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PALM OIL IMPORT DEMAND IN NORTH AMERICA COUNTRIES

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Abstract: Palm oil is one of the agricultural commodities grown in world trade. North America is one of the regions with high import demand, so that the region can be observed as an export destination. This study aimed to examine the palm import demand in three selected North American Countries (United States of America (USA), Canada and Mexico) and its determinants. Autoregressive Distributive Lags (ARDL) was applied in this study between 1990 and 2017. The results indicate that the demand for palm oil in North American countries has increased. However, the import growth and shares have fluctuated relatively. GDP, GDP Indonesia, GDP Malaysia world palm oil prices, soybean oil prices, and biodiesel production significantly affect palm oil imports in the USA in the long and short-run. The GDP and GDP of Indonesia are the factors that influence palm oil import in Canada and Mexico in the long run. However, we found the impact of GDP Malaysia and GDP Indonesia in Canada in the short-run. Moreover, Indonesia's GDP and GDP significantly influenced palm oil import in Mexico. This research implies that oil palm exporting countries need to consider these factors, especially GDP, before expanding their market to North American countries as one of the biggest palm oil markets in the global world.

Keywords: business analytics, biofuel, GDP, import, palm oil, price, north america

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Abstrak: *Kelapa sawit merupakan salah satu komoditas pertanian yang berkembang dalam perdagangan dunia. Amerika Utara merupakan salah satu wilayah yang memiliki permintaan impor yang tinggi, sehingga wilayah tersebut berpotensi untuk dicermati sebagai tujuan ekspor. Penelitian ini memeriksa tentang permintaan impor kelapa sawit di tiga Negara Amerika Utara terpilih (Amerika Serikat, Kanada dan Meksiko), dan determinannya. Autoregressive Distributive Lags (ARDL) diterapkan dalam penelitian ini antara tahun 1990 hingga 2017. Hasil penelitian menunjukkan bahwa permintaan minyak sawit di negara-negara Amerika Utara terus meningkat setiap periode. Namun, pertumbuhan dan pangsa impornya relatif fluktuatif. PDB, PDB Indonesia, PDB Malaysia harga minyak sawit dunia, harga minyak kedelai, dan produksi biodiesel berpengaruh signifikan terhadap impor minyak sawit di AS dalam jangka panjang dan jangka pendek. PDB dan PDB Indonesia merupakan faktor-faktor yang mempengaruhi impor minyak sawit di Kanada dan Meksiko dalam jangka panjang. Namun, penelitian ini menemukan bahwa terdapat pengaruh PDB Malaysia dan PDB Indonesia terhadap impor kelapa sawit di Kanada untuk jangka pendek. Selain itu, PDB dan PDB Indonesia juga berpengaruh signifikan terhadap impor minyak sawit di Meksiko. Penelitian ini menunjukkan bahwa negara-negara pengekspor kelapa sawit perlu mempertimbangkan faktor-faktor ini, khususnya pada PDB sebelum memperluas pasar mereka ke negara-negara Amerika Utara sebagai salah satu pasar minyak sawit terbesar di dunia global.*

Kata kunci: *bisnis analitik, biodiesel, PDB, impor, minyak sawit, harga amerika utara*

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INTRODUCTION

Palm oil is one of the essential commodities globally, with various benefits for human needs. Since 2006, palm oil has been the world's most consumed vegetable oil commodity (Our World in Data 2020). Palm oil has a lower price and cheaper costs than other vegetable oils due to higher productivity (Carter et al. 2007). Moreover, this commodity is also credited with high yields by producing two different vegetable oil commodities: crude palm oil and palm kernel oil (Basiron 2007). The contribution of palm oil usage is derived from Food (80%) and Non-Food (20%) Products (Basiron, 2004). Indonesia and Malaysia are the main producer and exporters of palm oil, with higher competitiveness over several periods in the global world (Tandra et al. 2022). The role of palm oil in global trade has been overgrown in the last 25 years, surpassing competitor products such as soybean, rapeseed, and sunflower (FAO, 2022). It is predicted that the trade value of palm oil could be increased due to higher population growth, implicating the higher demand for palm oil globally. Therefore, palm oil has already become one of the important agricultural commodities in international trade. The productivity level of oil palm is much more efficient than other similar commodities due to the use of less land with higher production (Kaniapan, 2021).

