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The Determinants of Competitiveness in Global Palm Oil Trade

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Abstract: Palm oil is an essential commodity used in the manufacture of various daily products and is highly competitive with vegetable oil. However, the palm oil competition is fierce and complex due to movement of palm oil trade. The study examined the determinant, stability, and duration of competitiveness in the global palm oil trade involving countries worldwide. This research was analyzed from 1996 to 2019 using descriptive analysis, panel regression, stability, and Kaplan–Meier tests. The results showed that palm oil supply in the global market is centralized with distributed demand. The competitiveness of palm oil based on revealed symmetric comparative advantage (RSCA) and trade balance index (TBI) is similar to its suppliers globally. The positive factors that determine the competitiveness in the global palm oil trade are population and import of animal or vegetable fats and oils. GDP per capita and dummy RSPO negatively affect competitiveness. The stability and duration analysis showed that the global palm oil market is highly competitive.

Keywords: comparative advantage; competitiveness; global market; palm oil; trade

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1. Introduction

Palm oil is one of the flexible commodities due to its usable benefit for daily activities, such as human food consumption, with 80% to 90% of users (Shimizu and Desrochers 2012). Its global demand is predicted to increase alongside population growth. Moreover, palm oil development in the agroindustry has helped specific countries generate foreign exchange from global trade, extend job creation, and improve the welfare of its shareholders (Basiron 2007; Suroso and Ramadhan 2014; Ayompe et al. 2021). It is used by virtually all households and manufacturing industries worldwide, combining with agricultural appraisal (Suroso et al. 2014). Therefore, it is one of the most traded vegetable oils globally. According to the Food and Agriculture Organization (FAO), palm oil trade was predicted to increase significantly for three decades in 2021. It surpasses the competitors' products based on export and import values, as shown in Figure 1. Only a few countries produce palm oil; however, Indonesia and Malaysia are the main producers (United States Department of Agriculture (USDA) 2022). This analysis differs from several preliminary studies because the production variable due to the supply domination from the two nations was excluded. Nevertheless, it emerges from the quality of palm oil exported because higher unit values could influence the competitive position of this commodity (Török et al. 2020). Its price tended to be lower than other competitor products. Indexmundi (2022a) stated that the average monthly price of this commodity from December 1996 to 2019 was USD 672. This is lower than the average monthly price of other competitor products within this time range, namely soybean and groundnut oil, with USD 762 and 1323, respectively.

Specifically, 111 exporters and 153 importers participated in the global palm oil trade in 2019 (UNcomtrade 2022). The top exporter was Indonesia, followed by Malaysia, the Netherlands, and Guatemala, with a total palm oil export of USD 14.7 billion, USD

8.3 billion, USD 922 million, and USD 390 million, respectively. Additionally, the palm oil import was dominated by Asian countries, particularly India (USD 5.4 billion), China (USD 5.4 billion), and Pakistan (USD 1.7 billion), followed by European Union (EU) countries (Netherlands, Spain, and Italy) and the USA. However, this commodity is associated with sustainability issues, especially in the environmental, economic, and social sectors (Suroso et al. 2021). Therefore, events such as the global financial crisis and the decline in its prices could create a surge in agricultural trade (Anderson and Nelgen 2012). Many countries implemented tariff and non-tariff policies to hinder the accessibility of palm oil trade (Rifin et al. 2020; Annas et al. 2020; Pratama and Widodo 2020). The competitor products, namely soybean and sunflower, are also affecting their existence due to their similar characteristics and functions. Alternatively, virtually all countries around the globe engage in palm oil trade. Recently, it was revealed that palm oil trade is challenging to observe, especially its competitiveness in the worldwide market. Moreover, no preliminary investigatory analyses have been carried out on all the countries involved in exporting and importing this commodity. Therefore, the main research question is: What factors influence the global competitiveness of palm oil trade and its impact on all countries in the world?

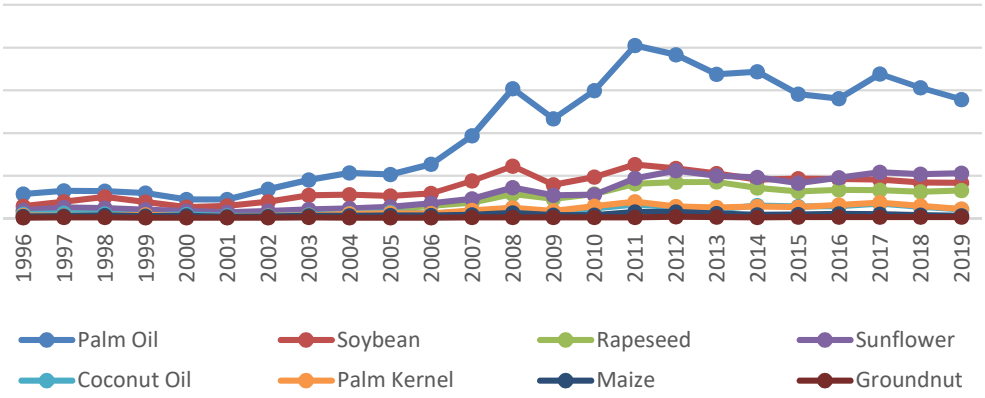

Figure 1. Vegetable oil trade in the global world (USD). Source: FAO (2022).

2. Literature Review

Based on the scope of this study, competitiveness has multiple definitions. In the business context, it refers to the growth and strengthening of the position of a particular enterprise (Jansik et al. 2014). Nationally, it could be defined as "a set of institutions, policies, and factors that determine a country's level of productivity" (World Economic Forum 2011). In a broader scope, competitiveness is the movement of selling products by an advantaged or disadvantaged country in the global market (OECD 2014). However, its meaning can also be inferred as the concept of efficiently getting involved in highly valuable industries to boost national welfare (Mulatu 2016). Based on these definitions, competitiveness could be classified as micro or macro, corporation capacity, or global trade. Empirically, its development in international trade is growing, relatively. The commonly used index to measure competitiveness theory in international trade is the revealed comparative advantage (RCA), developed by Balassa (1965). However, RCA usually obtains asymmetric values, thereby causing unbalanced weighting for applied regression. This is because the range of values obtained is between 0 to infinity. The revealed symmetric comparative advantage (RSCA) was designed to anticipate the asymmetric problem. Laursen (2015) reported that it was also tested, thereby resulting in the best comparative advantage measure.

Several preliminary studies have been carried out on competitiveness using RCA and modified measurements. Balassa and Noland (1989) measured the comparative advantage between Japan and the United States using RCA. It was revealed that Japan specializes in capital-intensive human products. Meanwhile, the natural resource-intensive industry was perceived as a comparative disadvantage. The United States specializes in physical

and human capital-intensive goods with enhanced comparative advantage in natural resource-intensive industry. Both countries have a comparative advantage in high-tech products. Serin and Civan (2008) identified the RCA and competitiveness between Turkey and the EU. It was further reported that Turkey has a comparative advantage in the fruit juice and olive oil sectors and a comparative disadvantage in tomatoes. Kim (2019) used the revealed comparative advantage (RCA), market comparative advantage (MCA), and comparative advantage by countries (CAC) to prove that India's textile and clothing sector had a comparative advantage in the US market.

