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An empirical analysis of Malaysian palm oil export to world main palm oil importing countries: evidence from a panel cointegration model

Nur Ain Mohd Hassan[1]* Kalsom Zakaria[1] Kamalrudin Mohamed Salleh[1]
Siti Mashani Ahmad[1]

[1] *Malaysian Palm Oil Board, 6 Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia*
* *Corresponding author: nurain.hassan@mpob.gov.my*

Abstract

The paper explores the long-term causal relationships of Malaysian palm oil exports with the real effective exchange rate of the respective importing countries, palm oil consumption, vegetable oil production, and GDP growth. The study applied panel cointegration and causality approaches based on data from 10 main palm oil importing countries between 2004 and 2018. The impacts of economic growth, the effective real exchange rate, and the production of other vegetable oils by the main palm oil importing countries on Malaysian palm oil exports were found to be negative. However, palm oil consumption by the main palm oil importers was found to be a statistically significant positive determinant of Malaysian palm oil exports. This finding indicates that consumption has a direct positive effect on the demand for exports. A panel Granger causality analysis revealed a unidirectional causality between importing countries' production of other vegetable oils and Malaysian exports of palm oil.

Keywords: *panel cointegration, FMOLS, palm oil export, Granger causality*

1. Introduction

According to the United States Department of Agriculture [9], global vegetable oil consumption is projected to increase by 2.8% in 2020, down from the 3.3% pace observed in the previous year. Vegetable oils have been consumed for thousands of years [18] and it is expected that consumption will continue to increase along with the increase in the global population [21]. It is widely used as cooking oil, margarine, shortening, and vegetable ghee in the food industry. The composition of global vegetable oil consumption reveals the preferences of international society. Figure 1 shows that the world consumption of vegetable oils has increased from 38,216 thousand tonnes in 1980 to 200,591 thousand tonnes in 2018.

The world consumption pattern of vegetable oils has changed over the years in line with consumer preference. In the 1980s, global consumption of vegetable oil was largely dominated by soybean oil,

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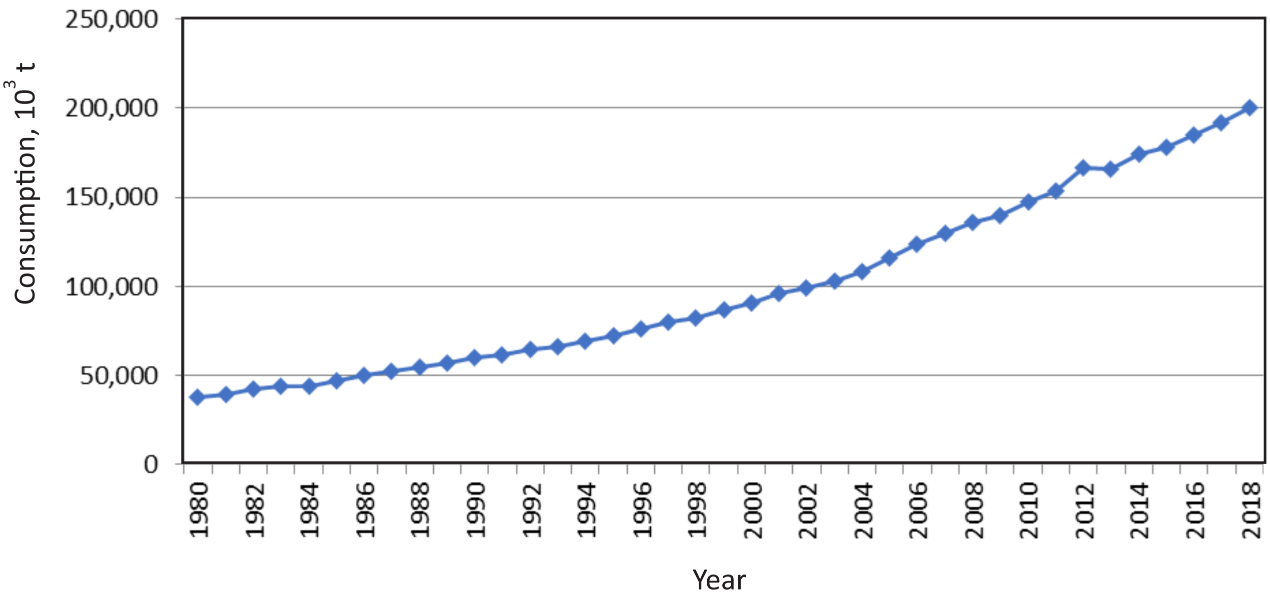

Figure 1. World consumption of vegetable oils 1980–2018 [1–8]

followed by sunflower oil, palm oil and rapeseed oil (Figure 2). After ten years, the consumption pattern of vegetable oils has changed; palm oil is preferred to other vegetable oils. The preference for palm oil continued to increase in the next decade, in line with the recognition given by the Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO) of palm oil as one of the 17 vegetable oils recommended as food ingredients [15]. In 2018, palm oil consumption was found to have already exceeded soybean oil as the most consumed vegetable oil in the world (Figure 2).