Additionally, oil palm development in industrial schemes can be used as an effort by local governments to generate foreign exchange, expand job opportunities and improve people's welfare (Susila, 2004; Suroso and Ramadhan, 2014; Santika et al. 2019). North America is one of the regions with higher demand for palm oil. Specifically, the import of this commodity in Northern America is also higher than in several other regions in America (Figure 1). In the American areas, 2 North America (USA and Canada) and 1 Latin America and Caribbean (Mexico) are the top three countries with higher palm oil import quantity. These countries can refer to the North American countries group based on geographical conditions. Based on World Bank (2022), the total population in this region, including the United States of America (USA), Canada, and Mexico, reached 500.4 million or 6.38% shares globally. However, the detailed exploration of the palm oil import demand and its determinants in these countries must be explored.

Furthermore, the condition of palm oil import in North America can be a reference for exporter countries to be considered potential export destination countries. In the scope of the industry, several internal and external factors affect the palm oil firm's performance (Suroso et al. 2020), indicating the various factors involved in palm oil import in countries' scope. Several kinds of literature have already explored the palm oil import demand from other regions. There is a discussion about the demand of palm oil in main destination countries, namely Asia, Turkey and several European Countries (Hameed et al. 2016; Zakaria et al. 2017; Zakaria et al. 2018). The observation in another region like North America could be an additional reference for the policymaker to consider the factors related to palm oil import demand. Rifin (2010) suggested that Indonesia, a major exporter of world palm oil, needs to penetrate markets with a low market share, so this research can be a reference for policymakers in global palm oil exporters to formulate entry strategies for palm oil products. Therefore, this article aims to investigate the palm oil import demand in North America Countries, represented by the USA, Canada and Mexico.

There are numerous studies about the palm oil trade in the global world, especially from import activities. Palm oil is one of the agricultural commodities that has an important role in vegetable oil trades in the global market (Suroso and Ramadhan, 2012). The rapid development of the oil palm trade encourages research on this commodity from export or import perspectives. Some research has already discussed import demand. Awad et al. (2007) examine the demand for palm oil in MENA countries, showing there were several factors such as palm oil prices, gross domestic products (GDP) as the representation of the national income, and substitution prices are significant in palm oil import demand in several MENA countries. Additionally, other factors were found to have a significant effect, namely high palm oil discounts, booming world oil prices, anti-palm oil campaigns, trade embargoes and exchange rates. Yulismi and Siregar (2007) calculated Indonesia's price and income elasticity for palm oil in China and India. The result concludes that Indonesian palm oil does not price elastic in both countries and has an income elasticity value above one. Rifin (2010) found that the global demand for palm oil is primarily due to rising global affluence. Furthermore, rather than competing, Indonesian and Malaysian palm oil products complement each other. As a result, both nations should cooperate in the future to enhance the global demand for palm oil. Applanaidu et al. (2011) examine the linkages between biodiesel demand and

the Malaysian palm oil market with two stages of least squares estimation, using annual data from 1976 until 2008. The domestic price is significantly affected by Malaysian stock, global palm oil price, biodiesel demand and lagged domestic price. There is a positive impact between biodiesel demand and Malaysian palm oil domestic price. Rifin (2013) found that Indonesian and Malaysian palm oil prices are more elastic in China and India through the Almost Ideal Demand System (AIDS).

Hameed et al. (2016) examined the demand for palm oil in six Asian countries: India, China, Japan, Bangladesh, Korea, and Pakistan. It is influenced by national income, palm oil prices, palm oil substitution prices, mandatory biodiesel, trade policies, and exchange rates in these countries importing palm oil. Egwuma et al. (2016) researched the Nigeria palm oil market model with an econometrics approach using Autoregressive Distributive Lag (ARDL) from 1970 until 2011. Nigeria's palm oil import demand influenced GDP and relative price ratio in long-run estimation. Furthermore, the world price of soybean oil and the relative price ratio are factors with short-run impacts. Zakaria et al. (2018) found that Gross Domestic Product (GDP) and sunflower prices have a positive and significant relationship with Turkey's long-term demand for palm oil. On the other hand, there is a negative and significant effect of the price of palm oil on demand for palm oil in Turkey simultaneously. Zakaria et al. (2019) found a significant influence of GDP, population, and palm oil prices on the demand for palm oil in Balkan countries. We have already observed some research with different applications and regions. However, a study has yet to reveal the import condition in North American countries, despite this region being a palm oil importer. This research aimed to examine the palm oil import in North American Countries and its determinants.