Recent studies on comparative advantage focused on various commodities. Rifin (2013) carried out similar research on the cocoa sector in Indonesia using the RCA and the almost ideal demand system (AIDS) from 1967 to 2011. It was reported that it had a comparative advantage in the world market compared to the other producing countries. Furthermore, Indonesian cocoa beans are price inelastic, which implies the demand is invulnerable to price changes. Balogh and Jámbor (2017b) investigated the global competitiveness of European wine producers. The stability regression and Kaplan–Meier survival tests prove that seven countries on this continent (Bulgaria, Cyprus, France, Greece, Italy, Portugal, and Spain) have a comparative advantage in the world market. The stability and duration tests were used to show that the trade advantages of these nations had reduced. Bojang and Gibba (2021) focused on cashew production in west African countries, namely Benin, Burkina Faso, Côte d'Ivoire, Gambia, and Ghana. It was reported that Guinea, Guinea-Bissau, Mali, Nigeria, and Senegal had a stable comparative advantage in the global market over time. A few studies have explored the various determinants of competitiveness in terms of commodity trade. Balogh and Jámbor (2017a) revealed that it was also positively affected by the GDP per capita, geographical indication, and EU membership, while FDI had a negative impact. Török et al. (2020) discovered that the positive determinants of global beer trade competitiveness are its total production, beer per capita consumption, EU membership, and the number with geographical indications. However, the negative determinants include barley production and foreign direct investment (FDI) made by accessible input of water and barley. Two other variables, namely population, consisting of exporters who relatively focus on the domestic market and the quality of beer export, such as those with similar products, also negatively influence RSCA.

Numerous studies have been carried out on the export competitiveness of palm oil. Salleh et al. (2016) used RCA to discover that Malaysia has a comparative advantage for crude palm oil (CPO), as well as Pakistan (1999 to 2011), China (1999 to 2008), and India (1999 to 2002), also the case for processed palm oil (PPO) in the USA market. Prasetyo and Marwanti (2017) investigated the comparative advantage of Indonesia's CPO in the global market. The results revealed that it is one of the countries with the highest comparative advantage in CPO. Arsyad et al. (2020) researched palm oil export competitiveness by comparing the two producer countries, Indonesia and Malaysia, using the RCA, RSCA, and TBI. It was reportedly discovered that there are three palm oil products: CPO, refined bleached deodorized (RBD) palm olein, and palm fatty acid distillate (PFAD). Saeyang and Nissapa (2021) also analyzed trade competitiveness in four specific palm oil products using the RSCA and TBI values. Indonesia and Malaysia reportedly have a high comparative advantage in four specific palm oil products. Based on the analyses carried out in 26 countries, the exchange rate and international processing are essential determinants of palm oil export competitiveness (Lugo Arias et al. 2020). In a narrow scope, the determinants of palm oil competitiveness are RSPO certification, soybean import value, Malaysia CPO export, and population growth discerned through panel regression from 1999 to 2018 (Rosyadi et al. 2021). However, preliminary research carried out in a particular country employed several variables.

Previous studies on palm oil competitiveness only referred to specific products, selected countries, and the involvement of external variables. The reverse was the case in this research because all countries associated with the international market were examined concerning this attribute. Moreover, studies on the determinant of palm oil competitive-

ness are rare, particularly in the global scope or context. Specifically, the econometrics for determining the factors that influence palm oil competitiveness in the global trade was applied. It differs from previous research that only centered on the description of palm oil competitiveness.

3. Methodology

3.1. Variables and Conceptual Framework

Based on the objectives of this study, several factors that influence export competitiveness in the global palm oil trade were examined. The index of revealed symmetric comparative advantage (RSCA) was used to determine the competitiveness for all exporter countries between 1996 and 2019. However, the revealed comparative advantage (RCA) designed by Balassa (1965) needs to be calculated by comparing an export share of the specific commodity with the total export in the observed country. The RCA index is obtained by using the following equation:

$$B_{ij} = RCA_{ij} = (X_{ij}/WX_j)/(X_i/WX) \quad (1)$$

where X_{ij} is the total export in country i for commodity j, X_i is the total export by country i, WX_j is world export for commodity j, and WX is world export. The value of the RCA index is within the range of zero to infinity. Additionally, when the value is between 1 and infinity, it simply indicates that the country has a comparative advantage for commodity j, implying export competitiveness. Meanwhile, when it is between zero and 1, the country has a comparative disadvantage. The RCA index is a helpful tool for building descriptive trade data and interpreting industry- or country-level outcomes (Deardorff 2011). As a linear transformation of the Balassa index (B), it was modified by Dalum et al. (1998) and renamed the revealed symmetric comparative advantage (RSCA) index.

$$RSCA_{ij} = (RCA_{ij} - 1)/(RCA_{ij} + 1) \quad (2)$$

where the RSCA is the symmetric value for the RCA index, which is the revealed comparative advantage obtained using Equation (1). Its value ranges between −1 and 1. A positive value indicates a comparative advantage and vice versa.

This study also investigated a palm oil trade specialization using the trade balance index (TBI) designed by Lafay (1992). The TBI is utilized to determine whether a country has an export or import specialization in a specific commodity. Equation (3) is used to calculate the TBI value:

$$TBI_{ij} = (X_{ij} - M_{ij})/(X_{ij} + M_{ij}) \quad (3)$$

where the TBI_{ij} implies the trade balance index of country i with commodity j, X_{ij} is the export of commodity j in country i, and Mij is the import of commodity j in country i. The TBI value ranges from −1 to +1. However, when the value is closer to +1, it simply means that the country has an export specialization or is a net exporter. Meanwhile, when the TBI value is close to −1, the country is interpreted as a net importer. Therefore, when the value is between −1 and +1, the country equally exports and imports a specific commodity.

The RSCA and TBI values can be combined simultaneously to construct product mapping (Widodo 2009). This can be further classified into four categories: A, B, C, and D (Figure 2). Category A represents a commodity with a comparative advantage and export specialization (net exporter). Category B consists of a commodity with comparative advantage and import specialization. Category C represents a commodity with comparative disadvantage and export specialization. Category D consists of a commodity with comparative disadvantage and import specialization. Mapping was performed to investigate the countries that have palm oil competitiveness (Saeyang and Nissapa 2021).

	TBI < 0	TBI > 0
RSCA > 0	**Group B:** Comparative Advantage Net-Importer (RSCA > 0 and TBI < 0)	**Group A:** Comparative Advantage Net- Exporter (RSCA > 0 and TBI > 0)
RSCA < 0	**Group D:** Comparative Disadvantage Net-Importer (RSCA < 0 and TBI < 0)	**Group C:** Comparative Disadvantage Net-Exporter (RSCA < 0 and TBI > 0)

Figure 2. RSCA-TBI product mapping. Source: Widodo (2009).

Several empirical studies used the regression model conceptual framework to determine the factors that influence the export competitiveness in the global palm oil trade (Torok and Jambor 2016; Balogh and Jámbor 2017a; Török et al. 2020; Wattanakul et al. 2021; Huo 2014; Hardi et al. 2021). In this research, a simple conceptual framework was formulated as follows:

$$CA_{it} = F(X_i) \quad (4)$$

where CA is a comparative advantage of the country i for specific commodity trade in year t, proxied by obtaining the values of RSCA and TBI from Equations (2) and (3), respectively. Xi is the explanatory variable, including all factors, and a potential determinant of palm oil trade competitiveness. This is consistent with previous studies.

