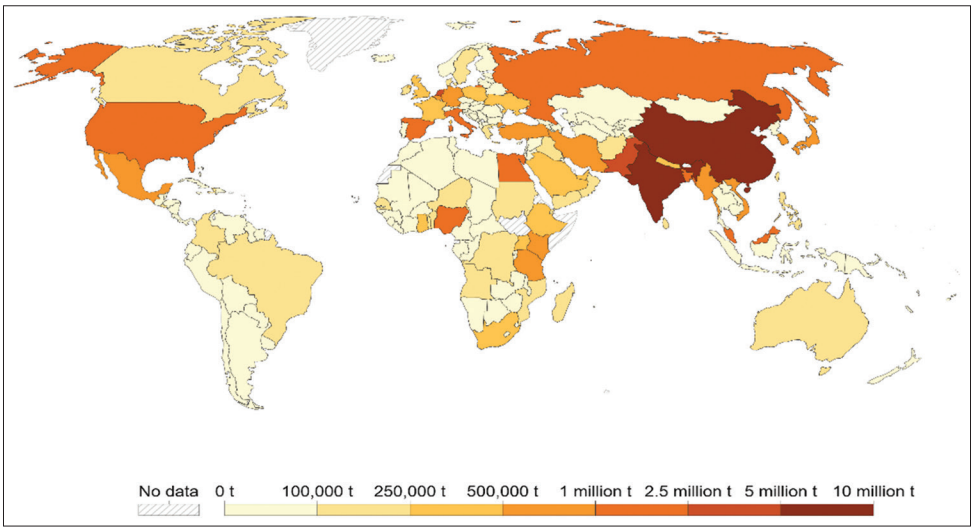
Export competitiveness is one of the determining factors in the persistence of a country's long-term economic growth (Ansonfino et al., 2021). The derivative value of RCA in 2008 was caused by the global economic crisis, affecting the competitiveness of the country's CPO exports because financial, credit, and mortgage pressures in developed countries changed the global demand for

Figure 1: Crude palm oil production



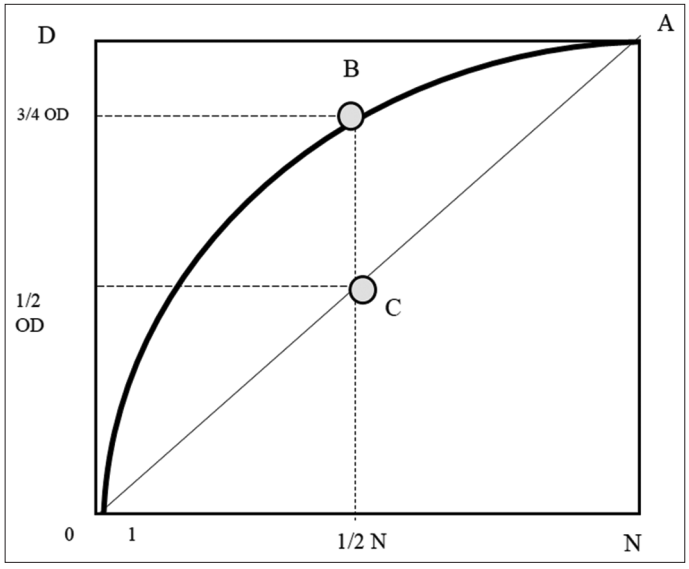
Source: Food and Agriculture Organization of the United Nations (2019)

Figure 2: Crude palm oil imports



Source: Food and Agriculture Organization of the United Nations (2019)

Figure 3: Lorenz curve



Source: Lipczynski et al., (2017)

this commodity (Krugman, 2011). Also, overvaluation of financial derivative products and rising oil prices raise input costs, shrinking investment, productivity, and competitiveness of CPO exports (Arias et al., 2020).

Indonesia has the highest competitiveness in the international market for CPO due to several factors, including: Indonesia is the world's largest palm oil producer and has abundant land suitable for growing oil palm trees, Indonesia has a favorable climate and geography, as well as relatively low labor costs, which contributes to the low cost of CPO production in the country, the Government of Indonesia has implemented policies to support and advance the palm oil industry, including tax incentives and export subsidies, Strong distribution network: Indonesia has an established distribution network, both domestically and internationally, that assists in efficient CPO exports (Petrenko et al., 2016; Varkkey et al., 2018).

Indonesia's main competitor in international trade in CPO is Malaysia. In research Othman and Tahir (2022) found that

Indonesia's competition in the long term is difficult to compete with because it has greater potential for economies of scale and other cost advantages when compared to Malaysia. Ramadhani and Santoso (2019) concluded that CPO exports by Indonesia are driven by the use of palm oil as cooking oil in Asian countries such as China, India, and Pakistan.

In terms of importers of CPO commodities in the world, India and China are the two largest (Guerrieri and Caffarelli, 2012). The role of the Indian state in international trade is enough to make Indian consumption the main determinant of the relative price of CPO (Carter et al., 2007).

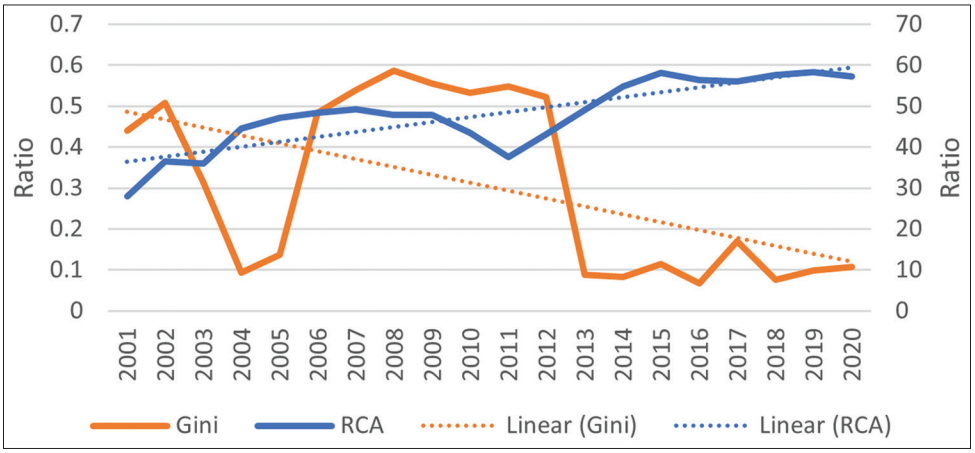
4.2. Results of Industrial Concentration Calculation using Gini Coefficient

The following is the result of the calculation of the Gini coefficient which is used as a measure of the concentration of the Indonesian CPO industry.

Based on Table 2, it is known that from 2001–2020 the results of calculating the Gini coefficient are getting closer to 0, which means that Indonesia's CPO industry is an industry that is not concentrated. In the research of Wibowo et al. (2021) which analyzed the concentration of the Malaysian and Indonesian CPO Industries resulted in a less concentrated market trend, but Indonesia and Malaysia as the main palm oil producers and exporters still have at least 70% of the total export share. The market trend of Indonesia's CPO industry is less concentrated due to several factors, including: The Indonesian government has implemented policies aimed at encouraging competition and reducing market concentration in the CPO industry, these include policies aimed at encouraging the development of smallholder farmers and increasing their participation in the industry, the growth of the CPO industry in Indonesia has attracted new players to the market, increased competition and reduced concentration, the increasing global demand for sustainable palm oil has led to an influx of new players in the industry, including smaller and more environmentally conscious producers (Hospes, 2014).

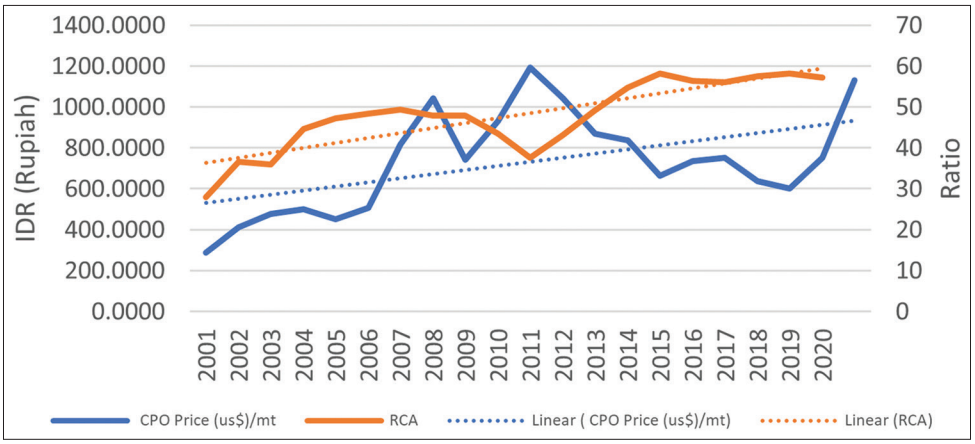
The market size (structure) effect shows the change of the receptivity of the reference market, which can also at constant market share modify the exports to the reference market (Juhász and Wagner, 2013). It is known from the Figure 4 that the results of the Gini ratio in the Indonesian CPO industry show a volatile movement. From the annual average results, the results are always close to zero, meaning that the Indonesian CPO Industry

Figure 4: Results of Industry Concentration and revealed comparative advantage



Source: UN Comtrade, data processed (2001–2020)

Figure 5: Crude palm oil prices and revealed comparative advantage



Source: World Bank and UN Comtrade, data processed (2001–2020)

is not concentrated. As concentration increases, competitiveness decreases, this shows a negative relationship between the two variables. High levels of concentration can also reduce the bargaining power of suppliers and consumers, as they have fewer options to choose from and less influence over the market (De Marchi et al., 2013).