METHODS

We used the framework of the import demand equation derived from the import demand model (Murray and Ginman, 1976; Goldstein and Khan, 1985). The determinant of import originated from two main factors: prices and national income. The substitution price is one of the price factors that have a contributing effect on imports. These variables could be applied because the observation is under "Imperfect Substitutes" conditions based on the financial condition of a country (Murray and Ginman, 1976; Gozgor, 2014). The theoretical framework can be written as follows:

$$Q_t = f(PP_t, PS_t Y_t) \text{ or}$$

$$Qt = \alpha_0 + \alpha_1 PP_t + \alpha_2 PS_t + \alpha_3 Y_t + \nu_t$$

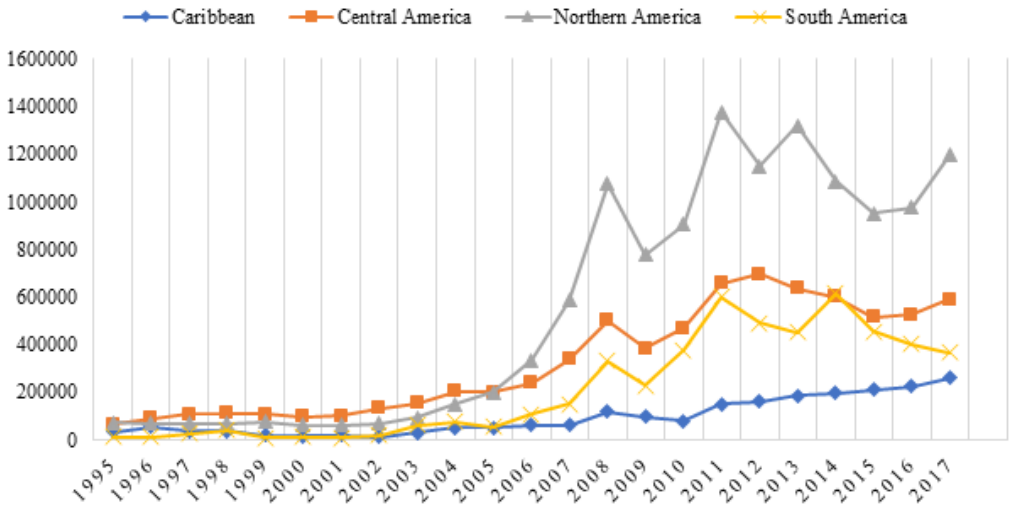

Figure 1 The palm oil import value trend in america regions (FAO, 2022)

Where Qt is the quantity of palm oil demanded (at time t), PPt is the price of palm oil (at time t), PSt is the substitution prices of some relevant commodities (at time t), and Yt is the national income level of importers (at time t), proxied by Gross Domestic Product (GDP). In this study, we added biofuel production as the representation of the biofuel policy made by importers. Palm oil is one of the materials used for biofuel, seen as a good alternative for biofuel production that produces a large residue for biofuels (Kurnia et al. 2016). The higher biofuel production could increase the demand for palm oil, implicating the higher import. However, we only applied this variable in USA and Canada. Based on our search, the data on biofuel production in Mexico is zero. Moreover, we added the GDP of Indonesia and Malaysia as the two countries with higher producers and exporters in the global world. Therefore, the equation in this study can be seen as follows:

USA:

$$PO_{it} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 GDPMLY_t + \alpha_3 GDPINA_{it} + \alpha_4 PPO_t + \alpha_5 SOYP_t + \alpha_6 BIOP_{it} + \varepsilon_{it}$$

Canada:

$$PO_{jt} = \alpha_0 + \alpha_1 GDP_{jt} + \alpha_2 GDPMLY_t + \alpha_3 GDPINA_t + \alpha_4 PPO_t + \alpha_5 SOYP_t + \alpha_6 BIOP_{jt} + \varepsilon_{it}$$

Mexico:

$$PO_{kt} = \alpha_0 + \alpha_1 GDP_{kt} + \alpha_2 GDPMLY_t + \alpha_3 GDPINA_t + \alpha_4 PPO_t + \alpha_5 SOYP_t + \varepsilon_{it}$$