Based on the literature review, the competitiveness of commodities in global trade depends on various factors. Equation (4) was revised by including several explanatory variables, such as the country's endowment, factors of production, resources, size and income level of the population, the domestic consumption of palm oil, and export accessibility to the Asian region as a vast market for this commodity. Others include trade openness, specific requirements in global trade, and the quality of palm oil export, as shown in Equation (5). After revision, the following two regression models were estimated using RSCA and TBI.

$$RSCA_{it}/TBI_{it} = \alpha + \beta 1FDI_{it} + \beta 2logGdppc_{it} + \beta 3logPop_{it} + \beta 4logIMPAVFO_{it} + \beta 5LogEUV_{it} + \beta 6Asia_{it} + \beta 7logTO_{it} + \beta 8RSPO_{it} + e_{it} \quad (5)$$

where $RSCA_{it}$ and TBI_{it} are the measurement of palm oil trade competitiveness in country i and year t. FDI is a foreign direct investment in the same country and year, likewise Gdppc, which is the gross domestic product (GDP) per capita, Pop_{it} is the population, $POcon_{it}$ is the palm oil domestic consumption, $IMPAVFO_{it}$ is the import of animal or vegetable fats and oil in nation i with year t, EUV is the export unit value of palm oil, $Asia_{it}$ is the export activity to the Asian countries, $_{it}$ is the trade openness of a nation, RSPO is the Roundtable on Sustainable Palm Oil (RSPO) that the participating organization represents, log is the natural logarithm of variables, and $_{it}$ is the residual component from regression.

Panel regression was applied through ordinary least squares (OLS), generalized least square (GLS), and fixed effect model (FEM) estimation. However, the correlation matrix was initially performed to check for multicollinearity, and the regression value has to be less than 0.8 or 0.9 (Franke 2010; Senaviratna and Cooray 2019). Using the Levin–Lin–Chu procedure, we tested for the stationary of the series. The test allows us to control for the effect of cross-sectional dependence. Non-stationary variables are introduced in the first differences. After determining the sign of impact in three models, we used the Chow and Hausmann tests to choose the best model for explaining the determinants. There are merely 35 countries that were tested for the determinants of competitiveness due to lack of data availability (Austria, Brazil, Bulgaria, Canada, China, China, Hong Kong, SAR, Colombia, Costa Rica, Côte d'Ivoire, Egypt, France, Germany, Greece, Guatemala, India, Indonesia, Ireland, Italy, Japan, Lithuania, Malaysia, The Netherlands, New Zealand, Portugal, Korea, Russian Federation, Senegal, Singapore, Spain, Sweden, Switzerland, Thailand, Uganda,

United Kingdom, and United States of America). Moreover, we tested regression in two main groups: advanced economies and emerging and developing economies. The panel regression in advanced economies classification was obtained using the ordinary least squares (OLS) and fixed effect model (FEM). The number of countries realized was below that of the independent variables (Baltagi 2008).

3.2. Expected Relationships and Data Source

Competitiveness means the comparative advantage of a country in specific commodity trade. RSCA and TBI are two measurement tools based on the global market share. Several kinds of literature have reported that a country's competitiveness is determined by its endowments factor (Delgado et al. 2012; Narayan and Bhattacharya 2019). Therefore, comparative advantage is generated by managing this factor (Bhawsar and Chattopadhyay 2015). Subsequently, FDI is the driver of export competitiveness in Chinese manufacturing companies (Zhang 2015). Torok and Jambor (2016) discovered a positive correlation between the endowment factors of European ham trade competitiveness in global commodity trade, as the food commodity. However, the input commodity, namely crude or refined palm oil, is one of the input commodities. Investment in the one sector can affect the other sectors based on to the commodity roles (Suroso and Ramadhan 2012). Moreover, FDI has a negative impact on its competitiveness and the beer trade (Török et al. 2020).The palm oil industry has played an essential role in the past three decades due to its numerous benefits. Based on previous empirical studies, it was predicted that the FDI has a negative impact on the competitiveness of palm oil trade because it serves as a feedstock for processing products.

The market is an essential factor for a country's competitiveness. Generally, many empirical studies have approved the GDP's impact on a country's competitiveness (Rusu and Roman 2018; Simionescu et al. 2021). However, a country's size and income are measured by food commodities' market identification and competitiveness (Matkovski et al. 2019; Török et al. 2020). Bahta (2021) reported that GDP per capita positively impacts the competitiveness of agri-food commodities. This differs from several literature works. For example, the palm oil commodity could be processed into other palm-based products. It could implicate a higher demand from the domestic market and negatively affect palm oil trade due to a higher population and its income, proxied by GDP per capita. This research applied the GDP per capita and population analyzed in previous studies. Additionally, the import of animal or vegetable fats and oils is dispersed in practically all nations, implying that greater imports in this category undermine palm oil's competitiveness. The increased need for fats and oils suggests that palm oil products have a possibility to meet the demand, meaning that palm oil has a potential in domestic markets. Import value may be used to estimate demand capacity (Kea et al. 2019). Furthermore, the domestic consumption of a commodity could reflect competitiveness. United States Department of Agriculture (USDA) (2022) reported that the higher palm oil exporter is also the leading consumer. It is consumed in virtually all countries. The palm oil related to demand processing products based on vegetable oil is highest in Asia because it is the region with the largest population globally, followed by America and Africa. The two leading importers of this commodity in Asia are India and China, with a dominant consumption rate based on the population. Therefore, any country that exports palm oil to Asia needs to ensure it possesses higher competitiveness, accessibility, and trade openness (Guerrieri and Caffarelli 2012). It also drives the share of goods production to have a comparative advantage (Tsurumi and Managi 2014). Based on these two statements, trade openness positively impacts palm oil competitiveness. The tight competition in the global market led to the enactment of multiple policies, which could restrict and facilitate trade. The Roundtable on Sustainable Palm Oil (RSPO) is the organization responsible for controlling this industry by implementing sustainable development in palm oil (RSPO 2022). Rosyadi et al. (2021) revealed that the certification of RSPO had a positive effect on Indonesian palm oil export competitiveness to major destination countries. Additionally, there were differences in palm oil market

share and competitiveness in several European countries before and after the RSPO's first shipment in 2008 (Tandra et al. 2021). The sustainable certification is an important criterion for attracting an investor in scope of firms (Suroso et al. 2021).

The duration of this study ranges from 1996 to 2019, involving the top 10 countries with the highest shares in production, consumption, export, import, and competitiveness. The palm oil competitiveness movement was examined based on RSCA-TBI mapping with three classifications (1996 to 2003, 2004 to 2011, and 2012 to 2019). The data source was mainly obtained from UN Comtrade, World Bank Database, United States Department of Agriculture (USDA), FAO Statistics, and RSPO Website. The specific descriptions of variable definitions, data source, and the expected relationships are summarized in Table 1.

Table 1. The values, source, and expected sign of variables.