In the long term, the price and demand for CPO shows an increasing trend in line with the growth of the world population and therefore increases the consumption of products with palm oil raw materials such as food and products (Figure 5). The increase in CPO prices itself results in a decrease in demand for purchasing power for CPO products and their derivatives, thereby reducing the volume and value of exports and the competitiveness of CPO in the international market. Higher prices for palm oil can lead to decreased demand for palm oil-based products, as consumers switch to alternative, lower-priced products (Ruggeri and Samoggia, 2018). Consumers will also tend to choose other substitutes or in this case other vegetable oils such as sunflower oil and soybean oil which are increasingly relatively more affordable although still more expensive compared to the price of CPO oil.

Intense competition in the global market has led to the enactment of several policies, which can limit and facilitate trade (Tandra et al., 2022). As a highly contested oilseed crop, CPO dominates discussions on sustainability compared to other vegetables in the oil and fat sector (Naidu and Moorthy, 2021). The formulation of policies underlying the sustainable development of the palm oil industry needs to strike a balance between environmental, social, and economic attitudes (Zakaria et al., 2020). Based on Figure 6, it is known that Indonesia's biodiesel policy has been implemented since 2016. When the biodiesel policy was implemented, the competitiveness of the Indonesian CPO Industry increased. Although it is still increasing, in the future Indonesia's CPO exports do face several challenges. Indonesia's palm oil exports are increasing in line with the increasing demand for palm oil in international markets, especially India, China, and the European Union. In the domestic market, the consumption of palm-based biofuels is higher than the composition of biofuel exports, due to the government's mandatory policy on the use of biodiesel from B-5(2010), B-10(2012), B-15(2014), B-20(2016), and B-30(2020) (Jamilah et al., 2022). The Indonesian government has set mandates for the use of biofuels, such as biodiesel, in the domestic market to reduce the country's dependence on fossil fuels and increase the use of renewable energy sources (Kumar et al., 2013; Mofijur et al., 2015). Development of downstream palm oil industry including Biodiesel is expected to increase the added value of palm oil products for Indonesia which are mostly just enjoyed by other countries (Singagerda et al., 2018).

From the Figure 7 above, it is known that the price movement of subsidized diesel oil in Indonesia always increases. The highest price of subsidized diesel in 2014 was Rp 7,500 rupiah but fell in 2015 at Rp 6,500 due to the decline in world crude oil prices and the rupiah exchange rate (Baumeister and Kilian, 2016).

In this case, subsidized diesel oil has an impact on its price which is cheaper than the market price which the difference reaches an average of 66% if averaged from 2001-2020 so that it affects the increasing competitiveness caused by the Indonesian CPO industry using subsidized fuel oil in its production and transportation.

4.3. Results and Discussion of Estimated ECM

The following are the stages of the estimation results of the ECM method in this study:

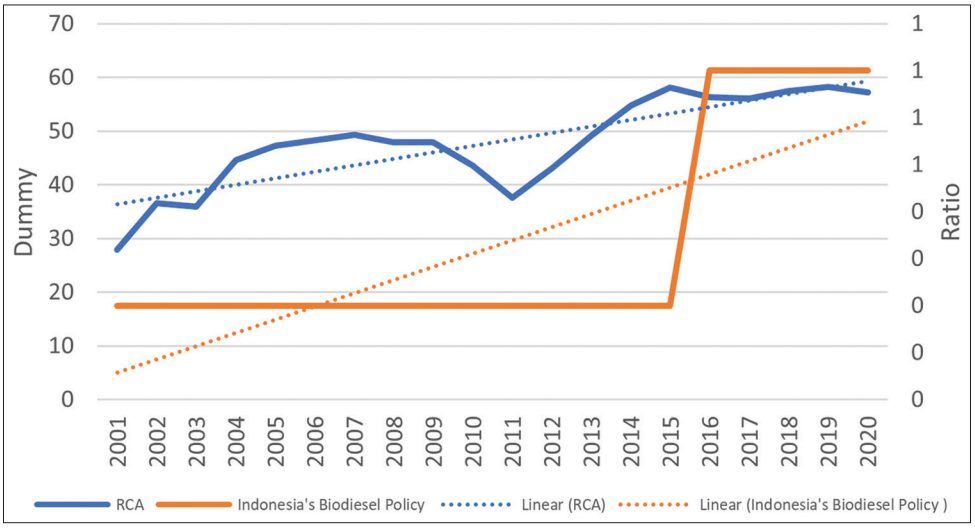
4.4. Unit Root Test

Based on Table 3, it can be seen that all variables are stationary on the first different, because all variables have a probability of less than alpha $\alpha = 5\%$ (significant).

4.5. Cointegration Test

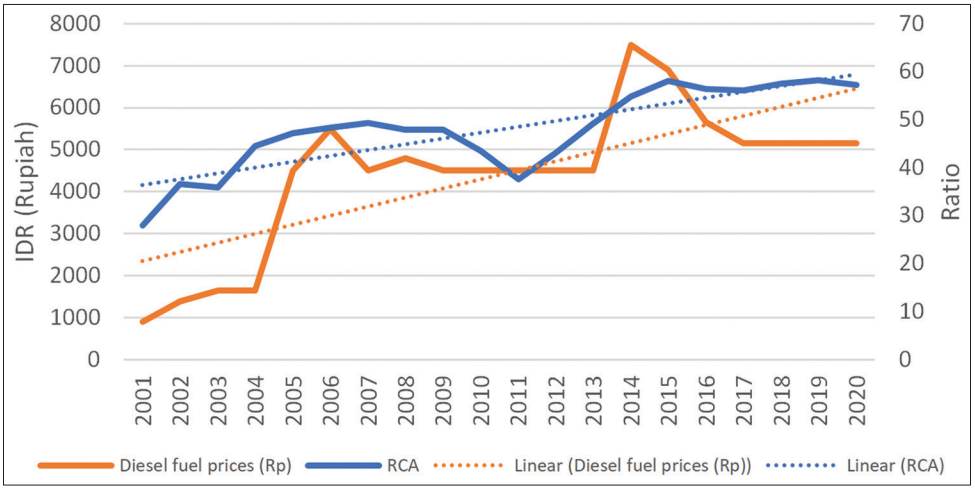
Based on Table 4, the cointegration test from Johansen, a statistical trace value = 121.8242 was obtained > a critical value of $\alpha = 5\% = 69.82$ with a probability of $0.000 < \alpha = 0.05$ then H0 was rejected, which means that the data of all variables have a long-term relationship (cointegrated).

Figure 6: Indonesia's Biodiesel Policy and revealed comparative advantage



Source: Institute for Essential Services Reform and UN Comtrade, data processed (2001–2020)

Figure 7: Indonesian Subsidized Diesel Fuel Prices and revealed comparative advantage



Source: CEIC Data and UN Comtrade, data processed (2001–2020)

4.6. Short-term Estimation Results

In the short-term ECM model using Least Squares, the following short-term estimates are generated:

$$\Delta RCA = 0.820035 + (-5.712165)\,\Delta_PCPO_t + 1.395145\Delta_BD_t + 5.863557\Delta_PBBM_t + -8.312636\Delta Gini_t + (-0.792963)ECT$$

From the short-term estimation equation in Table 5, it shows that CPO Price (PCPO) and Industry concentration is negatively and significantly correlated to CPO competitiveness. Biodiesel Policy (BD) is positively correlated but not significant. The variable price of fuel oil (diesel) subsidies correlates positively and significantly.

The value of the ECT coefficient shows how much the equilibrium cost at the level of competitiveness (RCA) in the earlier period adjusted for the present change is -0.792963 where the probability of ECT is 0.0084 which means significant at $\alpha = 5\%$. While the ECT coefficient that has a negative sign indicates that the model has a short-term relationship.

4.7. Long-Term Estimation Results

In the long-term ECM model using Least Squares, a long-term estimate is generated as follows:

$$RCA = -6.110938 + (-4.414982)\,PCPO + 5.139311\,BD + 10.2749\,PBBM + (-9.918397)\,GINI + \varepsilon$$

From the long-term estimation equation in Table 6, it shows that CPO Price (PCPO) is negatively and insignificantly correlated to CPO competitiveness. Biodiesel policy (BD) and the price of fuel oil are positive and significant. Industry concentration is negatively correlated and has a significant effect.

4.8. Discussion of CPO Industry Analysis in the Short and Long Term

The short-term estimation equation shows that CPO prices are negatively and significantly correlated to CPO competitiveness.