Where POi,j and k is the palm oil import from USA, Canada and Mexico in period t, GDPi,j and k is the national income from USA, Canada and Mexico in period t, GDPMLYt and GDPINAt are the GDP in Malaysia and Indonesia in period t. PPOt and SOYPt are the global palm oil price and soybean prices. BIOPi and j are the dummy biofuel production (1 = there is a biofuel production in this year, 0 = otherwise) from USA and Canada in period t, and ε is the residual or error. Based on theory and previous literature, the hypotheses in independent variables are as a following:

1. The effect of GDP Importer

H0: GDP is not affecting positive and significant on the palm oil import

H1: GDP is affecting positive and significant on the palm oil import

2. The effect of GDP Import Destination Countries (Indonesia and Malaysia)

H0: GDP is not affecting positive and significant on the palm oil import

H1: GDP is affecting positive and significant on the palm oil import

3. The effect of palm oil prices

H0: Palm oil prices are not affecting negative and significant on the palm oil import

H1: Palm oil prices are affecting negative and significant on the palm oil import

4. The effect of substitutions commodity prices (Soybean)

H0: Soybean prices are not affecting positive and significant on the palm oil import

H1: Soybean prices are affecting positive and significant on the palm oil import

5. The effect of biofuel production

H0: Biofuel production is not affecting positive and significant on the palm oil import

H1: Biofuel production is affecting positive and significant on the palm oil import

The ARDL approach was employed in this study to examine the long-run and short-run effects with several advantages. This approach could be implemented for smaller sizes and non-stationary data. We only used 27 observations in this research. Therefore, this ARDL can facilitate the estimation. Furthermore, several steps were employed: unit root test by applying Augmented Dicky-Fuller (ADF) and Philips Perron (PP), cointegration test, diagnostic models, long-run and short-run estimation, and stability test. This study involved the annual data range from 1990 until 2017 for the USA, Canada and Mexico. We used these countries due to higher palm oil import demand so that it can be represented as a North American country's demand. The data on palm oil import was gathered from FAO Statistics. The data of GDP in Indonesia, Malaysia and Importer Countries were compiled from World Bank Open Data. Furthermore, the palm oil and soybean prices were obtained from International Monetary Fund through Federal Reserve Bank St. Louis. The biofuel production also compiled from Our World in Data and categorized into dummy one if there is a value of biofuel production above zero or 0 is otherwise.

RESULTS

Palm Oil Import in North America Region

Figure 2 shows the quantity of palm oil imports in North American Countries. This figure revealed the positive trend in palm oil import in the USA, Canada and Mexico. A higher quantity of palm oil import has already been found in the USA, compared to Canada and Mexico. It implies that the USA is the biggest importer of palm oil in North America Countries. However, Figure 3 also compares the quantity growth of palm oil imports. It was revealed that the growth of palm oil imports fluctuated from 1991-2017. Canada is the palm oil importer with higher growth, reaching almost 150%. Furthermore, Mexico has the lowest import growth with nearly -50%. The USA is relatively balanced over the period, indicating one of the North American Countries with stable performance of imports. Indonesia and Malaysia are the two countries with the biggest producer and exporters of palm oil globally. We also examined the import quantity of North American Countries, compared with both countries, revealed in Figure 4 from the total quantity of imports from 1990-2017. This figure indicated that the USA depends on Malaysia (74,33%) and Indonesia (23,35%) for palm oil from import shares. Moreover, Canada also depends on Malaysia and Indonesia, with 73,37% and 20,41%, respectively. Mexico is not involved in palm oil import from both countries, with shares below 10%, indicating Mexico's palm oil market is still widely developed for Indonesia and Malaysia.