Variables	Values	Source	Expected Sign
RSCA	The values range between −1 and +1	Calculation by Author	
TBI	The values range between −1 and +1	Calculation by Author	
LogGDPpc	USD	World Bank	−
LogPOP	Total	World Bank	−
FDI	% of GDP (net, inflows)	World Bank	−
logIMPAVFO	USD	UN Comtrade	+
expAsia	Dummy Variable, 1 = the countries that have exported palm oil to Asian countries, 0 = otherwise	UN Comtrade	+
Logeuv	Index	FAOSTAT	+
LogTO	% of GDP	World Bank	+
RSPOpart	Dummy Variable, 1 = the countries already have an organization to participate in RSPO, 0 = otherwise or not reported on the website, converting from RSPO member data in the first participation of the organization in year t while observing the country i origin	RSPO member	+

3.3. Additional Analysis

Numerous studies have been carried out on the stability of competitiveness and duration measurement. In investigating the stability of the RSCA index, a regression analysis was run on the dependent variable at time $_{t2}$ (for sector i in country j), which was tested against the RSCA index in year $_{t1}$.

$$RSCA_{ij}{}^{t2} = \alpha_i + \beta_i RSCA_{ij}{}^{t1} + \varepsilon_{ij} \quad (6)$$

where α and β are normal linear regression parameters, and ε is a residual term. Bojnec and Fertő (2008) stated that when β = 1, it suggests an unchanged pattern of the RSCA between periods t1 and t2, meaning there was no change in the overall degree of specialization in the global palm oil trade. On the one hand, when β > 1, existing specialization is increased, and a low degree of specialization in the initial stages leads to minor specialization, a phenomenon known as divergence. However, if 0 < β < 1, it implies commodity groups with low initial B indices expanding with time, a phenomenon known as convergence (Bojnec and Fertő 2008). Conversely, if β < 0, there is no change in the index's sign. In addition, a non-parametric Kaplan–Meier product limit estimator was constructed to examine the survival function of the RSCA index's product-level distribution analysis (Bojnec and Fertő 2015). The Kaplan–Meier estimator of the survival function is obtained using the following equation:

$$\hat{S}(t) = \prod_{t(i)<t} \frac{N_j - d_j}{n_j} \quad (7)$$

where i = 1, 2, n, t_i is the survival time, and ci is the censoring indicator variable C of observation I (which takes on a value of 1, assuming a failure occurs, and 0 if otherwise). Furthermore, it is believed that the m n failure times have been documented. The rank-ordered survival periods are then denoted as t (1) t (2) . . . < t(m). Let n_j be the number of

subjects who are at failure risk, critically at t(j). Meanwhile, DJ is the number of observed failures. In this research, the failure is the comparative disadvantage with values between −1 and 0, and vice versa.

4. Results

4.1. The Global Production, Consumption, and Trade of Palm Oil

This subsection analyzes the global production, consumption, and trade (export and import) of palm oil. The top 10 highest shareholder countries were investigated by calculating the total data. This was further divided into three subperiods of the global palm oil trade, namely 1996 to 2003, 2004 to 2011, and 2012 to 2019, which are known as the beginning, growth, as well as maturity and decline periods. Table 2 shows the production and global condition of palm oil supply and demand, revealing the countries which are producers and consumers of palm oil in the global world. There are two main producer countries in the three subperiods, namely Indonesia and Malaysia.

Table 2. Top 10 highest-share palm oil production countries, from 1996 to 2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
Malaysia	48.62%	Indonesia	45.98%	Indonesia	55.33%
Indonesia	34.83%	Malaysia	39.78%	Malaysia	30.38%
Nigeria	3.19%	Thailand	3.06%	Thailand	3.70%
Thailand	2.66%	Nigeria	2.02%	Colombia	2.02%
Colombia	2.11%	Colombia	1.77%	Nigeria	1.56%
Papua New Guinea	1.33%	Papua New Guinea	1.08%	Papua New Guinea	0.92%
Côte D'Ivoire	1.22%	Ecuador	0.94%	Ecuador	0.87%
Ecuador	0.99%	Ghana	0.84%	Honduras	0.82%
The Democratic Republic of The Congo	0.66%	Côte D'Ivoire	0.74%	Côte D'Ivoire	0.71%
Cameroon	0.65%	Honduras	0.62%	Brazil	0.70%

Source: FAO (2022).

There was no variation in production. Indonesia has become the largest palm oil producer in the subperiod from 2004 to 2011. Malaysia had a negative trend for palm oil production from the subperiod 1996 to 2003 until 2012 to 2019. The other countries only produced palm oil with average shares of less than 10%. Thailand is the growing palm oil producer, with the last shares reaching 3.70% in the previous subperiod from 2.66% in 1996 to 2003. It is higher than other countries, except for the involvement of Indonesia and Malaysia. Colombia is another developing palm oil producer with positive trends recorded from 1996 to 2003 and from 2012 to 2019. There were other countries with stable growth in the three subperiods, namely Papua New Guinea, Cote d'Ivoire, and Ecuador

The concentration of palm oil production in Indonesia and Malaysia had total shares higher than 80% in the three subperiods. It simply implies that its supply is relatively centralized depending on these countries. In addition, its consumption tends to be spread across various countries. Table 3 reveals the top 10 highest shares of palm oil consumption globally. Indonesia was the highest palm oil producer and consumer from 1996 to 2003 and 2012 to 2019. On the other hand, in terms of palm oil consumption, Malaysia was ranked fifth, and this tended to decrease from 1996 to 2003 and from 2012 to 2019. China and India are the two Asian countries regarded as the main consumers of palm oil. China experienced a fluctuating trend. From 2004 to 2011, it was in a higher position, with 13.73% share. Meanwhile, from 2012 to 2019, it was ranked fourth, with 9.49% share.

Asia and the EU-27 countries were among those with the highest consumption of palm oil, ranking fourth from 1996 to 2003 and third from 2004 to 2011 and 2012 to 2019.

There are seven Asian countries were listed in the top 10 highest shares of palm oil consumption. Overall, it is currently consumed in several nations globally. Zahan and Kano (2018) predicted that its consumption was bound to be used as raw material for

petro-diesel, thereby serving as an alternative transportation energy. India and China are the two countries with high demand for palm oil based on domestic consumption and import. These nations require minor sustainable production requirements compared to the European Union markets (Kadarusman and Pramudya 2019). Globally, the consumption and importation of this commodity are distributed equally, thereby leading to a competitive and prospective palm oil market. Indonesia and Malaysia are also regarded as the primary consumers of palm oil due to high production and supporting government policies related to palm oil utilization. Unlike Indonesia, Malaysia had a downgrade in domestic consumption from 10% in 1996 to 5% in 2019. On the other hand, EU-27 was formed in 1993. The data in the EU-28 from 1998 to 2019. However, EU-27 also equalized China's consumption in 2019 based on the 27 European countries concerned. Meanwhile, other countries, such as Thailand, Bangladesh, Egypt, and Nigeria, showed no significant variation.

Table 3. Top 10 highest-share palm oil consumption countries, from 1996 to 2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
Indonesia	15.80%	China	13.73%	Indonesia	16.73%
India	12.84%	Indonesia	12.91%	India	15.00%
China	9.78%	EU-27	12.09%	EU-27	10.93%
EU-27	8.57%	India	12.07%	China	9.49%
Malaysia	7.38%	Malaysia	5.87%	Malaysia	4.96%
Pakistan	5.69%	Pakistan	4.65%	Pakistan	4.74%
Nigeria	4.37%	Nigeria	3.18%	Thailand	3.52%
Thailand	2.55%	Thailand	2.73%	Bangladesh	2.28%
Egypt	2.32%	Bangladesh	2.20%	Nigeria	2.21%
Japan	1.92%	Egypt	2.15%	USA	2.20%

Source: Indexmundi (2022b).