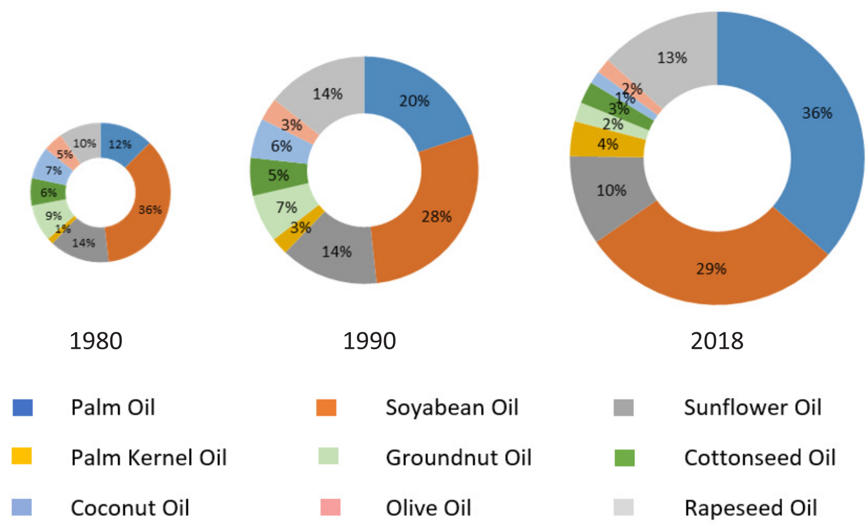

Figure 2. World vegetable oil consumption patterns 1980, 1990, and 2018. Source: Oil World [1, 3, 8]

The consumption of four main vegetable oils by ten main palm oil importing countries is shown in Figure 3. In 2018, India consumed palm oil the most than other vegetable oils, followed by Pakistan, Bangladesh, Nigeria, the Philippines, and Egypt, while soybean oil was dominated in China and the United States (USA). China has consumed soybean oil more than 15 million tons; it is used extensively as cooking oil. Meanwhile, rapeseed oil and sunflower oil were highly consumed in the European Union (EU) and Russia, respectively.

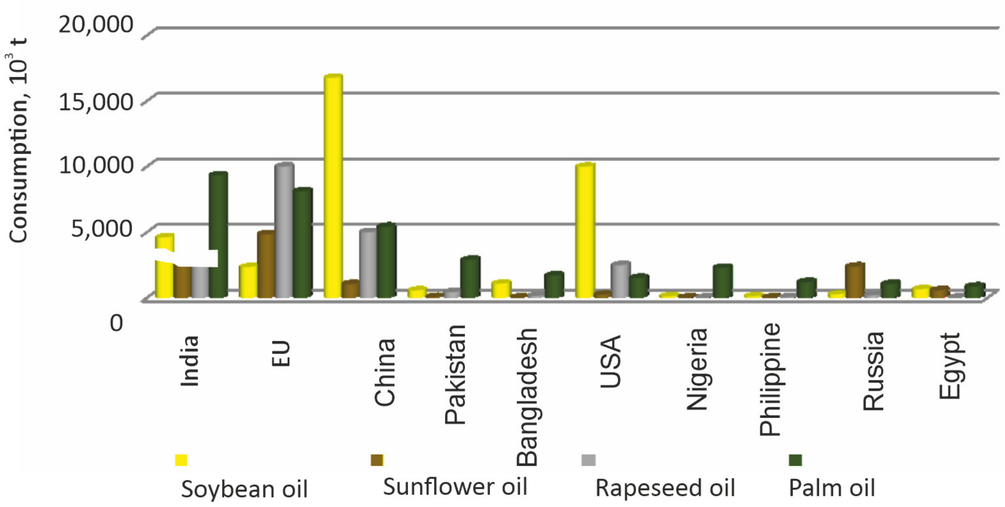

Figure 3. Consumption of 4 main vegetable oils by 10 main palm oil importing countries in 2018. Source: Oil World [8]