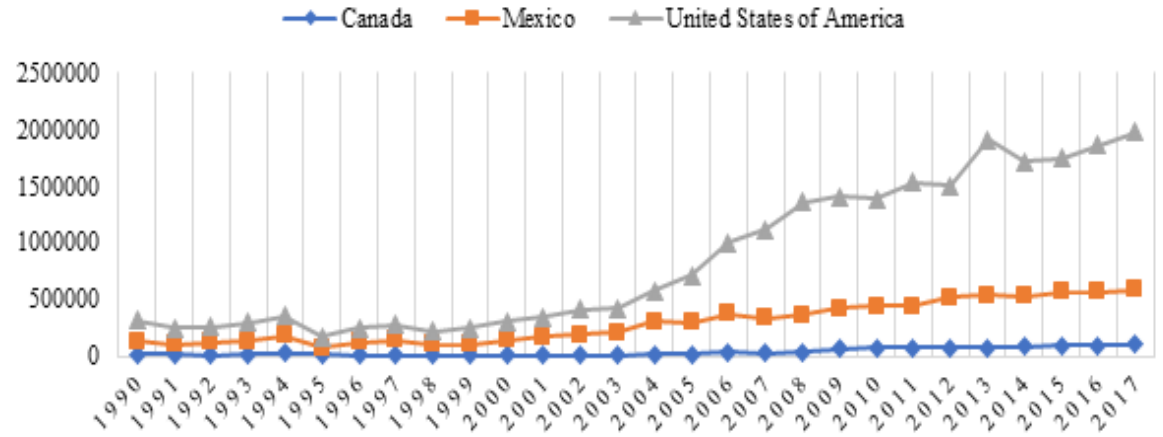

Figure 2. The palm oil import quantity in North American Countries (FAO, 2022)

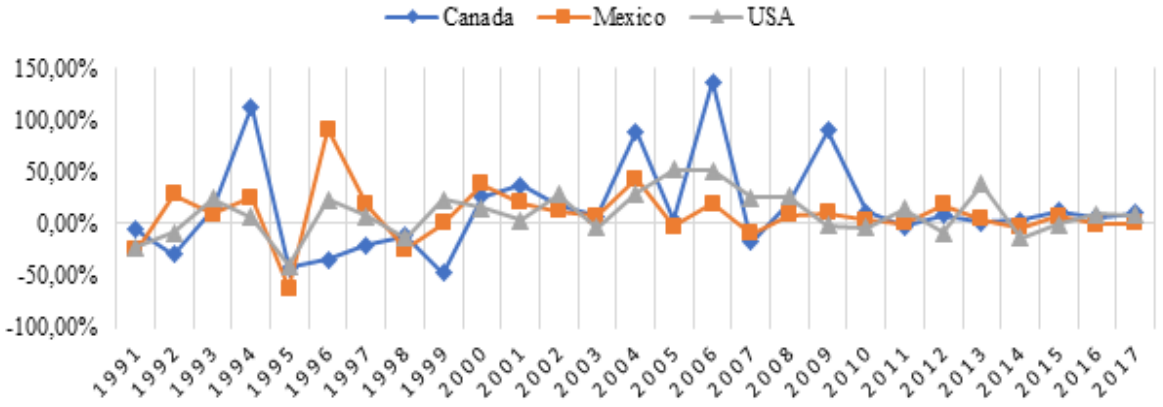

Figure 3. The palm oil import growth in North American Countries (FAO Database, 2022)

The Determinant of Palm Oil Import

Unit Root Test

The unit root test, such as Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP), indicated that all variables were stationary at the level and first difference. Table 1 shows that at the level of the stationary test to reveal the type of difference (level or first difference). It is found that the quantity of palm oil import demand (POi,j and k), GDP Importer (GDPi,j and k), GDP Malaysia (GDPMLY), GDP Indonesia (GDPINA), Palm Oil Prices (PPO), Soybean Price (SOYP) and dummy biofuel production (BIOP i and j) are more significant than the 5%, which shows that these variables are stationary at the level I(1) and I(0). Therefore, these variables could be included in ARDL model.

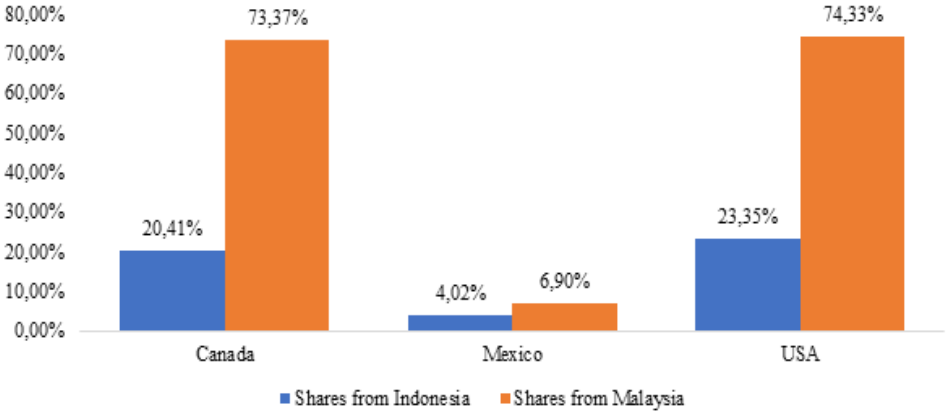

Figure 4. The palm oil import of North America region from Indonesia and Malaysia (UN Comtrade, 2022)