The top 10 countries with highest share in palm oil exporting from 1996 to 2019 are shown in Table 4. Currently, Indonesia has replaced Malaysia and is ranked first in palm oil export. This trend is similar to palm oil production, in that its replacement only involved these two countries. Indonesia had a higher improvement in palm oil export, from 23.70% share in the subperiod 1996 to 2003, to 51.63% share in 2012 to 2019. Conversely, Malaysia had a negative trend from the subperiod 1996 to 2003 and 2012 to 2019. On the contrary, there has been no higher change and shift in the export shares of other countries.

Table 4. Top 10 palm oil exporters, from 1996 to 2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
Malaysia	59.17%	Malaysia	43.21%	Indonesia	51.63%
Indonesia	23.70%	Indonesia	42.62%	Malaysia	33.64%
Netherlands	4.19%	Netherlands	4.73%	Netherlands	3.85%
Singapore	2.03%	Germany	0.88%	Germany	1.09%
Papua New Guinea	1.66%	Singapore	0.80%	Guatemala	1.09%
China, Hong Kong, SAR	1.05%	Thailand	0.79%	Colombia	0.91%
Côte d'Ivoire	0.87%	Ecuador	0.76%	Honduras	0.69%
Germany	0.84%	Colombia	0.72%	Thailand	0.64%
Costa Rica	0.64%	Côte d'Ivoire	0.54%	Côte d'Ivoire	0.62%
Colombia	0.57%	Costa Rica	0.49%	Ecuador	0.57%

Source: UNcomtrade (2022).

The Netherlands is the only country with export shares greater than 3%, placing it in the third position for the three subperiods. It is one of the European Union countries with high-intensity trade in palm oil; therefore, it has control over the global price. Rotterdam is regarded as the central city for the trading of this commodity. It has similar characteristics to Singapore as the major regional trade connectivity, implying that the geographical hubs between the main exporters (Indonesia and Malaysia) and major importers (China and

India) are the same. Germany is one of the exporter countries due to its high exportation of refined palm oil and derivative products. Table 4 also reveals several growing palm oil exporters with positive trends, such as Germany, Colombia, Guatemala, and Honduras. Table 5 shows the top 10 highest-share importer countries from 1996 to 2019. India and China have alternatively occupied the position of the largest importer for 24 years. India occupied the highest position in two subperiods (1996 to 2003 and 2012 to 2019). Meanwhile, China remained the leading importer in the subperiod from 2004 to 2011. The imports by China and India from 1996 to 2003 increased from 12.91% and 18.89% to 13.11% and 19.90% from 2012 to 2019, respectively. Other information related to palm oil import growth in European countries implies its improvement based on the shift made in four to five countries from 2004 to 2011 and 2012 to 2019, respectively. On the other hand, these countries, excluding India and China, relatively have an import share of less than 10% apart from these two countries. As a prominent product leader and exporter, Malaysia was also among the top 10 palm oil importers from 2004 to 2011. The negative trend of palm production has led to Malaysia's higher import of palm oil.

Table 5. Top 10 palm oil importers, from 1996 to 2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
India	18.89%	China	17.42%	India	19.90%
China	12.91%	India	13.10%	China	13.11%
Netherlands	5.96%	Pakistan	5.85%	Netherlands	6.39%
United Kingdom	4.76%	Netherlands	5.59%	Pakistan	5.91%
Germany	4.70%	Bangladesh	5.25%	Italy	3.66%
Japan	3.58%	Germany	4.00%	Spain	3.30%
Bangladesh	2.92%	Malaysia	3.13%	USA	3.29%
Singapore	2.72%	USA	2.90%	Germany	3.06%
Italy	2.50%	Italy	2.48%	Bangladesh	2.26%
China, Hong Kong, SAR	2.12%	Russian Federation	2.30%	Russian Federation	2.16%

Source: UNcomtrade (2022).

4.2. The Competitiveness of Global Palm Oil Trade and Determinants

This subsection describes the list of countries with high competitiveness for palm oil based on RSCA and its determinants. The top 10 countries with highest RSCA in the three subperiods are shown in Table 6. Conversely, palm oil competitiveness varies due to its export value change. This could implicate several countries' shifts within the stipulated period based on the RSCA value.

Table 6. Top 10 palm oil competitiveness based on RSCA, from 1996 to 2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
Malaysia	0.952	Indonesia	0.958	Niger	0.963
Indonesia	0.925	Malaysia	0.942	Indonesia	0.963
Honduras	0.918	Solomon Isds	0.933	Togo	0.936
Côte d'Ivoire	0.849	Guatemala	0.805	Malaysia	0.926
Costa Rica	0.781	Benin	0.802	Sao Tome and Principe	0.901
Uganda	0.744	Costa Rica	0.787	Guatemala	0.894
Guatemala	0.720	Côte d'Ivoire	0.785	Nepal	0.891
Togo	0.678	Ecuador	0.754	Côte d'Ivoire	0.797
Colombia	0.487	Uganda	0.678	Uganda	0.792
Panama	0.278	Colombia	0.566	Benin	0.764

Source: Author Calculation.

Malaysia was the country with the highest comparative advantage from 1996 to 2003, followed by Indonesia, Honduras, and Cote d'Ivoire. Indonesia overtook Malaysia from 2004 to 2011, with 0.958. On the other hand, there was a shift in four countries from 1996 to

2003 and 2004 to 2011. Different from the two subperiods, Indonesia or Malaysia are not placed in the first place. Niger has the highest comparative advantage, with an RSCA value of 0.963, followed by three other countries, Indonesia, Togo, and Malaysia. Additionally, there is a shift in five countries was observed from 2012 to 2019, with a significant change in the RSCA position, whose value was higher than the initial two subperiods.

The competitiveness was identified with TBI, using export and import as the prime measurements. Table 7 shows the top 10 countries with the highest TBI, divided into three subperiods. Compared with RSCA, certain changes are observed in the country list, especially in the last subperiod with varying ranks. Indonesia was relatively stable in the first place in three subperiods. Conversely, Malaysia tended to fluctuate due to decreasing TBI values from 2004 to 2011, which increased from 2012 to 2019. Ecuador and Guatemala had growing competitiveness based on TBI. Surprisingly, Ecuador reached the second place from 2004 to 2011. Therefore, TBI measurements had no variations compared to the RSCA index due to rank and country shift composition. Indonesia remained in the first place based on RSCA and TBI assessments for several subperiods. This research supports the findings of previous studies that Indonesia is competitive in the global palm oil market by representing the major export and import countries (Rifin 2010; Salleh et al. 2016; Ramadhani and Santoso 2019). However, based on the derivative palm oil products, Malaysia is more competitive than Indonesia (Arip et al. 2013). It can be shown that the RSCA value has a relatively negative trend. Moreover, several countries with higher potential competitiveness almost reach Indonesia and Malaysia's competitiveness, such as Niger and Guatemala, have proved to experience higher growth in recent decades. Therefore, the TBI results claim that Ecuador is the potential country for palm oil competitiveness in the global market, particularly in terms of redeveloping the governing institutions and increasing the domestic funding by stimulating this industry (Johnson 2014).

Table 7. Top 10 palm oil competitiveness based on TBI, 1996–2019.