Table 1: Results of RCA Indonesia CPO Industry 2001–2020

Year	RCA value	Year	RCA value
2001	27.98183	2011	37.63006
2002	36.59414	2012	43.12149
2003	35.96132	2013	49.16183
2004	44.55598	2014	54.81517
2005	47.24825	2015	58.15362
2006	48.36279	2016	56.39279
2007	49.32231	2017	56.09925
2008	47.87606	2018	57.55124
2009	47.93711	2019	58.23941
2010	43.53909	2020	57.24834

Source: UN Comtrade, data processed (2001–2020). RCA: Revealed Comparative Advantage, CPO: Crude palm oil

Table 2: Results of Indonesia CPO Industry Concentration 2001–2020

Year	Gini	Year	Gini
2001	0.439615	2011	0.548842
2002	0.508395	2012	0.521722
2003	0.31367	2013	0.088816
2004	0.093358	2014	0.083853
2005	0.136281	2015	0.115198
2006	0.483983	2016	0.067441
2007	0.539051	2017	0.170539
2008	0.586615	2018	0.075846
2009	0.555527	2019	0.098709
2010	0.533207	2020	0.107863

Source: Central Bureau of Statistics Indonesia, data processed (2001–2020). CPO: Crude palm oil

Table 3: Unit root test

Variable	Level		Level 1	
	T-Statistics	Probability	T-Statistics	Probability
PCPO	−6.53545	0.0075***	−6.53545	0.0000***
BD	−5.03496	0.0668*	−5.03496	0.0000***
PBBM	37.2242	0.0788*	37.2242	0.0000***
Gini	44.9013	0.0001***	44.9013	0.0000***

***, ** represent statistical significance at 1%, 5%, and 10%, respectively
Source: Output EViews (2001-2020)

This shows that any increase in international prices will always be followed by a decrease in the level of export competitiveness,

Table 4: Cointegration Test

No. of CE (s)	Eigenvalue	Statistics	Critical value	Probability
None*	0.953767	121.8242	69.81889	0.0000***
At most 1*	0.806125	66.49117	47.85613	0.0004***
At most 2*	0.692394	36.96141	29.79707	0.0063***
At most 3*	0.552497	15.74059	15.49471	0.0459**
At most 4	0.067983	1.267277	3.841466	0.2603

***, **, and * represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001–2020)

Table 5: Short-term ECM estimation results

Variables	Coefficient	Std. Error	t-Statistics	Probability
C	0.820035	0.703570	1.165535	0.2647
D (PCPO)	−5.712165	2.285745	-2.499039	0.0266**
D (BD)	1.395145	3.025837	0.461077	0.6524
D (PBBM)	5.863557	2.368215	2.475940	0.0278**
D (GINI)	−8.312636	4.693110	−1.771243	0.0999*
ECT(-1)	−0.792963	0.255509	−3.103462	0.0084***
R Squared	0.669915			
Prob F Statistics	0.007274***			

***, **, and * represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001-2020). ECM: Error correction model

Table 6: Long-term ECM estimation results

Variables	Coefficient	Standard error	t-statistics	Probability
C	−6.110938	19.57744	−0.312142	0.7592
PCPO	−4.414982	2.890605	−1.527356	0.1475
BD	5.139311	1.920145	2.676523	0.0173**
PBBM	10.27249	1.305558	7.868274	0.0000***
GINI	−9.918397	4.342323	−2.284123	0.0374**
R-squared	0.902956			
Prob F statistics	0.0000***			

***, ** represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001-2020). ECM: Error correction model

and vice versa. In the short term, the price of CPO and the competitiveness of CPO can be negatively and significantly correlated for several reasons including, when CPO demand increases and supply remains, prices will rise, and competitiveness will decrease. On the contrary, when demand decreases and supply remains, prices will fall, and competitiveness will increase. CPO competes with other vegetable oils such as soybean oil and sunflower oil. If the price of this oil falls, it will increase its competitiveness and reduce the competitiveness of CPO. This is in line with research conducted by Arias et al. (2020); Ziae and Ali (2021); Jambor and Babu (2016). However, this only has a significant effect on short-term circumstances, in the long-term, the result is that the CPO price has no effect. There is no effect on CPO prices on their competitiveness because CPO prices tend to be relatively stable in the long term, and price fluctuations do not have a significant impact on the demand for these commodities. In addition, CPO is often substituted with other vegetable oils, so changes in its price do not necessarily affect its competitiveness. Overall, while short-term changes in CPO prices can affect its competitiveness, the long-term stability of demand, substitution options, and cost competitiveness make it a competitive commodity.

Biodiesel policy targets aim to reduce imported fossil fuels, diversify energy sources, and reduce GHG emissions. Indonesia has biodiesel blending targets for the transportation and industrial sectors set at 15% in 2015, 20% in 2016 and 30% from 2020 to 2025 (Khatiwada et al., 2021). In the short term, Biodiesel (BD) policy is positively but not significantly correlated. Meanwhile, in the long term, the policy is positive and significant. In the short term, the relationship between biodiesel policy and CPO prices can be positively correlated but not necessarily significant for several reasons: In the short term, market conditions can be very volatile and uncertain, making it difficult to establish a strong and significant relationship between policy and price. Policies may take some time to impact the market, so their effect on CPO prices may not be direct or significant (Dutta et al., 2021). Whereas in the long run, the relationship between biodiesel policy and CPO prices can be positive and significant because in the long run, policies tend to become more stable, reducing market uncertainty and allowing the emergence of a stronger relationship between policy and price. Over time, policies will most likely be implemented more consistently and effectively, leading to a stronger and significant relationship between policy and price. In the long run, market participants can adapt to policies and their influences, which leads to a more stable and predictable relationship between policy and prices. Overall, while the relationship between biodiesel policy and CPO prices may not be significant in the short term, it can be both positive and significant in the long run as policies become more stable, implemented more consistently, and market participants adjust to their influence. This is in line with the research of Von Geibler (2013); Johari et al. (2015); and Rifin et al. (2020). On one hand, the policy has helped to promote the development of the domestic biodiesel industry, which is a key driver of economic growth in Indonesia (Koizumi, 2015; Ewing and Msangi, 2009). The policy requires a mandatory use of biodiesel in transport, with a target of reaching 30% biodiesel blend (B30) in 2020, which has increased the demand for palm oil as the main raw material for biodiesel production (Zahan, 2018). This has boosted the demand for CPO and supported the growth of the CPO industry, which is a major contributor to Indonesia's economy. On the other hand, the biodiesel policy has had negative impacts on the competitiveness of the CPO industry and the environment. Firstly, the mandatory use of biodiesel has resulted in a significant increase in the domestic consumption of CPO, leading to a shortage of supply for export markets and, as a result, higher prices for CPO in the domestic market. This has made it difficult for CPO exporters to compete with other producers in the global market, which has hurt the competitiveness of the industry (Mekhilef et al., 2011, Johari et al., 2015, Ahmad et al., 2011). Secondly, the expansion of the CPO industry has also led to deforestation and loss of biodiversity, which has negative environmental impacts (Taheripour et al., 2019). The expansion of oil palm plantations has been associated with the destruction of rainforests, leading to habitat loss for wildlife, increased greenhouse gas emissions, and soil degradation (Meijaard et al., 2020).

The price of subsidized fuel oil (diesel) is positively and significantly correlated in both the long and short term. Fuel oil

is one of the main elements, even the largest in the components of carrying costs, production, and distribution costs. In the subsidy, the price of diesel fuel oil so that the price is cheaper than the market price has a positive influence on competitiveness due to the Indonesian CPO industry using subsidized fuel in production and transportation. This is an advantage for the Indonesian CPO Industry because it is more efficient in competing with CPO products from other countries. This is supported by the Indrawan (2020) report. Favorable government policies: The Indonesian government provides various incentives and support for the palm oil industry, making it easier for companies to operate and increasing competitiveness. The provision of various subsidies by the Indonesian government is in accordance with a study conducted by Brandi et al. (2013). The Indonesian government subsidizes fuel oil to the industry as part of its economic and energy policy. The reasons for this subsidy include: to support economic growth: By reducing the cost of energy, the government hopes to boost the competitiveness of Indonesian industries, including the palm oil industry, and stimulate economic growth (Dartanto, 2013). However, it is important to note that the subsidized diesel oil policy is not without its drawbacks. The policy can lead to overconsumption of fuel, which can contribute to pollution and harm the environment (Wesseh et al., 2016). Furthermore, the subsidies are costly to the government, which can put a strain on public finances and limit the government's ability to invest in other areas, such as education and healthcare (Javier et al., 2012).

Industrial concentrations are negatively and significantly correlated in both the long and short term. From the results of concentration, it shows that the Indonesian CPO Industry is an industry that is not concentrated. Negative signs indicate that the lower the industry concentration, the higher the competition between CPO industries, which has an impact on the price of Indonesian CPO getting cheaper and has an impact on high competitiveness. The effect of concentration on competitiveness is in line with Aritenang (2021) research. This is not in line with the research conducted by Marković et al. (2019) mentioning that concentrated industries have greater opportunities in International trade. The positive impact of the low concentration level of the CPO industry i.e., Low-concentrated industries can lead to more competition among companies, which can benefit consumers and lead to innovation and lower prices (Kariyasa and Dewi, 2011). This can make the industry more attractive to buyers and increase the demand for CPO. In addition, Low-concentrated industries will be more resilient to economic shocks or changing global market conditions, as smaller companies may be able to adapt more quickly to changing circumstances and find new markets or niches to serve (Curzi et al., 2021).

5. CONCLUSION

Indonesia's CPO industry has a comparative advantage in the international trading market. This is showed through the calculation of more than one RCA value. Indicates that the Indonesian CPO industry can produce and export CPO products and their derivatives at a relatively cheaper cost than other countries so as to increase competitiveness in the international market. In addition, with more stable prices, Indonesia does not need to import CPO from other countries and is able to meet domestic needs. Based on the ECM estimates, the factors that affect competitiveness in the short term are the price of CPO, solar subsidies, and the concentration of industry, while in the long term the variables that affect are biodiesel policy, subsidized diesel oil and industrial concentration.

The results show that the lack of concentrated CPO industry in Indonesia indicates that there is no gap between large companies and companies with small business scales. A Gini coefficient value close to zero indicates the more dispersed concentration, or close to perfect competition behavior. The less concentrated CPO industry results in a more competitive market and prices. The low concentration of the CPO industry makes competition between companies higher so that it can reduce price levels and affect the competitiveness of CPO.

Nationally, the B30 policy has many benefits for Indonesia. From an economic point of view, the use of biodiesel, which is a mixture of diesel fuel, has an impact on reducing oil imports so as not to reduce the country's foreign exchange reserves. The large absorption of CPO as a feedstock for biodiesel due to the B30 policy has implications for palm oil stocks in the global market to be maintained (no oversupply). The implication is that international prices of palm oil are stable and tend to increase. Another implication is that the biodiesel policy can maintain domestic CPO prices so that they are stable and do not fall, supply added value through down streaming the agricultural industry, save the country's foreign exchange and trade balance, provide job opportunities, and maintain energy security. In addition, the increase in CPO production has an impact on increasing CPO demand, thereby increasing competitiveness in international trade. Therefore, while Indonesia's biodiesel policy has had positive impacts on the domestic economy and the development of the biodiesel industry, policymakers must also consider the negative impacts on the competitiveness of the CPO industry and the environment. It is important to strike a balance between economic growth, social welfare, and environmental sustainability to ensure that the benefits of the policy are realized without harming the competitiveness of the CPO industry or the environment.