Table 1. Unit Root Test

Variables	ADF-Test		PP-Test	
	Level	First-Difference	Level	First-Difference
Ln(POit)	0.104	-4.998***	0.104	-4.998***
Ln(POjt)	-0.238	-4.874***	-0.238	-4.874***
Ln(POkt)	-0.322	-2.410	-0.618	-17.030***
Ln(GDPit)	-2.380	-3.020**	-2.115	-3.020**
Ln(GDPjt)	-0.494	-3.609**	-0.549	-3.568**
Ln(GDPkt)	-2.218	-4.678***	-2.953*	-5.279***
Ln(GDPMLYt)	-1.252	-4.422***	-1.249	-4.388***
Ln(GDPINAt)	-0.565	-5.209***	-0.507	-5.223***
Ln(PPOt)	-2.462	-5.651***	-2.435	-9.648***
Ln(SOYPt)	-1.737	-4.887***	-1.709	-5.178***
BIOPit	-0.891	-5.099***	-0.891	-5.099***
BIOPjt	-1.443	-5.099***	-1.443	-5.099***

Notes: *, *, and *** = significant at 10%. 5% and 1%

Furthermore, we run the bound test to investigate the cointegration. According to Table 2, the long-run link between the variables exists since the calculated F-statistics in all models are more significant than the upper critical limits at 5% and 10% levels of significance. It implies that long-run relationships exist between dependent and independent variables in three North America Countries. Before we ran the estimation of ARDL, the diagnostics tests were applied to detect the model fit (Table 3). The results show that the probability value between Breusch–Godfrey Serial Correlation LM and Heteroscedasticity (glejser test) above 5% (0.05) means there is no indication of autocorrelation and heteroscedasticity issues. Therefore, this model could be continued in estimation. The long-run effect was estimated in Table 4. We found that the GDP positively and significantly affects palm oil import demand in three North American countries, implying this effect. However, Malaysia's GDP negatively affects palm oil imports in the USA. Differing from Malaysia's GDP, we found the positive and significant from Indonesia's GDP. Palm oil international price was influenced by imports negatively and significantly in the USA. Otherwise, the soybean international price and biofuel production has a positive and significant impact. We only found that GDP importer and GDP Indonesia are positive and significant on palm oil import in Canada and Mexico cases.

The short-run effect was estimated in Table 5. In the USA, in the short run, we found that GDP from importers and Indonesia have a positive impact and significant on palm oil import. Furthermore, the palm oil price has a negative and significant effect. Conversely, soybean prices and dummy biofuel production have a negative and significant impact on palm oil import. In Canada, in the short-run, the GDP of Malaysia has a negative and significant on palm oil imports. GDP Indonesia has positive and significant. In Mexico, in the short-run, the GDP and GDP of Indonesia are positive and significant for palm oil import.

These ARDL results show that GDP factors align with several previous results (Awad et al. 2007; Zakaria et al. 2019; Zakaria et al. 2022). GDP could be the proxy of the market size of countries, comprising the consumption component (Kimino et al. 2017; Khan et al. 2015). However, the negative effect and significance in the GDP of importer destination countries have been found. The decline of Malaysia's Economy could lead to higher palm oil imports due to unabsorbed palm oil in domestic. It could imply that palm oil demand was increased for importers as the main industry in Malaysia for the past three decades (Mahat, 2012). There is a difference between Indonesia and Malaysia due to shares of Malaysia's relatively higher.