The consumption of vegetable oils around the world is increasing year by year, which sometimes is not aligned with the production of oil seeds due to certain factors that decrease production, such as weather conditions and response to low prices [9]. Therefore, to meet the increasing demand for vegetable oil, many countries have to rely on imports. Figure 4 shows the imports of four main vegetable oils from ten main countries that import palm oil, in which palm oil is highlighted as the oil most imported. The United States prefers to import more rapeseed oil. China was also found to be one of the top three palm oil import countries, as China used palm oil extensively for the food industry to make instant noodles, margarine, and shortening.

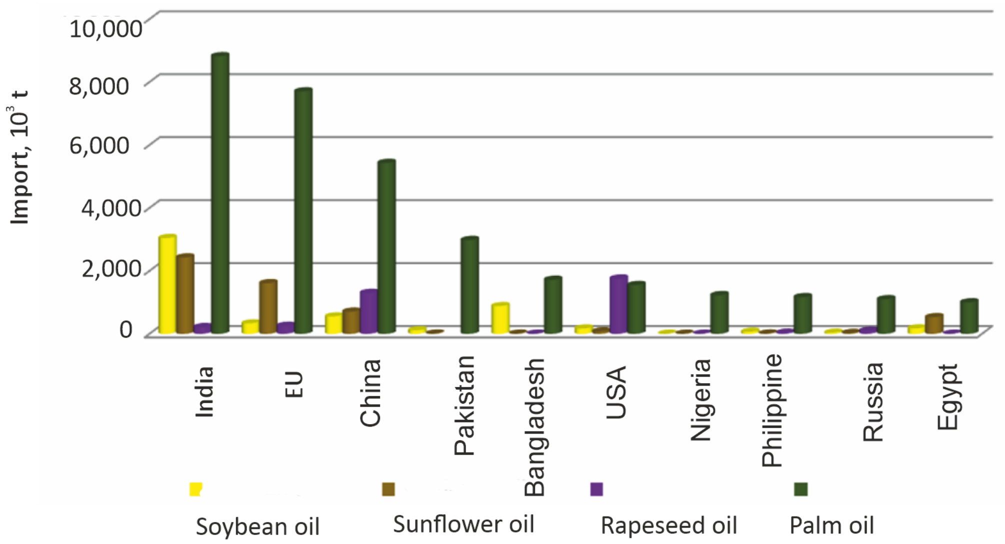

Figure 4. Imports of 4 main vegetable oils by 10 main palm oil importing countries in 2018. Source: Oil World [8]

Palm oil continues to hold its position as the largest export of vegetable oils in the world, representing 56.5% of the vegetable oils exported in 2019 [40]. Meanwhile, Malaysia is one of the largest palm oil exports on the global market, covering 34.2% of the total palm oil exported in 2019 [11]. Of the total destination of Malaysian palm oil, India, with an intake of 4.41 million tonnes, represents 23.9% of the total export of Malaysian palm oil in 2019, followed by China at 2.49 million tonnes (3.5%), the EU at 2.09 million tonnes (11.3%) and Pakistan at 1.09 million tonnes (5.9%) Parveez et al. [33].

Many authors studied the factors influencing the demand for palm oil. Sayili and Vuray [42] investigated the relationship between edible oil consumption and the elasticity of income expenditure. The finding of their study shows that an increase in household income of 1% would lead to an increase in household expenditure on butter, margarine, and olive oil, by 0.8902%, 2.1948%, 1.0715%, respectively. Another study by Egwuma et al. [20] focused on palm oil markets in Nigeria. The results revealed that the price of palm oil and the national income of a country are among the significant factors that determine the domestic demand for palm oil. Some authors found the negative impact of the price of palm oil on domestic demand, which means that a 0.138% decrease in the demand for palm oil would accompany every 1% increase in the price of palm oil. National income has a positive relationship of 0.234% with palm oil demand since 1% increases the price of palm oil. Other findings supporting the importance of the price of palm oil for its demand include Applanaidu et al. [13], Talib and Darawi [47], and Shamsudin et al. [44] with a price elasticity obtained for the demand of 0.16, 0.388, and 0.242, respectively.