The fact that the CPO industry that uses subsidized diesel oil in the production and transportation process has an impact on its price that is cheaper than the market price, which has a difference of an average of 66% if on average from 2001-2020 so that this affects the increase in competitiveness. In terms of policy making, the efficiency of fuel oil consumption in the industrial sector and other sectors needs to be improved. In addition, the high dependence on fuel oil in energy consumption needs to be corrected through the substitution of fuel oil with non-fuel oil energy sources. Although this policy is felt to be unfair to the public, the provision of subsidies by the Indonesian government is a form of protecting the domestic industry so that solar subsidies show positive results for the increasing competitiveness of the Indonesian CPO industry. Overall, the subsidized diesel oil policy in Indonesia is intended to support the country's industrial competitiveness, but policymakers must carefully balance the benefits of the policy against its potential costs and drawbacks.

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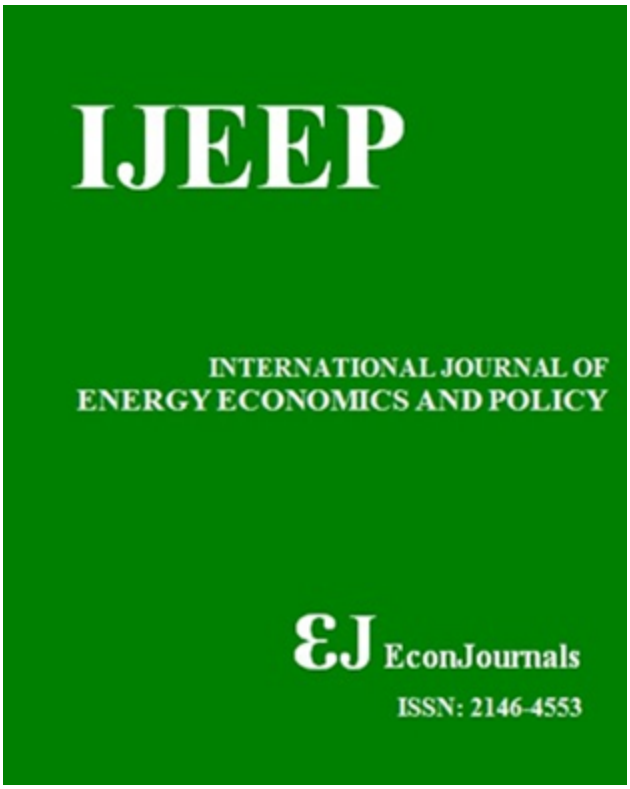

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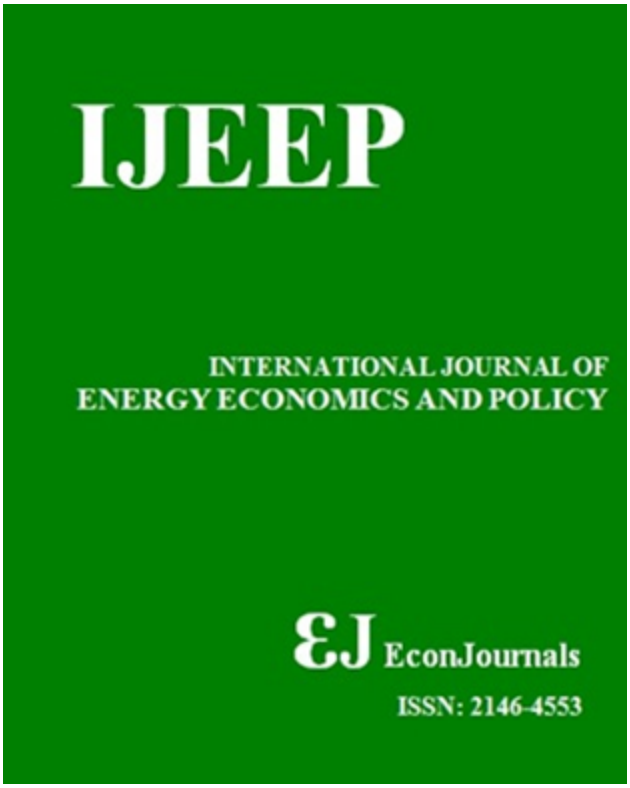

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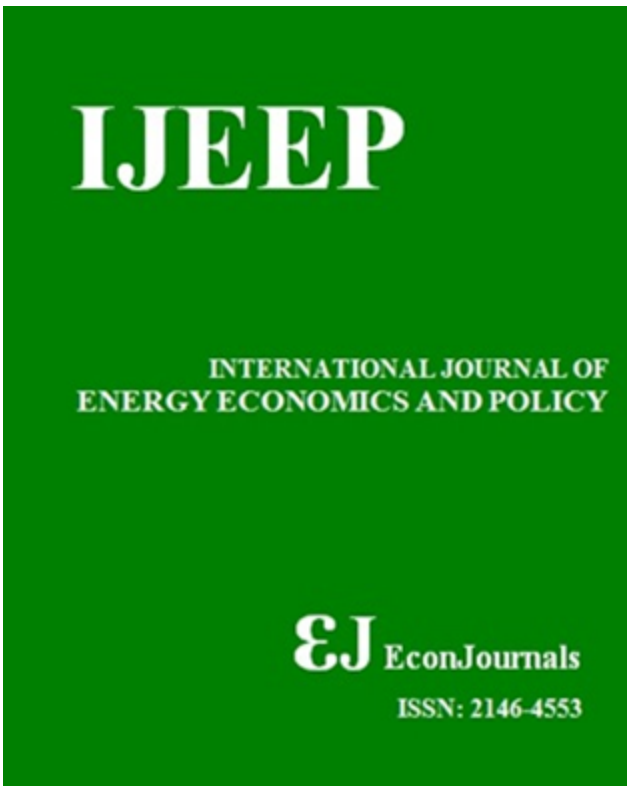

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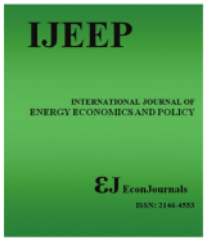

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Competitiveness, Market Structure, and Energy Policies: A Case Study of the World's Largest Crude Palm Oil Exporter

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ABSTRACT

Crude palm oil (CPO) is the mainstay of Indonesian agricultural products which is the largest CPO producing country in the world. The high market share of Indonesian CPO exports reflects the high competitiveness of Indonesian CPO in the global market. The purpose of this study is to determine the competitiveness of Indonesian CPO, the concentration of the Indonesian CPO industry, and analyze the factors that are suspected to affect the competitiveness of the CPO industry in Indonesia. The data used in this study are secondary data with a five-digit International Standard Industrial Classification (10432) using time series data for 2001–2020 and the analytical techniques used in this study include revealed comparative advantage, Gini coefficient, and error correction model. The results showed that Indonesian CPO has high competitiveness in the international market, the Indonesian CPO industry is not concentrated, in the short term the variables that affect competitiveness are CPO prices, subsidized solar prices policy, and industrial concentrations, while in the long term the influential variables are biodiesel policy, subsidized diesel oil policy and industrial concentration.

Keywords: Crude Palm Oil, Competitiveness, Biodiesel Policy, Subsidized Fuel Oil
JEL Classifications: D24, F62, L11, O13

1. INTRODUCTION

The crude palm oil (CPO) industry is one of the plantation commodities that has a strategic role in economic development, generates domestic income and foreign exchange (Nurfatriani et al., 2022). CPO is also known as a critical component for food security in Indonesia and other countries (Goh and Lee, 2010). CPO is one of the flexible commodities because of its benefits that can be utilized for daily activities, such as human food consumption, with 80% to 90% of users (Shimizu and Desrochers, 2012).

Based on Figure 1, Indonesia as the largest producer CPO in the world controls 56% of total global exports with an export capacity of 73.5% of total production in 2020 (Purba, 2020). Even though in 2020 Indonesia and the world were hit by the Covid-19 pandemic, the export value of these palm oil products still showed a positive figure of around US$ 35 billion in 2021, up 9.32% due to rising prices. In terms of CPO demand due to the Covid-19 pandemic, only import demand from the Netherlands and Italy has decreased (Jamilah et al., 2022). This shows the high competitiveness of Indonesian CPO in the global market even though the world economy is experiencing a decline.

Price elasticity has become an important element in controversy among empirical studies of commodity competitiveness (Ismail et al., 2022). The nature of markets and their role in price determination are central to economics (Kharin, 2019). The significant increase in global CPO prices since the end of 2019 has resulted in an increase in the prices of CPO derivative products such as cooking oil, butter and other derivative products that have put great pressure on the Indonesian economy (Rosyadi et al., 2021). This also has an impact on unrest in Indonesia's CPO export destination countries such as India, China, Pakistan and as well as Bangladesh where most of the world's population is located (Figure 2) (Ali, 2019).

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The existence of the Indonesian government's policy regarding biodiesel production for sustainable energy utilization will reduce Indonesia's dependence on fuel oil imports. Furthermore, the implementation of the B30 policy has an impact on increasing domestic demand for CPO and also causes a multiplier effect in the form of added value in the downstream palm oil industry (CPO to biodiesel) and employment (Zulqarnain et al., 2020).

