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Factors Contributing to China's Intake of Palm Oil

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ABSTRACT

China, a country with the largest population of over 1.3 billion was identified as a region with huge potential for export market. Currently, China is one of the largest palm oil importers and has shown an increasing trend over the years, with CAGR of 7.87 from 1.40 million tonnes to 6.37 million tonnes between 2000 and 2020. This translated into a scenario of a growing palm market in China. Thus, this study aims to investigate factors influencing the demand for palm oil in China using Autoregressive Distributed Lag (ARDL). Annual time series data from 1980 to 2019 has been used for the analysis. The bound test indicates that there is a long run relationship among the studied variables. The empirical results showed that gross domestic products, both in producing and importing countries; consumer price index; palm oil consumption; the population of China; palm oil and soyabean oil prices are the significant determinants of Malaysian palm oil demand in China.

Keywords: ARDL, bound test, CPI, error correction models, palm oil.

INTRODUCTION

China is the world's largest consumer of oils and fats (Oil World, 2021). As the world's most populous country with a population of over 1.3 billion, China consumed more than 38.6 million tonnes of oils and fats and is becoming one of the leading importers of oils and fats in the world market which amounting to about 13.9 million tonnes per year (National Bureau of Statistics of China, 2021). Due to land constraints and shortages in domestic oils and fats production, as well as competition in grain production, China has continued to rely on imported oils and fats to meet their country's demand for oils and fats (Ooi and Yoong, 2011).

With China's diversity in population, the type of oil consumed somewhat follows the regional patterns that can be explained by climatic conditions, land conditions for growing oil crop, cultural taste and preference as well as consumers' socioeconomic standards (Sheng and Song, 2019). As the per capita income increases, the pattern of vegetable oil consumption in this country has also increasingly diversified. The consumption pattern of vegetable oils in China has been changing through time. In 2000, the major vegetable oil consumed in China was rapeseed oil, which accounted for 25% of the total oils and fats consumption. This was then followed by groundnut oil, butterfat, palm oil and soyabean oil. However, in 2020, the five major vegetable oils consumed in China were soyabean oil, palm oil, sunflower oil, rapeseed oil and groundnut oil (*Figure 1*). The shift and increase in consumption of soyabean oil and palm oil in China since 2011 can be attributed

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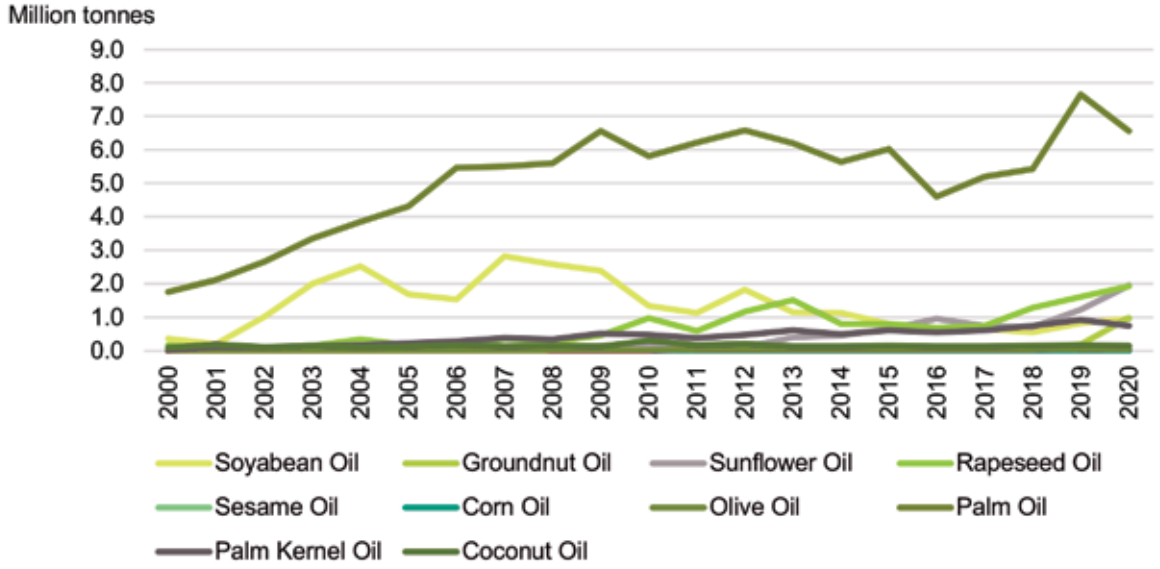


Sources: Oil World 2004; 2008; 2012; 2017 and 2020.