Countries	1996–2003	Countries	2004–2011	Countries	2012–2019
Indonesia	0.970	Indonesia	0.998	Indonesia	0.998
Malaysia	0.966	Ecuador	0.977	Malaysia	0.893
Costa Rica	0.947	Costa Rica	0.909	Guatemala	0.887
Ecuador	0.848	Malaysia	0.877	Cambodia	0.782
Colombia	0.847	Côte d'Ivoire	0.802	Ecuador	0.726
Côte d'Ivoire	0.709	Thailand	0.799	Thailand	0.723
Honduras	0.654	Guatemala	0.739	Honduras	0.636
Thailand	0.550	Honduras	0.646	Costa Rica	0.626
Guatemala	0.498	Colombia	0.606	Côte d'Ivoire	0.608
Panama	0.148	Solomon Isds	0.471	Colombia	0.337

Source: Author Calculation.

The RSCA and TBI values can be combined to investigate the countries' mapping. Groups of palm oil competitiveness in the three periods are from 1996 to 2003, 2004 to 2011, and 2012 to 2019, as shown in Table 8. Moreover, group A constantly contains eight countries in the two initial periods. However, it has declined to seven countries in the last period. Six countries, namely Indonesia, Malaysia, Guatemala, Colombia, Cote d'Ivoire, and Costa Rica, remained in group A in the three periods. In Group B, enhancements were made from three to eight country lists and were compared to the first and last periods. The Netherlands and Uganda are two countries that have consistently been in this group. Meanwhile, Group C has a minor number and low growth in the country list. Thailand is the only country that remained in Group C in all periods. Group D had the highest number of countries. It experienced significant growth, especially from 1996 to 2003 until 2004 to 2011, in accordance with the addition of 38 countries. The total number of competitive countries in the palm oil trade was less than 20, with advantages in RSCA and TBI. The mapped results include countries in the top exporter list, such as Indonesia, Malaysia, Colombia, Costa Rica, Guatemala, Cote d'Ivoire, and Ecuador.

Table 8. RSCA-TBI countries mapping for palm oil.

Group/Period	1996–2003	2004–2011	2012–2019
Group A (RSCA > 0 and TBI > 0)	8 Countries (Colombia, Costa Rica, Cote d'Ivoire, Guatemala, Honduras, Indonesia, Malaysia, and Panama)	8 Countries (Colombia, Costa Rica, Cote d'Ivoire, Ecuador, Guatemala, Indonesia, Malaysia, and Solomon Isds)	7 Countries (Colombia, Costa Rica, Cote d'Ivoire, Ecuador, Guatemala, Indonesia, and Malaysia)
Group B (RSCA > 0 and TBI < 0)	3 Countries (Netherlands, Togo, and Uganda)	5 Countries (Cameroon, Netherlands, Niger, Uganda, and United Rep. of Tanzania)	8 Countries (Benin, Ghana, Netherlands, Nicaragua, Niger, Rwanda, Togo, and Uganda)
Group C (RSCA < 0 and TBI > 0)	2 Countries (Brazil and Thailand)	2 Countries (Singapore and Thailand)	3 Countries (Cambodia, Peru, and Thailand)
Group D (RSCA < 0 and TBI < 0)	74 Countries (Albania, Algeria, Andorra, Argentina, Australia, Austria, Azerbaijan, Bulgaria, Burkina Faso, Burundi, Canada, Central African Rep., Chile, China, China, Hong Kong, SAR, Croatia, Cyprus, Egypt, Estonia, Faeroe Isds, Finland, Fmr Sudan, France, French Polynesia, Gabon, Gambia, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Jamaica, Japan, Latvia, Lithuania, Madagascar, Mali, Malta, Mauritius, Mexico, Morocco, New Zealand, Nicaragua, Niger, Nigeria, North Macedonia, Norway, Oman, Peru, Philippines, Poland, Portugal, Rep. of Korea, Romania, Russian Federation, Saint Lucia, Senegal, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Turkey, Ukraine, United Kingdom, Uruguay, USA, Venezuela, and Zambia)	112 Countries (Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Benin, Bolivia (Plurinational State of), Bosnia Herzegovina, Botswana, Brazil, Bulgaria, Burundi, Cambodia, Canada, Chile, China, China, Hong Kong SAR, Comoros, Croatia, Cyprus, Czechia, Denmark, Dominican Rep., Egypt, El Salvador, Estonia, Eswatini, Ethiopia, Fiji, Finland, Fmr Sudan, France, French Polynesia, FS Micronesia, Gambia, Germany, Ghana, Greece, Greenland, Guyana, Hungary, Iceland, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lebanon, Lithuania, Luxembourg, Madagascar, Malawi, Malta, Mauritius, Mexico, Morocco, Mozambique, Namibia, New Caledonia, New Zealand, Nicaragua, North Macedonia, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Rep. of Korea, Rep. of Moldova, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Samoa, Saudi Arabia, Senegal, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Suriname, Sweden, Switzerland, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, Uruguay, USA, Vietnam, Yemen, Zimbabwe)	116 Countries (Albania, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan Bahrain, Barbados, Belarus, Belgium, Bermuda, Bolivia (Plurinational State of), Bosnia Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Canada, Chile, China, China, Hong Kong SAR, Comoros, Congo, Croatia, Cyprus, Czechia, Denmark, Dominican Rep., Egypt, El Salvador, Estonia, Eswatini, Ethiopia, Fiji, Finland, France, French Polynesia, Gambia, Georgia, Germany, Greece, Grenada, Guyana, Hungary, Iceland, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kyrgyzstan, Lao People's Dem. Rep., Latvia, Lebanon, Lesotho, Lithuania, Luxembourg, Madagascar, Malawi, Maldives, Malta, Mauritania, Mauritius, Mexico, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, New Zealand, Nigeria, North Macedonia, Norway, Pakistan, Paraguay, Philippines, Poland, Portugal, Qatar, Rep. of Korea, Rep. of Moldova, Romania, Russian Federation, Saint Lucia, Samoa, Saudi Arabia, Senegal, Serbia, Seychelles, Singapore, Slovakia, Slovenia, South Africa, Spain, State of Palestine, Sweden, Switzerland, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United Rep. of Tanzania, Uruguay, USA, Vietnam, Zambia, Zimbabwe)

Source: Author Calculation.

The integration of RSCA and TBI shows that only a few countries have competitiveness in palm oil. Constantly, Indonesia, Malaysia, Guatemala, Côte d'Ivoire, Colombia, and Costa Rica have remained competitive from 1996 to 2019. It simply implies that the global palm oil market tends to be an oligopoly.

This study also revealed that the determinants of competitiveness in the global palm oil trade were obtained using RSCA and TBI as a dependent variable. Table 9 shows the summary statistics of the data. The mean, median, maximum, minimum, and standard deviation (Std Dev) of all dependent and independent variables in the whole sample were plotted. Table 10 shows that the null hypothesis (series have a unit root) may be strongly rejected at the 5% level for a number of variables, including RSCA, TBI, FDI, GDPC, IMPAVFO, TO, and OEXR. According to these characteristics, all panel time series give considerable evidence for stationarity, the only exceptions being POP and EUV, which are non-stationary at the level with probability above 5%.

Table 9. Descriptive statistics.