The biodiesel policy in Indonesia has several objectives including, increasing the export value of the country's palm oil by encouraging its use in domestic transportation, reducing the country's dependence on imported fossil fuels, which can significantly drain the country's foreign exchange reserves, encouraging the domestic agricultural industry by providing new markets for domestic crops such as palm oil, which is used as the main raw material for biodiesel production in Indonesia, promoting energy security and reducing the country's vulnerability to fluctuations in world oil prices, the use of biodiesel can result in significant reductions in greenhouse gas emissions, and creating new jobs in agriculture and biofuel production ((Naylor and Higgins, 2017; Manik et al., 2013; Kharina et al., 2016; Halimatussadiah et al., 2021).

In Indonesia, the government still uses subsidized fuel policies, including solar is a type of fuel oil which is still massively used for transportation in the plantation and mining sectors, including the CPO industry. The purpose of the subsidized diesel oil policy in Indonesia is to support the country's industrial competitiveness by providing cheap and affordable fuel for the transportation and manufacturing sectors Dartanto (2013), which are the main drivers of economic growth in the country. In addition, the policy also aims to encourage the development of the country's manufacturing sector and support the growth of other industries, such as agriculture, by providing a reliable source of affordable fuel (Kumar et al., 2013).

Industrial competitiveness has always been an interesting study in empirical studies, one of which is due to market structure (Worley et al., 2008). Market structure is a market component that will affect the nature of competition (Wilden et al., 2013). The CPO industry in Indonesia continues to grow every year, of course, it has an impact on the competitive nature of the CPO industry in Indonesia. The lower concentration of an industry makes competition high, thus suppressing price levels and affecting competitiveness. In addition to market structure, global influences such as the Covid-19 pandemic, the war between Russia and Ukraine which has an impact on world CPO prices, are expected to affect the competitiveness of Indonesian CPO in the global market. We, therefore, answer the following questions:

- What is the structure of the Indonesian CPO Industry?
- How is the competitiveness of the Indonesian CPO Industry in the international market?
- Do market structures, CPO prices, subsidized fuel oil prices, and Biodiesel policies affect the competitiveness of the Indonesian CPO industry?

Several empirical studies support the arguments in this research objective. Othman et al. (2022) studied the competitiveness of the Malaysian CPO industry and other major producing countries, showing that Indonesia is a strong competitor to Malaysia. The level of continuity of trade continues to increase from time to time, reflecting the increasing competitiveness of Indonesian CPO Industry companies in the global market, and in terms of competitiveness is heavily influenced by government policies and taxes. Harahap et al. (2019) concluded that dependence on the use of subsidized fuel oil affects the competitiveness of the CPO industry. Rifin et al. (2020) found that CPO prices also affect competitiveness in international trade.

2. LITERATURE REVIEW

According to Lipczynski et al. (2017) industry concentration refers to the number and size distribution of companies. In this case, the fewer the number of companies that exist in the market and the larger the size of those companies relative to the size of the entire company in the industry is usually indicated by a higher sales share. This is based on the argument that as the level of industry concentration increases, the ability of existing companies in the market to suppress competition and coordinate price policies among such companies tends to get higher.

According to Rostow (1960) in Cho and Moon (2003) competitiveness is the ability to produce goods or services that meet the test of international competition while our citizens enjoy sustainable standards. Krugman et al. (2012) explain that the country's competitiveness depends on the country's industrial capacity to continue to innovate and develop.

Cho and Moon (2003) explains the nine-factor model for assessing international competitiveness. According to him, there are four physical determinants of international competitiveness, namely the resources conferred, the business environment, related industries and supporting domestic demand; there are also four human factors namely workers, government policies, entrepreneurs and professional managers and engineers. External opportunities are listed as the ninth factor. Political factors and bureaucrats that can increase international competitiveness are through the application of efficient and non-corrupt bureaucracies to implement state policies and politicians who have a commitment to growth and success. Regulation can change demand factors (e.g. regulations related to fuel subsidies), a country's government has an important role in shaping the extensibility of factors that determine a country's level of competitive advantage in the industry. Porter (1990) also explained that the company's strategy, structure, and level of competition can affect competitiveness. Furthermore, factors in the condition of resource availability in a country, namely human resources, raw materials, knowledge, capital, and infrastructure that affect the price of these commodities so that they affect competitiveness.

3. METHODOLOGY

The scope of this study is the CPO industry. The industry category in this study is from the 2020 Indonesian Business Field Standard Classification (KBLI) with code 10432, which is included in the production of the processing industry sub-industrial vegetable and animal oils and fats (Central Bureau of Statistics Indonesia, 2022).

Annual data from 2001 to 2020. The data used in this study are secondary data related to the Indonesian CPO industry, the total number of Indonesian CPO companies officially registered with the government, Indonesia's biodiesel policy, subsidized fuel oil (diesel) price. In this study, data were obtained from the Indonesian Central Bureau of Statistics (BPS), UN Comtrade, Ministry of Trade of the Republic of Indonesia.

3.1. Revealed Comparative Advantage (RCA)

The most popularly used measurement of competitiveness is the RCA which measures comparative advantage. Introduced by Ballasam (1965), the rationale underlying this method is that a country's export performance is determined by its relative level of competitiveness against related products made by other countries. Mathematically to calculate the RCA index is as follows:

$$RCA = \left(\frac{X_{IK}}{X_{IM}}\right) / \left(\frac{X_{WK}}{X_{WM}}\right) \quad \text{(i)}$$

Where:
X_{IK} = Export value of products I country K
X_{IM} = Total export value of country k
X_{WK} = Export value of world product I

The RCA method is used to measure a country's comparative advantage over a product by comparing its share or ratio of exports to the ratio of that product to world exports. If the RCA values >1, it means that a country has a comparative advantage over the world average, so the product is of high power.

3.2. Lorenz Curve and Gini Coefficient

Lipczynski et al. (2017) the Lorenz curve shows a variation in the cumulative size of n largest companies in an industry, since n varies from 1 to N (where N is the total number of companies) (Figure 3).

- If all companies are the same size, the Lorenz curve is a 45° line OCA. At point C, for example, exactly half of the industry member companies make up exactly half of the total industry size, represented by the OD distance.
- If the company size distribution is skewed, the Lorenz curve is an OBA concave curve. At point B, exactly half of the industry member companies make up three-quarters of the total industry size, represented by OD. The Gini coefficient is defined as follows:

$$G = \frac{\text{The crescent area between OBA and OCA}}{\text{Area of triangle ODA}}$$

- The maximum possible value of G = 1 corresponds to the case of one dominant company with a market share close to one, and N-1 small companies each with a negligible market share. In this case the Lorenz curve approaches the OD line.
- The minimum value of G = 0 corresponds to the case of N the same sized company. In this case the Lorenz curve is the OCA of the 45-degree line, so the numerator in the formula for G is zero.

The definition of the formula for the Gini coefficient is as follows:

$$G = \left\{ \frac{\sum_{n=1}^{N} \sum_{i=1}^{n} Xi}{0.5(N+1)\sum_{i=1}^{N} Xi} \right\} - 1 \quad \text{(ii)}$$

Where xi is the size of company i (as before, measured using sales, assets, jobs, or some other appropriate size indicator) when the company is ranked in descending order of size.

3.3. Error Correction Model (ECM)

The ECM regression aims to explain whether an independent variable affects the dependent variable in the short and long term. This study analyzes the effect of CPO Price, Indonesian Biodiesel Policy, Subsidized Fuel Oil (Diesel) Price, and Structure used as independent variables (X) and Competitiveness as bound variables (Y). The equation in the short term is as follows:

$$\Delta Y = \beta_0 + \beta_1 \Delta_X1_t + \beta_2 \Delta_X2_t + \beta_3 \Delta_X3_t + \beta_4 \Delta X4_t + \beta_5 ECTe_t \quad \text{(iii)}$$

$$\Delta RCA = \beta_0 + \beta_1 \Delta_PCPO_t + \beta_2 \Delta_BD_t + \beta_3 \Delta_PBBM_t + \beta_4 \Delta Gini_t + \beta_5 ECTe_t \quad \text{(iv)}$$

While the equation in the long term is as follows:

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + e \quad \text{(v)}$$

$$RCA = \beta_0 + \beta_1 PCPO + \beta_2 BD + \beta_3 PBBM + \beta_4 GINI + e \quad \text{(vi)}$$

Where, Y is the dependent variable, β_0, 1, 2, 3, 4 is the coefficient of the 1st, 2, 3, 4th variable, RCA is competitiveness, PCPO is International CPO Price, BD is Indonesia's Biodiesel Policy, PBBM is Subsidized fuel prices, and Gini Coefficient is Industry concentration, e is the error term.

4. ANALYSIS AND DISCUSSION

The following is the analysis of the data and the trend of the variables used in the research:

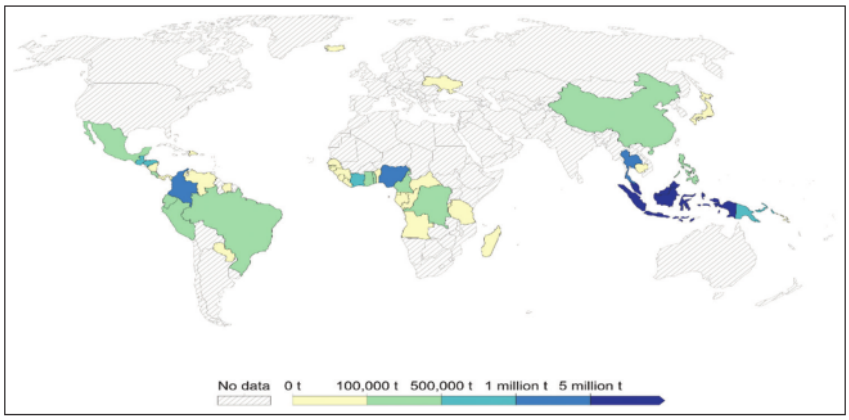
4.1. Competitiveness Calculation Results using Revealed Competitive Advantage (RCA)

A country or region will have competitiveness in the form of a comparative advantage if the country or region is able to produce and export goods or services at relatively lower costs than the country or region imports goods and services from other countries (Nesti and Tan, 2017). Higher specialization can lead to higher productivity and competitiveness (and vice versa) (Zdráhal et al., 2020).