Talib and Darawi [47] found that important factors that influence palm oil demand include the exchange rate, the world population, the price of palm oil, technological advancement in production techniques, and the price of soybean oil. Malaysia's exchange rate was found to be an important determinant of the quantity of palm oil export, in which Malaysia's palm oil export increased by approximately 8.6% for every 20% increase in the Malaysian Ringgit-US Dollar exchange rate. The world population also influenced the volume of palm oil export with a short-term population elasticity of 3.9. Priyati [37] also examined the determinants of palm oil demand but focused on the Indonesian market by using the gravity model over the period of 1999–2011. GDP growth, GDP per capita, and distance were found to be important determinants of palm oil demand. Research on the palm oil market in Ghana from 1987 to 2006 shows that a one% decrease in the real domestic price of Ghana's palm oil led to an 11.9% increase in the quantity exported by Kuwornu et al. [29]. Another factor is related to the Malaysian palm oil export price, whereby a one% increase in the Malaysian palm oil export price would increase the demand for palm oil in Ghana by 2.1%. Furthermore, every% decrease in the export price of Ghana's palm oil would lead to an 11.1% increase in the demand for palm oil in Ghana.

Several other studies have also focused on the palm oil markets. Zakaria et al. [48] studied the demand for palm oil on the Turkish market using autoregressive distributed delay (ARDL) from 1980 to 2015. In Turkey, GDP and sunflower oil prices were found to have a significant positive influence on long-term palm oil demand, while palm oil prices had a significant negative relationship with palm oil demand. Ismail et al. [27] discussed the Russian market for palm oil and discovered that palm oil consumption, sunflower seed crushing, Russian palm oil import from Indonesia, palm oil price, and sunflower oil price were significantly correlated with palm oil demand. In the Indian market, the price discount of palm oil over soybean oil and GDP was found to have a significantly negative impact on palm oil demand. In particular, the results on the correlation between GDP and palm oil demand are different between the Indian and Turkish markets. Meanwhile, the population was found to have a significant positive influence on the demand for palm oil, so an increase in the population would lead to an increase in the demand for palm oil Zakaria et al. [50]. Most studies show that palm oil prices, its substitutes, population, and consumption influence palm oil demand (e.g., Hassan et al. [24]; Shariff et al. [45]).

Awad et al. [16] analysed palm oil import demand in selected countries in the Middle East and North Africa (MENA) using the ARDL technique. The countries studied were Algeria, Egypt, Iran, Jordan, Libya, Morocco, Saudi Arabia, Sudan, Syria, and Turkey. Palm oil prices and income were significant for all the countries studied, while soybean oil was proven to be an important substitute for palm oil in Algeria, Egypt, Iran, Jordan, Morocco and Turkey. For Saudi Arabia and Libya, the palm oil substitute was corn oil, while rapeseed oil and sunflower oil were the palm oil substitutes in Sudan and Syria. The exchange rate also had an important influence on the demand for palm oil in Libya. In addition, the high palm oil price discount, the 1970s world petroleum price boom, the anti-palm oil campaign, and the trade embargo also influenced the demand for palm oil in Libya and Iraq.

Hameed et al. [22] focused on six Asian countries, which are India, China, Japan, Bangladesh, Korea, and Pakistan. The finding in his research was the main significant determinants of palm oil demand, which are the national income of importing countries, the prices of substitute oils, and the price of palm oil. However, this study also found other factors that shape palm oil demand, such as biofuel mandate, trade policies, and exchange rates. Similarly, Seng and Ahmad [43] examined factors influencing the long-term and short-term demand for Malaysian palm oil exports by India, EU countries, China, the United States and Pakistan. They found that global GDP had a significant influence on palm oil demand in these countries.

As Malaysia and Indonesia are the main palm oil exporting countries, the study by Salleh et al. [41] investigated the competitiveness of palm oil exports between Malaysia and Indonesia. This study covered five main markets using market share and comparative advantage analysis. The results show that Indonesia is more dominant in exporting palm oil to world markets, and Malaysia has lost its comparative advantage, particularly in exporting crude palm oil (CPO) and processed palm oil (PPO). Before that, Rifin [38] analysed the export competitiveness of Indonesian palm oil products compared to Malaysia in Asia, Africa and Europe. The results also show that Indonesia is more competitive compared to Malaysia in terms of palm oil export. However, these results contradict the findings of Zakaria et al. [51], who looked at the competitiveness of Malaysian and Indonesian palm oil exports to Balkan countries using a constant market share analysis, and Indonesian has lost its comparative advantage in the Balkan market. While many studies have shown that Malaysia has lost its competitiveness with Indonesia in the export of palm oil, research on the potential of Malaysian palm oil is still ongoing. For example, the study by Abdullah et al. [32] investigated the market potential for Malaysian palm oil export to Africa using selection matrix analysis. From the 49 countries on the African continent, 10 countries (Nigeria, Ghana, Egypt, Kenya, Tanzania, South Africa, Benin, Ethiopia, Mozambique, and Angola) were recommended to Malaysian exporters to increase their palm oil export volumes to these countries. Furthermore, three of the four Balkan countries studied, namely Bulgaria, Croatia, and Greece showed the existence of a long--term relationship between the variables studied (GDP, population, and palm oil price) and the demand for palm oil Zakaria et al. [49]. According to Rifin [39], palm oil products from Indonesia and Malaysia are complementary to each other rather than competing, and both countries should cooperate to increase the global demand for palm oil in the future.