	Mean	Median	Maximum	Minimum	Std Dev
RSCA	−0.496	−0.866	0.967	−1.000	0.691
TBI	−0.482	−0.831	1.000	−1.000	0.688
FDI	4.776	2.543	86.479	−37.712	8.553
LOG(GDPC)	9.342	9.843	11.390	5.991	1.406
LOG(POP)	17.257	17.231	21.065	14.843	1.541
LOG(IMPAVFO)	19.878	19.827	23.291	14.597	1.491
LOG(EUV)	4.402	4.454	5.932	3.045	0.450
ASIA	0.636	1.000	1.000	0.000	0.482
LOG(TO)	4.239	4.129	6.093	2.750	0.638
RSPO	0.445	0.000	1.000	0.000	0.497

Table 10. Stationary test (Levin–Lin–Chu test).

Variables	Level (Prob)	First Differences (Prob)	Conclusions
RSCA	−7.355 ***	−15.974 ***	Stationary
TBI	−7.331 ***	−15.481 ***	Stationary
FDI	−4.454 ***	−16.465 ***	Stationary
GDPC	−2.245 **	−13.649 ***	Stationary
POP	1.164	−10.157 ***	Non-Stationary
IMPAVFO	−2.261 **	−14.702 ***	Stationary
EUV	−1.400	−14.742 ***	Non-Stationary
TO	−2.260 **	−15.579 ***	Stationary

Note: **, and *** = Significant at 5% and 1%.

Panel regression for RSCA and TBI using the OLS, GLS, and FEM models is shown in Table 11. The three models produce dense findings because they are statistically significant (p-value 5%). The Hausman test indicates that the FEM is a better model for RSCA and TBI than the other two models, with a significant difference of 5%. Oil has a negative influence on RSCA, GDP per capita, and dummy RSPO.

Other variables that have a positive impact include population and imports of animal or vegetable fats and oils. Furthermore, we analyze the competitiveness determinant based on TBI. Population and trade openness have a positive impact. On the other hand, the import of animal or vegetable fat and oil has the negative impact on TBI.

Based on RSCA, we only discovered four variables that have an effect on competitiveness. FDI as an endowment factor has no effect on RSCA, implying that the investment has had no effect on palm oil's competitiveness. Larger accessible commodities may frequently not necessitate higher investment. Palm oil has recently become the most traded vegetable oil commodity. As a result, FDI has no effect on RSCA. Market size measures, such as GDP per capita, also have a negative influence on competitiveness, since dominating producers

have greater domestic consumption and rank in the top ten, especially Indonesia and Malaysia (Table 3). The domestic supply of palm oil is used for fulfilling the domestic demand, implicating the lower export to measure export competitiveness. This is consistent with Huo's earlier results (Huo 2014). The findings agree with those of prior studies (Balogh and Jámbor 2017a; Török et al. 2020). Conversely, we discovered that a larger population might boost competitiveness by serving as a human resource to support palm oil trading activities. According to Török et al. (2020), the export unit value of input products, one of which is palm oil, may not have an impact on palm oil competitiveness. This indicates that the worldwide palm oil sector is competing with goods of similar or lower quality.

Table 11. Panel regression.

Variables	RSCA			TBI		
	OLS	FEM	GLS	OLS	FEM	GLS
C	3.637 ***	−1.118 ***	−0.980 ***	4.285 ***	−0.117	0.049
FDI	−0.001	−0.001	0.000	−0.006 **	−0.001	−0.001
LOG(GDPC)	−0.167 ***	−0.081 ***	−0.090 ***	−0.115 ***	−0.001	−0.016
D(LOG(POP))	23.724 ***	2.893 **	3.506 ***	11.354 ***	5.241 ***	5.664 ***
LOG(IMPAVFO)	−0.174 ***	0.078 ***	0.073 ***	−0.250 ***	−0.035 **	−0.037 **
D(LOG(EUV))	0.012	-4×10^{-4}	1.09×10^{-5}	−0.006	−0.009	−0.009
ASIA	0.104 ***	−0.005	−0.006	0.301 ***	−0.028	−0.026
LOG(TO)	0.100 ***	−0.042	−0.033	0.187 ***	0.074 *	0.076 *
RSPO	0.389 ***	−0.045 ***	−0.035 **	0.472 ***	−0.012	−0.002
R-squared	0.488	0.961	0.054	0.377	0.946	0.061
F-statistic	94.727 ***	451.958 ***	5.684 ***	60.325 ***	315.101 ***	6.478 ***
N	805	805	805	805	805	805
Chow Test		276.079 ***	-		233.867 ***	
Hausman Test		-	42.538 ***			26.595 ***

Note: *, **, and *** = Significant at 10%, 5% and 1%.

Furthermore, the dummy RSPO and trade openness does not affect palm oil's competitiveness. The distribution of palm oil has already expanded to all nations throughout the world, implying that trade levels do not affect palm oil export competitiveness. Alternatively, India and China are among the Asian countries with fierce rivalry in the vegetable oil industry. These nations are also major markets for soybean and sunflower oil, with soybean making the largest contribution to the global oilseed economy (Sharma et al. 2012). Following this, we discovered that larger imports of animal or vegetable fats and oil had a positive influence on RSCA, implying that increased local demand for vegetable oil or comparable items might boost competitiveness. Malaysia being the leading producer, had a consistent import of palm oil from 2004 to 2011.

Dummy RSPO is the final negative component that influences competitiveness as one of numerous countries' export criteria (in the case of export to the European Union). The guaranteed premium price for sustainable palm oil, which includes export revenues, contributed to the increasing competitiveness. (Rosyadi et al. 2021). We evaluated these independent factors on TBI to provide further understanding and obtained nearly identical findings. However, GDP per capita and trade openness have two distinct consequences due to the fulfillment of local demand. GDP per capita has not influenced on palm oil competitiveness. This is also in accordance with the harmful impact of animal or vegetable fats and oils imported. Trade openness has a positive influence on TBI because more global trade participation may lead to a greater trade value between export and import. Palm oil trade spreads to many countries with various classifications. Hence, this research analyzed the global competitive determinants of palm oil based on advanced, emerging, and developing economies in accordance with the International Monetary Fund (IMF) classification (International Monetary Fund 2022). The advanced emerging and developing economies consist of 6 and 12 countries. Multicollinearity was applied to determine the predictor correlation value below 0.9. Although the value of trade openness and FDI approached the

collinearity limit of 0.8 or 0.9, in the scope of advanced economies, for the emerging and developing countries, OLS and GLS were used to predict the determinants. Table 12 shows the panel regression results in advanced economies and panel regression in the emerging and developing economies. The advanced economies classifications are discussed using REM as the appropriate model using Hausman test with insignificance at 5%. In contrast, FEM is utilized to explain the determining factor of palm oil competitiveness in emerging and developing countries, since the Hausman test value is significant at 5%. In Table 12, we discovered that GDP per capita and RSPO had a negative impact on RSCA in the case of advanced economies. On the other hand, the population and import of animal or vegetable fats and oils have a positive influence. Similar to RSCA, there are information about the effect on TBI. In the case of advanced economies, GDP per capita has a negative influence on TBI. Population and trade openness, on the other hand, have a beneficial influence. Furthermore, TBI is unaffected by FDI, imports of animal or vegetable fats and oils, export unit value, dummy Asia, and dummy RSPO. Population growth and the import of animal or vegetable fats and oils have a positive influence on the emerging and developing economies. TBI also provides us with further information regarding the positive effects of GDP per capita, population, and trade openness. Moreover, the imports of animal or vegetable fats and oils have a negative influence.

Table 12. Panel regression by classification of economies.