Based on Table 1, the value of processed RCA products, the results are obtained annually from 2000-2020, the value of RCA > 1, then CPO commodities in Indonesia have a comparative advantage above the world average so that CPO commodities have strong competitiveness in the international market.

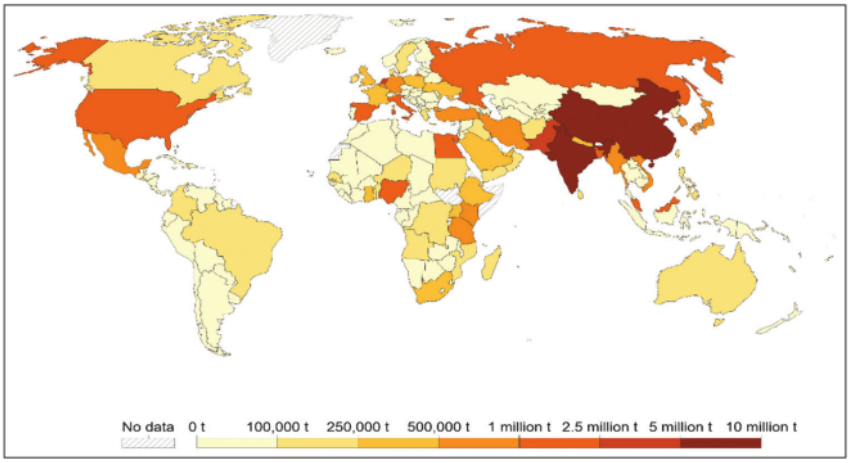
Export competitiveness is one of the determining factors in the persistence of a country's long-term economic growth (Ansonfino et al., 2021). The derivative value of RCA in 2008 was caused by the global economic crisis, affecting the competitiveness of the country's CPO exports because financial, credit, and mortgage pressures in developed countries changed the global demand for

Figure 1: Crude palm oil production



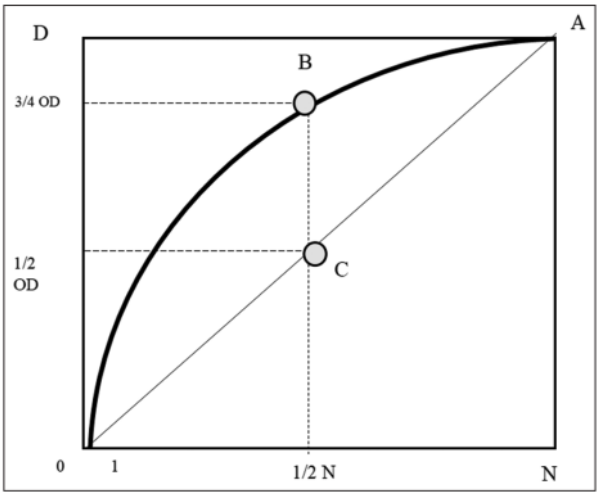
Source: Food and Agriculture Organization of the United Nations (2019)

Figure 2: Crude palm oil imports



Source: Food and Agriculture Organization of the United Nations (2019)

Figure 3: Lorenz curve



Source: Lipczynski et al., (2017)

this commodity (Krugman, 2011). Also, overvaluation of financial derivative products and rising oil prices raise input costs, shrinking investment, productivity, and competitiveness of CPO exports (Arias et al., 2020).

Indonesia has the highest competitiveness in the international market for CPO due to several factors, including: Indonesia is the world's largest palm oil producer and has abundant land suitable for growing oil palm trees, Indonesia has a favorable climate and geography, as well as relatively low labor costs, which contributes to the low cost of CPO production in the country, the Government of Indonesia has implemented policies to support and advance the palm oil industry, including tax incentives and export subsidies, Strong distribution network: Indonesia has an established distribution network, both domestically and internationally, that assists in efficient CPO exports (Petrenko et al., 2016; Varkkey et al., 2018).

Indonesia's main competitor in international trade in CPO is Malaysia. In research Othman and Tahir (2022) found that

Indonesia's competition in the long term is difficult to compete with because it has greater potential for economies of scale and other cost advantages when compared to Malaysia. Ramadhani and Santoso (2019) concluded that CPO exports by Indonesia are driven by the use of palm oil as cooking oil in Asian countries such as China, India, and Pakistan.

In terms of importers of CPO commodities in the world, India and China are the two largest (Guerrieri and Caffarelli, 2012). The role of the Indian state in international trade is enough to make Indian consumption the main determinant of the relative price of CPO (Carter et al., 2007).

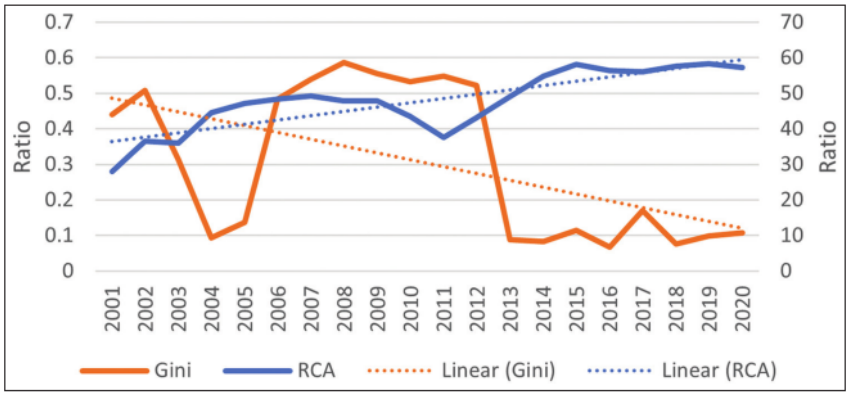
4.2. Results of Industrial Concentration Calculation using Gini Coefficient

The following is the result of the calculation of the Gini coefficient which is used as a measure of the concentration of the Indonesian CPO industry.

Based on Table 2, it is known that from 2001–2020 the results of calculating the Gini coefficient are getting closer to 0, which means that Indonesia's CPO industry is an industry that is not concentrated. In the research of Wibowo et al. (2021) which analyzed the concentration of the Malaysian and Indonesian CPO Industries resulted in a less concentrated market trend, but Indonesia and Malaysia as the main palm oil producers and exporters still have at least 70% of the total export share. The market trend of Indonesia's CPO industry is less concentrated due to several factors, including: The Indonesian government has implemented policies aimed at encouraging competition and reducing market concentration in the CPO industry, these include policies aimed at encouraging the development of smallholder farmers and increasing their participation in the industry, the growth of the CPO industry in Indonesia has attracted new players to the market, increased competition and reduced concentration, the increasing global demand for sustainable palm oil has led to an influx of new players in the industry, including smaller and more environmentally conscious producers (Hospes, 2014).

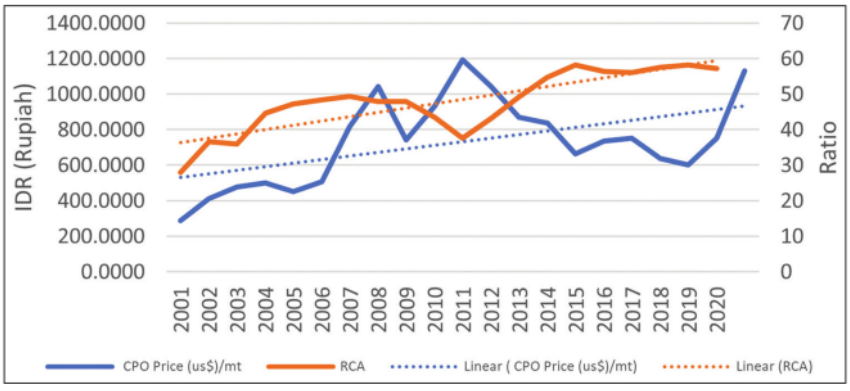
The market size (structure) effect shows the change of the receptivity of the reference market, which can also at constant market share modify the exports to the reference market (Juhász and Wagner, 2013). It is known from the Figure 4 that the results of the Gini ratio in the Indonesian CPO industry show a volatile movement. From the annual average results, the results are always close to zero, meaning that the Indonesian CPO Industry

Figure 4: Results of Industry Concentration and revealed comparative advantage



Source: UN Comtrade, data processed (2001–2020)

Figure 5: Crude palm oil prices and revealed comparative advantage



Source: World Bank and UN Comtrade, data processed (2001–2020)

is not concentrated. As concentration increases, competitiveness decreases, this shows a negative relationship between the two variables. High levels of concentration can also reduce the bargaining power of suppliers and consumers, as they have fewer options to choose from and less influence over the market (De Marchi et al., 2013).

In the long term, the price and demand for CPO shows an increasing trend in line with the growth of the world population and therefore increases the consumption of products with palm oil raw materials such as food and products (Figure 5). The increase in CPO prices itself results in a decrease in demand for purchasing power for CPO products and their derivatives, thereby reducing the volume and value of exports and the competitiveness of CPO in the international market. Higher prices for palm oil can lead to decreased demand for palm oil-based products, as consumers switch to alternative, lower-priced products (Ruggeri and Samoggia, 2018). Consumers will also tend to choose other substitutes or in this case other vegetable oils such as sunflower oil and soybean oil which are increasingly relatively more affordable although still more expensive compared to the price of CPO oil.