Table 2. Bound test based cointegration

Countries	Test Statistic	Value	Significant	I(0)	I(1)
USA	F-statistic	8.213	10%	1.99	2.94
	k	6	5%	2.27	3.28
			1%	2.88	3.99
Canada	F-statistic	5.136	10%	1.99	2.94
	k	6	5%	2.27	3.28
			1%	2.88	3.99
Mexico	F-statistic	5.691	10%	2.08	3
	k	5	5%	2.39	3.38
			1%	3.06	4.15

Table 3. Diagnostic tests

Test	Countries	Obs*R-Square	F-Statistics	Probability
Serial correlation:	USA	3.671	2.360	0.055
Breusch–Godfrey Serial	Canada	1.244	0.725	0.265
Correlation LM Test (Include Lag 1)	Mexico	0.561	0.340	0.454
Heteroscedasticity: Glejser	USA	6.121	0.469	0.805
	Canada	12.664	1.413	0.243
	Mexico	7.472	0.723	0.588

Table 4. Long-run estimation of palm oil import

Variables	USA	Canada	Mexico
Constant	-31.815***	-47.045***	-21.384***
	(-5.078)	(-3.507)	(-7.740)
Ln(GDP)	1.614***	1.737*	1.036**
	-4.159	-2.019	-2.693
Ln(GDPMLY)	-0.868*	-1.628	-0.676
	(-1.759)	(-1.338)	(-0.809)
Ln(GDPINA)	0.602**	1.924**	0.932*
	-2.392	-2.582	-1.892
Ln(PPO)	-0.953***	-1.564	-0.347
	(-3.850)	(-1.513)	(-1.046)
Ln(SOYP)	1.238***	1.564	0.022
	-3.761	-1.258	(0.060)
BIOP	0.901***	-0.597	-
	-6.006	(-3.507)	-

Notes: *, *, and *** = significant at 10%. 5% and 1%

Table 5. Short-run estimation of palm oil import

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	(-5.078)	(-3.507)	(-7.740)
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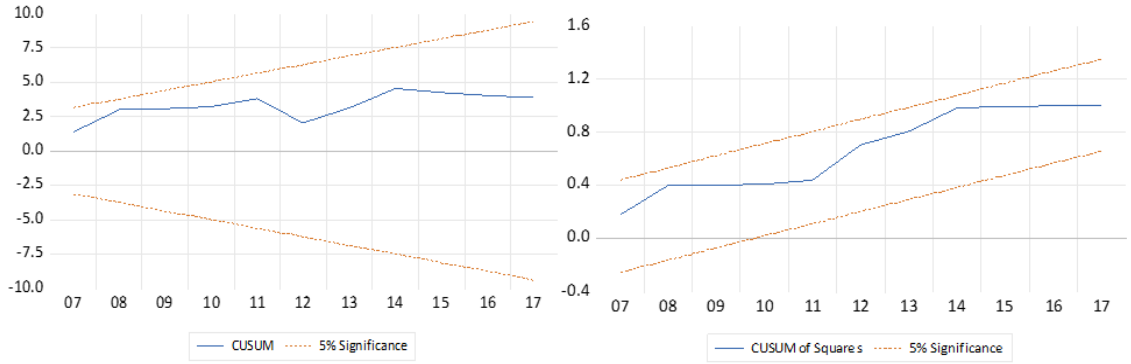
Notes: *, *, and *** = significant at 10%. 5% and 1%

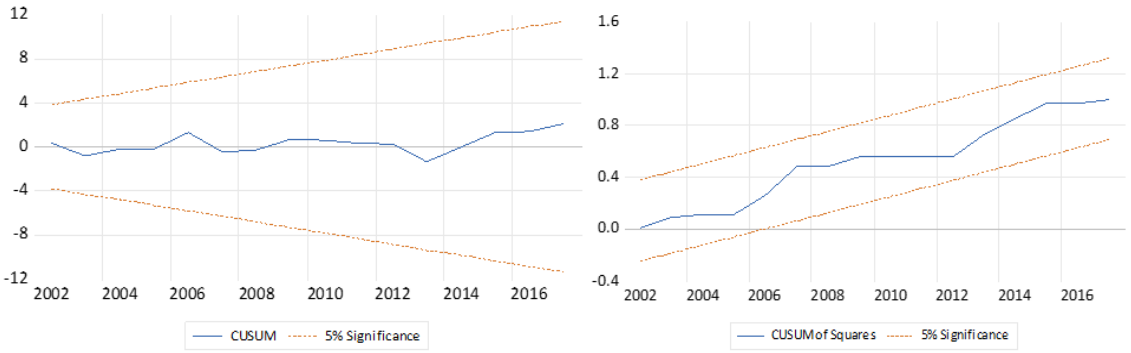
The commodity prices in this research, including palm oil and soybean, align with the theory, as the lower commodity price implicates the higher import demand. Previous literature also found similar results (Hameed et al. 2016; Ismail et al. 2022). The substitution commodity (soybean) price could increase the demand for palm oil import. It is also in line with several results in other regions (Awad et al. 2007; Zakaria et al. 2022). The biofuel production in these results also positively and significantly implicating that biofuel development needs the availability of raw materials from harvesting or importing (Malode et al. 2021).