Variables	Advanced Economies				Emerging and Developing Economies			
	RSCA		TBI		RSCA		TBI	
	FEM	GLS	FEM	GLS	FEM	GLS	FEM	GLS
C	−0.001	−0.152	0.839	0.436	−1.438 ***	−1.383 ***	−0.205	−0.200
FDI	-8.670×10^{-5}	-3.320×10^{-5}	-2.450×10^{-4}	-8.040×10^{-5}	-3.790×10^{-3}	-3.833×10^{-3}	-1.775×10^{-3}	-2.695×10^{-3}
LOG(GDPC)	−0.243 ***	−0.238 ***	−0.196 ***	−0.186 ***	−0.073 *	−0.038	0.103 ***	0.155 ***
D(LOG(POP))	2.286 **	2.455 ***	4.576 ***	4.950 ***	13.144 ***	14.896 ***	12.529 ***	13.082 ***
LOG(IMPAVFO)	0.075 ***	0.075 ***	0.003	0.012	0.100 ***	0.072 ***	−0.071 ***	−0.108 ***
D(LOG(EUV))	−0.004	−0.004	−0.001	−0.003	0.009	0.010	−0.027	−0.026
ASIA	0.007	0.009	−0.011	−0.004	0.020	0.011	−0.044	−0.040
LOG(TO)	0.043	0.065 *	0.082	0.108 **	−0.032	0.011	0.134 **	0.206 ***
RSPO	−0.053 ***	−0.057 ***	−0.015	−0.030	−0.003	0.003	−0.030	−0.026
R-squared	0.899	0.196	0.740	0.094	0.953	0.069	0.958	0.133
F-statistic	142.230 ***	13.731 ***	45.485 ***	5.860 ***	299.543 ***	3.095 ***	334.773 ***	6.423 ***
N	460	460	460	460	345	345	345	345
Chow Test	137.128 ***		41.360 ***		157.246 ***		202.607 ***	
Hausman Test		12.389		13.975 *		29.382 ***		55.698 ***

Note: *, **, and *** = Significant at 10%, 5% and 1%.

4.3. The Stability of Global Palm Oil Competitiveness

The RSCA index was used to measure the stability of palm oil competitiveness to examine the durability of comparative advantages, as shown in Table 13. The calculated results showed that the global palm oil trade tendencies have remained relatively constant across the period studied. The value was relatively high when the model was run with a single lag, and the values generally remained consistent as the number of time delays increased. The data showed that the pattern of disclosed comparative advantage diverged from high to low B values with increasing comparative benefits of the global palm oil trade.

The durability of comparative advantages in the international palm oil trade was investigated to determine the duration analysis using the non-parametric Kaplan–Meier product. The result showed that comparative advantages in the global palm oil trade persisted from 1996 until 2017, with the value of survival function above 10% (Table 14). Survival rates declined from 96 percent at the start of the period to 0 percent in 2019, thereby reflecting that the global palm oil trade is competitive. The only countries with stable comparative advantage in the palm oil trade are Indonesia, Malaysia, Guatemala, Côte d'Ivoire, Netherlands, Colombia, and Costa Rica. Two non-parametric tests, such as Log-rank and Wilcoxon, can be used to determine whether survival functions are identical across countries. The 1% level of significance implies that there are no similarities across nations regarding the duration of comparative advantage. The stability and duration

results demonstrated that the worldwide palm oil trade is highly competitive due to the varying comparative patterns across the 24 years of studies. A few countries with the most significant comparative advantages have always been competitive and are expected to continue to be so even in the future.

Table 13. Stability of RSCA.

Lags	α	β	*p*-Value	R-Square	R	β/R	N
1	−0.0260	0.9625	0.0000	0.9178	0.9580	1.0047	1886
2	−0.0290	0.9550	0.0000	0.8912	0.9440	1.0116	1804
3	−0.0298	0.9509	0.0000	0.8763	0.9361	1.0158	1722
4	−0.0346	0.9422	0.0000	0.8534	0.9238	1.0199	1640
5	−0.0346	0.9383	0.0000	0.8355	0.9141	1.0266	1558
6	−0.0299	0.9402	0.0000	0.8275	0.9097	1.0336	1476
7	−0.0301	0.9350	0.0000	0.8052	0.8974	1.0419	1394
8	−0.0255	0.9385	0.0000	0.8050	0.8972	1.0460	1312
9	−0.0291	0.9304	0.0000	0.7858	0.8864	1.0496	1230
10	−0.0348	0.9180	0.0000	0.7585	0.8709	1.0541	1148
11	−0.0355	0.9171	0.0000	0.7605	0.8720	1.0517	1066
12	−0.0396	0.9098	0.0000	0.7448	0.8630	1.0542	984
13	−0.0355	0.9111	0.0000	0.7364	0.8581	1.0617	902
14	−0.0261	0.9159	0.0000	0.7241	0.8509	1.0764	820
15	−0.0369	0.8999	0.0000	0.6915	0.8316	1.0822	738
16	−0.0236	0.9143	0.0000	0.7005	0.8370	1.0923	656
17	−0.0269	0.9052	0.0000	0.6739	0.8209	1.1026	574
18	−0.0409	0.8878	0.0000	0.6507	0.8066	1.1006	492
19	−0.0403	0.8896	0.0000	0.6559	0.8099	1.0985	410
20	−0.0582	0.8664	0.0000	0.6246	0.7903	1.0963	328
21	−0.0656	0.8500	0.0000	0.5901	0.7682	1.1066	246
22	−0.0794	0.8296	0.0000	0.5478	0.7401	1.1210	164
23	−0.1243	0.7798	0.0000	0.5005	0.7075	1.1022	82

Table 14. Kaplan–Meier survival test.

Year	Survival Function	Indonesia	Malaysia	Guatemala	Cote d'Ivoire	Netherlands	Colombia	Costa Rica
1996	0.964	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	0.927	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1998	0.890	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1999	0.852	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2000	0.814	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2001	0.775	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002	0.736	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2003	0.698	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2004	0.660	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	0.620	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2006	0.582	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.543	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2008	0.504	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2009	0.463	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2010	0.423	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2011	0.381	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2012	0.340	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2013	0.298	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2014	0.254	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.210	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2016	0.164	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	0.116	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2018	0.067	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2019	0.009	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Log Rank	0.000							
Wilcoxon	0.000							

5. Conclusions

The worldwide supply of palm oil, including production and export, is predominantly based in Indonesia and Malaysia, which rank first or second in the three subperiods. In contrast, worldwide palm oil demand is spread in global market shares, with Indonesia, India, and China topping the list of nations with the highest consumption. India and China are the major importer countries, accounting for more than 10% of total global palm oil imports. Only Indonesia and Malaysia have stronger competitiveness in palm oil internationally. Potential nations, such as Niger and Togo, on the other hand, approach Indonesia and Malaysia in terms of palm oil competitiveness, particularly in the subperiods 2012–2019. The panel regression found that boosting palm oil competitiveness involves using the people as the primary resource for export activities and raising the demand capacity for animal or vegetable fats and oils.

Last but not least, RSPO certification must be considered in order to gain competitiveness in the global palm oil industry. Due to limited statistics on palm oil and total export, we only investigated the countries with comprehensive data. Due to a shortage of data availability, future study can broaden the samples and time periods for outcome analysis. Furthermore, determining the competitiveness of the global palm oil trade may be accomplished using a variety of methods, such as shift-share analysis or computable equilibrium models.

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