The prices of soybean, sunflower, and rapeseed oil influence the price of palm oil, while the price of soybean oil has a unidirectional causality with the price of palm oil, implying that soybean oil is a close substitute for palm oil Amiruddin et al. [12]. However, palm oil tends to command lower prices than the main alternative vegetable oils, although palm oil is the main vegetable oil by production and volume of trade Carte et al. [17]. In contrast, the study by Hassan and Nambiappan [23] shows that the price of palm oil is not completely influenced by the price of soybean oil, but also by other factors such as palm oil production and export. According to Ismail et al. [26], the rapeseed industry is an important sector in the EU to meet the domestic demand for oils and fats. However, due to stagnant production, the EU has continued to import other vegetable oils, particularly palm oil, to cover the balance of the low rapeseed supply. In India, palm oil is considered normal and can be easily substituted with other vegetable oils Dewanta et al. [19]. Rifin [40] found that the market for palm oil in India is more sensitive to price changes than other palm oil-importing countries.

Although many research studies have been conducted on factors that influence palm oil demand, the evidence of the direction of the relationship of the factors that influenced palm oil demand is still inconclusive due to the fact that the palm oil market is dynamic, therefore the current export situation may not be the same as in the past. Furthermore, since palm oil development is growing rapidly, palm oil importers vary in years depending on the situation of their local vegetable oil production and consumption. Therefore, investigating the factors that influence palm oil intake among the main current import countries is a continuing concern for palm oil producers. As the second largest palm oil producer and exporter [28], Malaysia should always be sensitive to current and recent market developments to ensure the sustainability of Malaysia's palm oil exports. This paper explores the long-term causal relationships between Malaysian palm oil exports and the real effective exchange rate of the respective importing countries, palm oil consumption, vegetable oil production, and GDP growth.

2. Methodology and methods

This study used data from 10 of the main palm oil importers in the world and covered data from 2004 to 2018. The data of are based on the overall palm oil performance in 2018. The countries are India, the EU, China, Pakistan, Bangladesh, the United States, Nigeria, the Philippines, Russia, and Egypt.

The variables used for this study are the real effective exchange rate index (2010 is 100) of the importing countries (IREER), the consumption of palm oil by the importing countries in tonnes (IPOC), the production of other vegetable oils by the importing countries in tonnes (IOOP), the real GDP in US $ (IRGDP), and the export of Malaysian palm oil in tonnes (MEXPORT). Data were taken from different databases, such as the Oil World Report [5–8], the Malaysian Oil Palm Statistics Book [11] and the World Bank Indicators [10].

In this study, we examine the factors affecting the demand for palm oil in the main palm oil importing countries according to the 2018 database. To obtain the objective of the study, we consider the following specification:

$$\ln Y_{it} = \beta_0 + \beta_1 X_{it} + e_{it} \tag{1}$$

In equation (1), Y_{it} is the dependent variable of the study, X_{it} is the composite function including REER, palm oil consumption, vegetable oil production, real GDP of the importing countries; i designates countries that are India, the EU, China, Pakistan, Bangladesh, United States, Nigeria, Philippines, Russia, and Egypt; t represents the time (annual period from 2004–2018); e_{it} is the error term. The logarithmic form of equation (1) is developed as follows:

$$\ln \mathrm{MEXPORT}_{it} = \beta_0 + \beta_1 \ln \mathrm{IREER}_{it} + \beta_2 \ln \mathrm{IPOC}_{it} + \beta_3 \ln \mathrm{IOOP}_{it} + \beta_4 \ln \mathrm{IRGDP}_{it} + e_{it} \quad (2)$$

Parameters such as β_0–β_4 represent the long-term elasticity. This study uses statistical EViews software to obtain the findings of the model.