The error correction term (ECT) from three countries in (-1) proved negative and highly significant. Moreover, these results suggest that causality is at least in one direction. For the USA, Canada and Mexico, the coefficients of ECT (-1) are -0.926, -0.666, and -0.914, respectively, indicating a higher degree of convergence towards equilibrium. Based on this result, the GDP is the main factor influencing the palm oil import demand in the North American region than other factors. It is also comparable with Hameed et al. (2016) by producing GDP as the important variable.

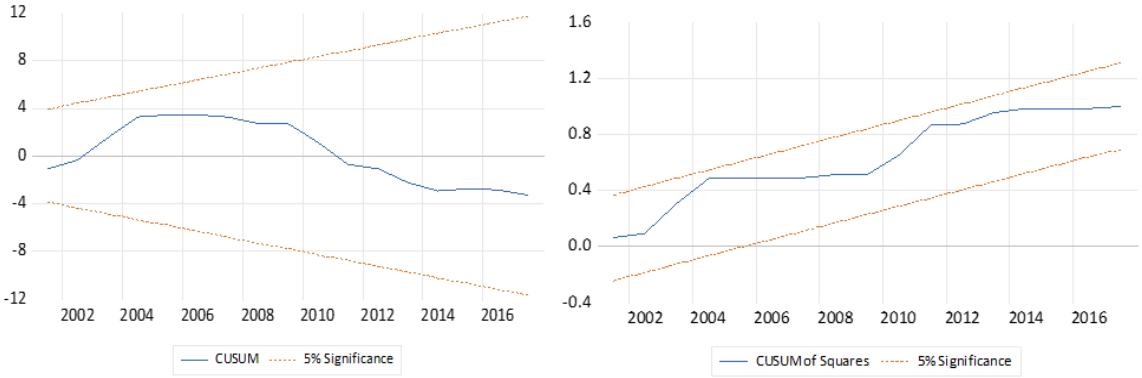
Figure 3 shows the plots of the CUSUM and CUSUM of Square (CUSUMSQ). The results reveals that all the estimated models have a high explanatory level and free from specification error. The plots of each blue line did not cross the red line defines the critical value line, which directs the stability of the estimated techniques. Additionally, plots of CUSUM and CUSUMSQ deny any support for the instability of the parameter. These outcomes recommend that the function of import demand applied in this study is appropriately and confirmed their stability throughout the sample periods, indicating that the short-run and long-run estimations could be acceptable.



a) USA



b) Canada



c) Mexico

Figure 3. CUSUM and CUSUM of Square

Managerial Implications

This study has several implications, namely the consideration of GDP for determining the palm oil import in the USA, Canada and Mexico due to long-run and short-run effects. Specifically, the data about the price of the commodity and its substitute must be considered due to the effect on USA palm oil import.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study investigates palm oil import in North America Region and its determinants. There are several results could be considered from this research. The demand for palm oil in this region has had a positive trend from 1990 until 2017, with the USA as the highest importer. However, import growth fluctuated relatively, especially in Canada and Mexico. The highest importer destinations in North America Countries are Malaysia because the share value is higher than Indonesia. In determinants, we find a long-term and short-term relationship between GDP in demand for palm oil import, implying that the higher economic performance of the North American region could lead the palm oil needs. Biofuel production, palm oil and soybean prices are two variables that can be a consideration in the USA due to the short-term and long-term effects.

Recommendation

Based on the result, the exporter can identify GDP by examining the import demand of palm oil, implying that the increase in GDP implicates import. It is an important variable to increase the demand for palm oil import in three North American countries. On the other hand, the prices of commodities and their substitutes must be considered by policymakers to expand the palm oil market, especially in the USA. In further research, this study did not include several variables due to limited access to data. Therefore, future studies must observe other variables excluded in this research to gain insight into factors are influencing the palm oil import demand in North American countries.

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