Intense competition in the global market has led to the enactment of several policies, which can limit and facilitate trade (Tandra et al., 2022). As a highly contested oilseed crop, CPO dominates discussions on sustainability compared to other vegetables in the oil and fat sector (Naidu and Moorthy, 2021). The formulation of policies underlying the sustainable development of the palm oil industry needs to strike a balance between environmental, social, and economic attitudes (Zakaria et al., 2020). Based on Figure 6, it is known that Indonesia's biodiesel policy has been implemented since 2016. When the biodiesel policy was implemented, the competitiveness of the Indonesian CPO Industry increased. Although it is still increasing, in the future Indonesia's CPO exports do face several challenges. Indonesia's palm oil exports are increasing in line with the increasing demand for palm oil in international markets, especially India, China, and the European Union. In the domestic market, the consumption of palm-based biofuels is higher than the composition of biofuel exports, due to the government's mandatory policy on the use of biodiesel from B-5(2010), B-10(2012), B-15(2014), B-20(2016), and B-30(2020) (Jamilah et al., 2022). The Indonesian government has set mandates for the use of biofuels, such as biodiesel, in the domestic market to reduce the country's dependence on fossil fuels and increase the use of renewable energy sources (Kumar et al., 2013; Mofijur et al., 2015). Development of downstream palm oil industry including Biodiesel is expected to increase the added value of palm oil products for Indonesia which are mostly just enjoyed by other countries (Singagerda et al., 2018).

From the Figure 7 above, it is known that the price movement of subsidized diesel oil in Indonesia always increases. The highest price of subsidized diesel in 2014 was Rp 7,500 rupiah but fell in 2015 at Rp 6,500 due to the decline in world crude oil prices and the rupiah exchange rate (Baumeister and Kilian, 2016).

In this case, subsidized diesel oil has an impact on its price which is cheaper than the market price which the difference reaches an average of 66% if averaged from 2001-2020 so that it affects the increasing competitiveness caused by the Indonesian CPO industry using subsidized fuel oil in its production and transportation.

4.3. Results and Discussion of Estimated ECM

The following are the stages of the estimation results of the ECM method in this study:

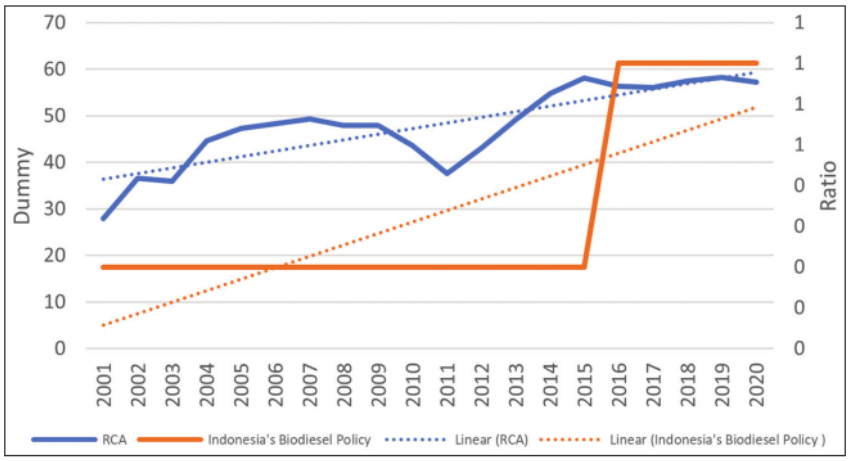
4.4. Unit Root Test

Based on Table 3, it can be seen that all variables are stationary on the first different, because all variables have a probability of less than alpha $\alpha = 5\%$ (significant).

4.5. Cointegration Test

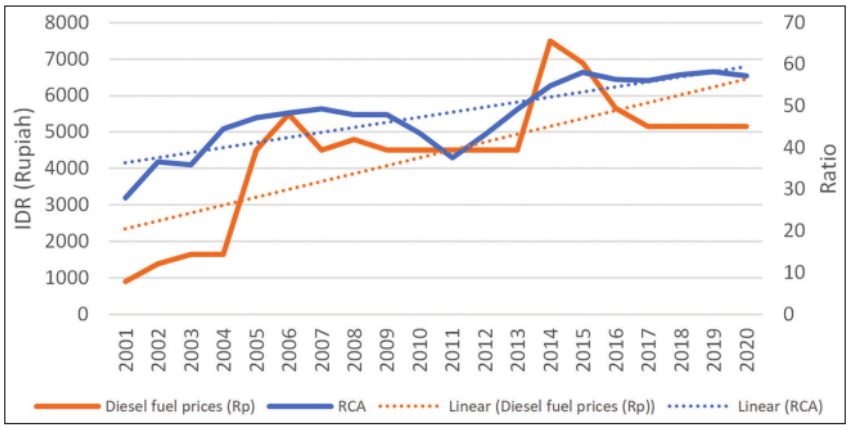
Based on Table 4, the cointegration test from Johansen, a statistical trace value = 121.8242 was obtained > a critical value of $\alpha = 5\% = 69.82$ with a probability of $0.000 < \alpha = 0.05$ then H0 was rejected, which means that the data of all variables have a long-term relationship (cointegrated).

Figure 6: Indonesia's Biodiesel Policy and revealed comparative advantage



Source: Institute for Essential Services Reform and UN Comtrade, data processed (2001–2020)

Figure 7: Indonesian Subsidized Diesel Fuel Prices and revealed comparative advantage



Source: CEIC Data and UN Comtrade, data processed (2001–2020)

4.6. Short-term Estimation Results

In the short-term ECM model using Least Squares, the following short-term estimates are generated:

$$\Delta RCA = 0.820035 + (-5.712165)\,\Delta_PCPO_t + 1.395145\Delta_BD_t + 5.863557\Delta_PBBM_t + -8.312636\Delta Gini_t + (-0.792963)ECT$$

From the short-term estimation equation in Table 5, it shows that CPO Price (PCPO) and Industry concentration is negatively and significantly correlated to CPO competitiveness. Biodiesel Policy (BD) is positively correlated but not significant. The variable price of fuel oil (diesel) subsidies correlates positively and significantly.

The value of the ECT coefficient shows how much the equilibrium cost at the level of competitiveness (RCA) in the earlier period adjusted for the present change is -0.792963 where the probability of ECT is 0.0084 which means significant at $\alpha = 5\%$. While the ECT coefficient that has a negative sign indicates that the model has a short-term relationship.

4.7. Long-Term Estimation Results

In the long-term ECM model using Least Squares, a long-term estimate is generated as follows:

$$RCA = -6.110938 + (-4.414982)\,PCPO + 5.139311\,BD + 10.2749\,PBBM + (-9.918397)\,GINI + \varepsilon$$

From the long-term estimation equation in Table 6, it shows that CPO Price (PCPO) is negatively and insignificantly correlated to CPO competitiveness. Biodiesel policy (BD) and the price of fuel oil are positive and significant. Industry concentration is negatively correlated and has a significant effect.

4.8. Discussion of CPO Industry Analysis in the Short and Long Term

The short-term estimation equation shows that CPO prices are negatively and significantly correlated to CPO competitiveness.

Table 1: Results of RCA Indonesia CPO Industry 2001–2020

Year	RCA value	Year	RCA value
2001	27.98183	2011	37.63006
2002	36.59414	2012	43.12149
2003	35.96132	2013	49.16183
2004	44.55598	2014	54.81517
2005	47.24825	2015	58.15362
2006	48.36279	2016	56.39279
2007	49.32231	2017	56.09925
2008	47.87606	2018	57.55124
2009	47.93711	2019	58.23941
2010	43.53909	2020	57.24834

Source: UN Comtrade, data processed (2001–2020). RCA: Revealed Comparative Advantage, CPO: Crude palm oil

Table 2: Results of Indonesia CPO Industry Concentration 2001–2020

Year	Gini	Year	Gini
2001	0.439615	2011	0.548842
2002	0.508395	2012	0.521722
2003	0.31367	2013	0.088816
2004	0.093358	2014	0.083853
2005	0.136281	2015	0.115198
2006	0.483983	2016	0.067441
2007	0.539051	2017	0.170539
2008	0.586615	2018	0.075846
2009	0.555527	2019	0.098709
2010	0.533207	2020	0.107863

Source: Central Bureau of Statistics Indonesia, data processed (2001–2020). CPO: Crude palm oil

Table 3: Unit root test

Variable	Level		Level 1	
	T-Statistics	Probability	T-Statistics	Probability
PCPO	−6.53545	0.0075***	−6.53545	0.0000***
BD	−5.03496	0.0668*	−5.03496	0.0000***
PBBM	37.2242	0.0788*	37.2242	0.0000***
Gini	44.9013	0.0001***	44.9013	0.0000***

***, ** represent statistical significance at 1%, 5%, and 10%, respectively
Source: Output EViews (2001-2020)

This shows that any increase in international prices will always be followed by a decrease in the level of export competitiveness,

Table 4: Cointegration Test

No. of CE (s)	Eigenvalue	Statistics	Critical value	Probability
None*	0.953767	121.8242	69.81889	0.0000***
At most 1*	0.806125	66.49117	47.85613	0.0004***
At most 2*	0.692394	36.96141	29.79707	0.0063***
At most 3*	0.552497	15.74059	15.49471	0.0459**
At most 4	0.067983	1.267277	3.841466	0.2603

***, **, and * represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001–2020)

Table 5: Short-term ECM estimation results

Variables	Coefficient	Std. Error	t-Statistics	Probability
C	0.820035	0.703570	1.165535	0.2647
D (PCPO)	−5.712165	2.285745	-2.499039	0.0266**
D (BD)	1.395145	3.025837	0.461077	0.6524
D (PBBM)	5.863557	2.368215	2.475940	0.0278**
D (GINI)	−8.312636	4.693110	−1.771243	0.0999*
ECT(-1)	−0.792963	0.255509	−3.103462	0.0084***
R Squared		0.669915		
Prob F Statistics		0.007274***		