2.1. Panel unit roots

The stationarity test is first examined in panel time series data. This is an important step because it will determine the selection of econometric models to be used to achieve the objective. The study applied the three main stationary tests for panel data analysis, which are LLC, IPS, and MW tests following Levin et al. [30], Im et al. [25] and Madala et al. [31]. With the panel cointegration model applied in this study, all variables have to be stationary at the first difference for all three tests before proceeding to the panel cointegration test.

2.2. Panel cointegration test

This study used heterogeneous panel cointegration proposed by Pedroni [34], [35] to examine the long-term relationship between variables. According to Pedroni's panel cointegration, the equation of this study can be written as:

$$\mathrm{X}_{i,t} = \alpha_i + \rho_i t + \beta_{1i} Z_{1i,t} + \ldots + \beta_{mi} Z_{mi,t} + \mu_{it} \quad (3)$$

where X is MEXPORT,Z – vector of independent variables comprising IREER, IPOC, IOOP, IRGDP, t – time, i – importing countries, m – independent variables, α – individual effects, ρ – trend effects, β – slope coefficients, μ – error term.

The null hypothesis of no cointegration in panels will be tested by seven statistics. The within-dimension group are: panel v-statistic, panel ρ-statistic, panel PP-statistic, and panel ADF-statistic tests will estimate the values based on the pooled coefficient of dependent variables across different cross sections. Meanwhile, there are three statistics under the between-dimension group; group ρ-statistic, group PP-statistic, and group ADF-statistic tests. This group will estimate values based on the individual coefficient of dependent variables that for each cross-section.

2.3. Panel long-term cointegration test

Provided evidence of cointegration is obtained, the study will proceed to the next step, which is to estimate long-term cointegration using the Pedroni fully modified OLS technique (FMOLS) [34]. A fully modified OLS method is used to estimate the nature of heterogeneity between variables to measure the strength of the relationship. In addition to that, the FMOLS technique will eliminate endogeneity bias and serial correlation, allowing efficient estimation and consistency of the long-term relationship. This approach proposes the estimated residuals to give the findings in terms of a long-term relationship. The use of FMOLS presupposes that the variables have a cointegration connection. The hypothesised form of the long-term regression technique is derived as follows:

$$Y_{it} = \lambda_1 + \vartheta_{it} + \sum_{i=1}^{n} \lambda_{j,\,t} + X_{j,\,it} + e_{it}, \quad t = 1, \ldots, T;\ i = 1, \ldots, N \tag{4}$$

2.4. Panel causality test

This study also performed the panel Granger causality test after confirming the existence of a long-term cointegration relationship. For this and long-term inference of results, a panel vector error correction model (VECM) by Pesaran et al. [36] is estimated using a two-step process. The F-statistics in the VECM may indicate short-term causality, and the error correction term (ECT) may indicate long-term cointegration. The first step, the long-term model is estimated using equation (2). After estimating equation (2), we obtained the estimated residual (the error correction term; ECT). In the second step, we estimated the panel Granger causality model as follows:

$$\begin{aligned}\Delta \ln \mathrm{MEXPORT}_{it} = \theta_{1j} + \gamma_{1i}\mathrm{ECT}_{it-1} &+ \sum_{k} \theta_{11ik} \Delta \ln \mathrm{MEXPORT}_{it-k} \\ &+ \sum_{k} \theta_{12ik} \Delta \ln \mathrm{IREER}_{it-k} + \sum_{k} \theta_{13ik} \Delta \ln \mathrm{IPOC}_{it-k} \\ &+ \sum_{k} \theta_{14ik} \Delta \ln \mathrm{IOOP}_{it-k} + \sum_{k} \theta_{15ik} \Delta \ln \mathrm{IRGDP}_{it-k} + u_{1it}\end{aligned} \tag{5}$$

where Δ denotes the first difference and k is the delay length. We use an instrumental variable estimator to eliminate the correlation between the error term and the lagged dependent variable. The optimal lag length was chosen when the error term satisfies all the essential classical assumptions.

For short-term causality, we tested the null hypothesis H_0: θ_{12ik} for all i and k in equation (5). Another possible source of causation is the ECT in equation (5). The ECT coefficient is called the adjustment speed, which represents how quickly the deviation from long-term equilibrium is eliminated after changes in each variable. For long-term causality, we tested H_0: $\gamma_{1i} = 0$ for all i in equation (5). For example, if $\gamma_{1i} = 0$, the output (Y) does not respond to a deviation from the long-term equilibrium in the previous period.

3. Results and discussion

The estimated results of the first-generation panel unit root test at the level and the first difference are presented in Table 1. Both are presented with and without trend using optimal lag length fixed to lag 3. For this purpose, the study used three-panel unit root tests: LLC, IPS and MW tests for each variable. The LLC unit root tests work based on a common unit root test process. For the five variables, the null hypothesis of unit root cannot be rejected at the level at the 1% significance level, with the exception of the palm oil consumption of the importing countries (IPOC) variable. These results indicate that the variables are non-stationary at level but only stationary after the first difference.

We also report the findings of the first-generation panel unit root tests of IPS and MW in which the IPS and MW tests work under the assumption of an individual unit process. The findings indicate that all statistics failed to reject the existence of a unit root at the level for constant with trend and constant without trend models. However, statistics can be rejected at the 1% significance level when integrated with order one. Thus, the results of the panel unit root test support the existence of a unit root at the level and stationary (absence of a unit root) after first differencing or when generated by an I (1) process.

Table 1. Panel unit root test results

Variable	Without trend	p-value	With trend	p-value	Without trend	p-value	With trend	p-value
				LLC test				
MEXPORT	0.7400	0.7704	–1.9845	0.0236	–7.4782	0.0000	–9.5373	0.0000
IRGDP	0.3380	0.6323	–5.0239	0.0000	–5.6827	0.0000	–5.7380	0.0000
IREER	–3.9363	0.0000	–1.7622	0.0390	–6.7464	0.0000	–6.0675	0.0000
IPOC	–3.0913	0.0010	–6.1132	0.0000	–10.1453	0.0000	–8.7833	0.0000
IOOP	–1.1725	0.1205	–3.3204	0.0004	–9.5265	0.0000	–9.0826	0.0000
				IPS test				
MEXPORT	0.3918	0.6524	–0.8848	0.1881	–6.4364	0.0000	–6.6060	0.0000
IRGDP	2.1238	0.9832	0.2811	0.6107	–2.8264	0.0024	–2.6722	0.0038
IREER	–0.9887	0.1614	–0.7137	0.2377	–5.1429	0.0000	–3.6512	0.0001
IPOC	0.5523	0.7096	–3.5385	0.0002	–8.1670	0.0000	–6.1972	0.0000
IOOP	0.9153	0.8200	–1.2238	0.1105	–7.2632	0.0000	–5.2884	0.0000
				MW test				
MEXPORT	16.049	0.714	1.0830	0.861	140.967	0.000	114.280	0.000
IRGDP	76.171	0.000	59.559	0.000	76.171	0.000	59.5590	0.000
IREER	23.473	0.266	49.534	0.000	23.473	0.266	49.5340	0.000
IPOC	37.988	0.009	–1.4530	0.073	188.032	0.000	150.775	0.000
IOOP	15.82	0.728	29.734	0.074	141.289	0.000	104.805	0.000

Cointegration among variables was tested to examine the long-term relationship between variables for the selected panel. The results of the first generation using Pedroni's [34], [35] panel cointegration tests are reported in Table 2. Pedroni uses seven different cointegration statistics to capture the within- and between-dimension effects in the panel.

Four within dimension panel test statistics contain the estimated values of test statistics based on estimators that pooled the coefficient across different cross sections for the unit root tests on the estimated residuals. Meanwhile, three between-dimension group statistics report the estimated values of test statistics based on estimators that average individually estimated coefficients for each cross-section. The results of the within- and between-dimension tests show that the null hypothesis of no cointegration is rejected at the significance level 1% and 5% in most cases. Therefore, all variables in the study are cointegrated for selected panels of palm oil-importing countries from 2004 to 2018.

Table 2. Pedroni's panel cointegration test results

	Within dimension (panel) test				Between dimension (group) test		
Test	v-statistic	ρ-statistic	PP-statistic	ADF-statistic	ρ-statistic	PP-statistic	AD-statistic
Statistic	–1.396	0.864	–4.732	–4.512	2.429	–3.532	–3.113
p-value	0.919	0.806	0.000	0.000	0.992	0.000	0.000

The study then proceeded to long-term equilibrium estimation using the FMOLS technique, and the results are reported in Table 3. At first glance, the panel results indicate that the coefficients for all variables have the expected sign according to economic theory and are statistically significant at least at the 5% significance level. The estimated coefficient of palm oil consumption by the main palm oil importing countries in the world is positive and a statistically significant determinant of Malaysian palm oil export. This indicates that consumption has a direct positive effect on export demand. A 1% increase in palm oil consumption would increase Malaysia's palm oil export by approximately 1.65%. This result agrees with the findings by Suherman and Suharno [46] that consumption increased export demand through increased population growth.