***, **, and * represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001-2020). ECM: Error correction model

Table 6: Long-term ECM estimation results

Variables	Coefficient	Standard error	t-statistics	Probability
C	−6.110938	19.57744	−0.312142	0.7592
PCPO	−4.414982	2.890605	−1.527356	0.1475
BD	5.139311	1.920145	2.676523	0.0173**
PBBM	10.27249	1.305558	7.868274	0.0000***
GINI	−9.918397	4.342323	−2.284123	0.0374**
R-squared	0.902956			
Prob F statistics	0.0000***			

***, ** represent statistical significance at 1%, 5%, and 10%, respectively.
Source: Output EViews (2001-2020). ECM: Error correction model

and vice versa. In the short term, the price of CPO and the competitiveness of CPO can be negatively and significantly correlated for several reasons including, when CPO demand increases and supply remains, prices will rise, and competitiveness will decrease. On the contrary, when demand decreases and supply remains, prices will fall, and competitiveness will increase. CPO competes with other vegetable oils such as soybean oil and sunflower oil. If the price of this oil falls, it will increase its competitiveness and reduce the competitiveness of CPO. This is in line with research conducted by Arias et al. (2020); Ziae and Ali (2021); Jambor and Babu (2016). However, this only has a significant effect on short-term circumstances, in the long-term, the result is that the CPO price has no effect. There is no effect on CPO prices on their competitiveness because CPO prices tend to be relatively stable in the long term, and price fluctuations do not have a significant impact on the demand for these commodities. In addition, CPO is often substituted with other vegetable oils, so changes in its price do not necessarily affect its competitiveness. Overall, while short-term changes in CPO prices can affect its competitiveness, the long-term stability of demand, substitution options, and cost competitiveness make it a competitive commodity.

Biodiesel policy targets aim to reduce imported fossil fuels, diversify energy sources, and reduce GHG emissions. Indonesia has biodiesel blending targets for the transportation and industrial sectors set at 15% in 2015, 20% in 2016 and 30% from 2020 to 2025 (Khatiwada et al., 2021). In the short term, Biodiesel (BD) policy is positively but not significantly correlated. Meanwhile, in the long term, the policy is positive and significant. In the short term, the relationship between biodiesel policy and CPO prices can be positively correlated but not necessarily significant for several reasons: In the short term, market conditions can be very volatile and uncertain, making it difficult to establish a strong and significant relationship between policy and price. Policies may take some time to impact the market, so their effect on CPO prices may not be direct or significant (Dutta et al., 2021). Whereas in the long run, the relationship between biodiesel policy and CPO prices can be positive and significant because in the long run, policies tend to become more stable, reducing market uncertainty and allowing the emergence of a stronger relationship between policy and price. Over time, policies will most likely be implemented more consistently and effectively, leading to a stronger and significant relationship between policy and price. In the long run, market participants can adapt to policies and their influences, which leads to a more stable and predictable relationship between policy and prices. Overall, while the relationship between biodiesel policy and CPO prices may not be significant in the short term, it can be both positive and significant in the long run as policies become more stable, implemented more consistently, and market participants adjust to their influence. This is in line with the research of Von Geibler (2013); Johari et al. (2015); and Rifin et al. (2020). On one hand, the policy has helped to promote the development of the domestic biodiesel industry, which is a key driver of economic growth in Indonesia (Koizumi, 2015; Ewing and Msangi, 2009). The policy requires a mandatory use of biodiesel in transport, with a target of reaching 30% biodiesel blend (B30) in 2020, which has increased the demand for palm oil as the main raw material for biodiesel production (Zahan, 2018). This has boosted the demand for CPO and supported the growth of the CPO industry, which is a major contributor to Indonesia's economy. On the other hand, the biodiesel policy has had negative impacts on the competitiveness of the CPO industry and the environment. Firstly, the mandatory use of biodiesel has resulted in a significant increase in the domestic consumption of CPO, leading to a shortage of supply for export markets and, as a result, higher prices for CPO in the domestic market. This has made it difficult for CPO exporters to compete with other producers in the global market, which has hurt the competitiveness of the industry (Mekhilef et al., 2011, Johari et al., 2015, Ahmad et al., 2011). Secondly, the expansion of the CPO industry has also led to deforestation and loss of biodiversity, which has negative environmental impacts (Taheripour et al., 2019). The expansion of oil palm plantations has been associated with the destruction of rainforests, leading to habitat loss for wildlife, increased greenhouse gas emissions, and soil degradation (Meijaard et al., 2020).

The price of subsidized fuel oil (diesel) is positively and significantly correlated in both the long and short term. Fuel oil

is one of the main elements, even the largest in the components of carrying costs, production, and distribution costs. In the subsidy, the price of diesel fuel oil so that the price is cheaper than the market price has a positive influence on competitiveness due to the Indonesian CPO industry using subsidized fuel in production and transportation. This is an advantage for the Indonesian CPO Industry because it is more efficient in competing with CPO products from other countries. This is supported by the Indrawan (2020) report. Favorable government policies: The Indonesian government provides various incentives and support for the palm oil industry, making it easier for companies to operate and increasing competitiveness. The provision of various subsidies by the Indonesian government is in accordance with a study conducted by Brandi et al. (2013). The Indonesian government subsidizes fuel oil to the industry as part of its economic and energy policy. The reasons for this subsidy include: to support economic growth: By reducing the cost of energy, the government hopes to boost the competitiveness of Indonesian industries, including the palm oil industry, and stimulate economic growth (Dartanto, 2013). However, it is important to note that the subsidized diesel oil policy is not without its drawbacks. The policy can lead to overconsumption of fuel, which can contribute to pollution and harm the environment (Wesseh et al., 2016). Furthermore, the subsidies are costly to the government, which can put a strain on public finances and limit the government's ability to invest in other areas, such as education and healthcare (Javier et al., 2012).

Industrial concentrations are negatively and significantly correlated in both the long and short term. From the results of concentration, it shows that the Indonesian CPO Industry is an industry that is not concentrated. Negative signs indicate that the lower the industry concentration, the higher the competition between CPO industries, which has an impact on the price of Indonesian CPO getting cheaper and has an impact on high competitiveness. The effect of concentration on competitiveness is in line with Aritenang (2021) research. This is not in line with the research conducted by Marković et al. (2019) mentioning that concentrated industries have greater opportunities in International trade. The positive impact of the low concentration level of the CPO industry i.e., Low-concentrated industries can lead to more competition among companies, which can benefit consumers and lead to innovation and lower prices (Kariyasa and Dewi, 2011). This can make the industry more attractive to buyers and increase the demand for CPO. In addition, Low-concentrated industries will be more resilient to economic shocks or changing global market conditions, as smaller companies may be able to adapt more quickly to changing circumstances and find new markets or niches to serve (Curzi et al., 2021).

5. CONCLUSION

Indonesia's CPO industry has a comparative advantage in the international trading market. This is showed through the calculation of more than one RCA value. Indicates that the Indonesian CPO industry can produce and export CPO products and their derivatives at a relatively cheaper cost than other countries so as to increase competitiveness in the international market. In addition, with more stable prices, Indonesia does not need to import CPO from other countries and is able to meet domestic needs. Based on the ECM estimates, the factors that affect competitiveness in the short term are the price of CPO, solar subsidies, and the concentration of industry, while in the long term the variables that affect are biodiesel policy, subsidized diesel oil and industrial concentration.

The results show that the lack of concentrated CPO industry in Indonesia indicates that there is no gap between large companies and companies with small business scales. A Gini coefficient value close to zero indicates the more dispersed concentration, or close to perfect competition behavior. The less concentrated CPO industry results in a more competitive market and prices. The low concentration of the CPO industry makes competition between companies higher so that it can reduce price levels and affect the competitiveness of CPO.

Nationally, the B30 policy has many benefits for Indonesia. From an economic point of view, the use of biodiesel, which is a mixture of diesel fuel, has an impact on reducing oil imports so as not to reduce the country's foreign exchange reserves. The large absorption of CPO as a feedstock for biodiesel due to the B30 policy has implications for palm oil stocks in the global market to be maintained (no oversupply). The implication is that international prices of palm oil are stable and tend to increase. Another implication is that the biodiesel policy can maintain domestic CPO prices so that they are stable and do not fall, supply added value through down streaming the agricultural industry, save the country's foreign exchange and trade balance, provide job opportunities, and maintain energy security. In addition, the increase in CPO production has an impact on increasing CPO demand, thereby increasing competitiveness in international trade. Therefore, while Indonesia's biodiesel policy has had positive impacts on the domestic economy and the development of the biodiesel industry, policymakers must also consider the negative impacts on the competitiveness of the CPO industry and the environment. It is important to strike a balance between economic growth, social welfare, and environmental sustainability to ensure that the benefits of the policy are realized without harming the competitiveness of the CPO industry or the environment.

The fact that the CPO industry that uses subsidized diesel oil in the production and transportation process has an impact on its price that is cheaper than the market price, which has a difference of an average of 66% if on average from 2001-2020 so that this affects the increase in competitiveness. In terms of policy making, the efficiency of fuel oil consumption in the industrial sector and other sectors needs to be improved. In addition, the high dependence on fuel oil in energy consumption needs to be corrected through the substitution of fuel oil with non-fuel oil energy sources. Although this policy is felt to be unfair to the public, the provision of subsidies by the Indonesian government is a form of protecting the domestic industry so that solar subsidies show positive results for the increasing competitiveness of the Indonesian CPO industry. Overall, the subsidized diesel oil policy in Indonesia is intended to support the country's industrial competitiveness, but policymakers must carefully balance the benefits of the policy against its potential costs and drawbacks.

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