Table 3. FMOLS long-term estimation (MEXPORTit: dependent variable)

Variable	Coefficient	p-Value
IPOCit	1.646	0.000
IRGDPit	–2.145	0.003
IREERit	–0.696	0.050
IOOPit	–0.983	0.004

The effect of the real GDP of the main palm oil importing countries in the world is found to be statistically significant in a negative term and indicates that a 1% increase in the real GDP of the importing countries would decrease Malaysia's demand for palm oil exports by approximately 2.15%. This study is consistent with the result of Applanaidu et al. [14], who reported that the real-world GDP determined the export demand for Malaysian palm oil. Similarly, a 1% increase in the real effective exchange rate would decrease the demand for palm oil export by 0.7% for these selected countries that import palm oil from the world. The estimated coefficient is statistically significant at the 5% significance level. Our findings are consistent with those reported by Applanaidu et al. [14], Hameed et al. [22] and Suherman and Suharno [46], which found that the exchange rate is another factor that influences the demand for Malaysian palm oil export.

Table 4. Granger causality results

Dependent variable	Source of causation (independent variables)					
	D(MEXPORT)	D(IPOC)	D(IREER)	D(IRGDP)	D(IOOP)	ECT_{t-1}
D(MEXPORT)	–	1.352	5.743	1.027	3.216	–0.167*
		(0.72)	(0.12)	(0.79)	(0.36)	[–5.37]
D(IPOC)	1.307	–	2.012	1.956	8.236	
	(0.73)	–	(0.57)	(0.58)	(0.04)**	
D(IREER)	0.432	1.706	–	2.257	1.88	
	(0.93)	(0.64)		(0.52)	(0.6)	
D(IRGDP)	1.8	2.498	0.181	–	2.92	
	(0.62)	(0.48)	(0.98)		(0.4)	
D(IOOP)	1.4	1.626	2.801	4.222	–	
	(0.71)	(0.65)	(0.42)	(0.24)		

[1] ECT represents the coefficient of the error correction term.
[2] Values in round brackets ( ) are p-values and values in square brackets [ ] are t-statistics.
[3] One asterisk * denotes significant at 1%, two asterisks – ** significant at 5%.

Finally, the estimated coefficient for other oils production by these selected importing countries is negative and statistically significant at the 1% significance level in determining the demand for Malaysian palm oil export. The higher the production of other oils in these importing countries, the lower the intake of palm oil from Malaysia. This result indicates that a 1% increase in the production of other oils would decrease the Malaysian palm oil export demand by approximately 0.98%. In the final step, this study searched for evidence of Granger causality between the variables.

Table 4 reports the results of the short- and long-term Granger causality tests. The coefficient of the lagged error-correction term is negative and significant at the 1% significance level. However, the coefficient is relatively small, indicating a low rate of adjustment to the long-term equilibrium. The negative error correction term confirms the existence of a long-term Granger causality that runs from the independent variables to the dependent variable. Regarding short-term causality tests, there is evidence of Granger causality that runs from other vegetable oils produced by selected importing countries to the Malaysian palm oil export demand.

4. Conclusions

The main focus of this study is to explore the long-term equilibrium and the existence and direction of Granger causality between Malaysia's export of palm oil with economic growth, real effective exchange rate, palm oil consumption, and the production of other vegetable oils by the main palm oil importing countries throughout 2004–2018.

In doing so, the study has applied panel FMOLS. Empirical results revealed that economic growth, real effective exchange rate, and the production of other vegetable oils by the main importing countries had an inverse relationship with the performance of Malaysian palm oil exports. Meanwhile, the results also revealed a positive relationship between palm oil consumption by importing countries and Malaysian palm oil exports.

Next, this study applied a panel vector error correction model to explore the causal relationship between the variables. The study established a short-term unidirectional Granger causality that runs from other vegetable oils produced by selected importing countries to the demand for Malaysian palm oil exports. The findings indicate that in the short term, the ability of other countries to produce their vegetable oils has a greater impact on the demand for Malaysian palm oil export demand. These findings suggest the importance of improving the trade openness policy to increase the export competitiveness of Malaysian palm oil.

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