Figure 1. China oils and fats imports.

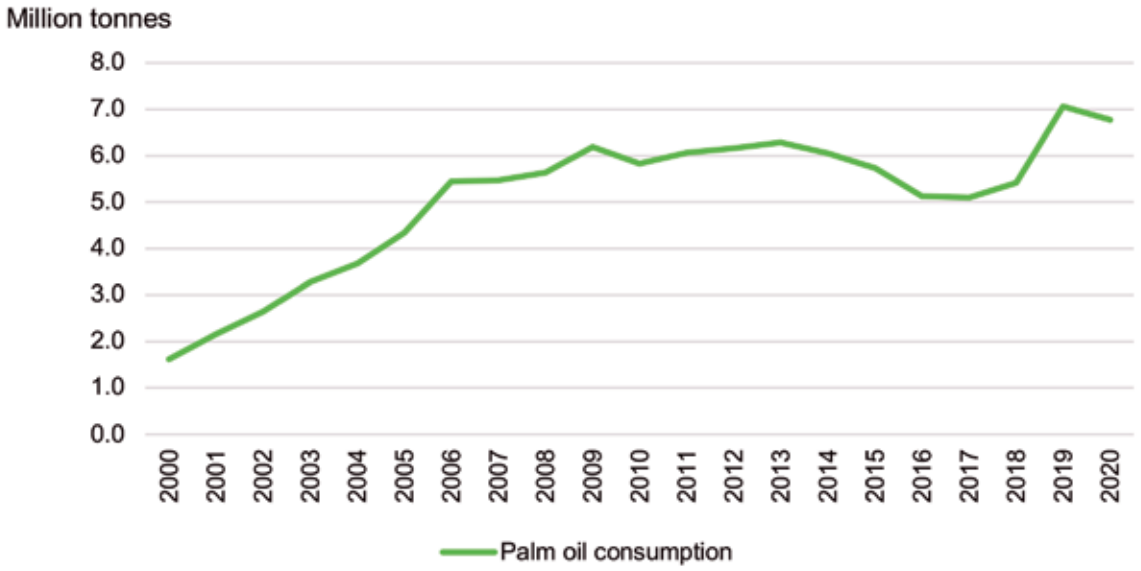
to various factors, including high economic growth, huge demand for animal feed and rising demand for processed foods (Guolin *et al.,* 2017).

In particular, soyabean and palm oil markets in China fluctuated up and down depending on the situation. The major disruption of soyabean's trade flow from the United States (US) to China trade war in July 2018 stretching to 2019 has triggered a major, but a temporary shift in China's reliance on the United States (US) soyabean to palm oil in order to meet its edible oil needs (Palmoil Update, 2020). A booming animal feed market against a flat domestic production of soyabean have increasingly turned China to be heavily dependent on the soyabean import, which is subsequently crushed to meet local demand for the animal feed industry but intensifying the supply of soyabean oil as a by-product from soyabean meal. The hike in tariff led China's soyabean import in 2017 from the United States (US) to fall by 49.4% or 16.2 million tonnes to 16.6 million tonnes in 2018. The drop in soyabean imports reduces soyabean crushing activities, which led to a reduction in soyabean oil production. The reduction in crushing was also exacerbated by lower domestic demand for meal arising from the African Swine Fever (Palmoil Update, 2020).

Nonetheless, understanding the China's market demand and buying patterns of palm oil is important as palm oil ranked second behind soyabean oil, which accounted for 42.0% of China's oils and fats consumption (Oil World, 2021) *Figure 2*. China also ranked fourth as the major palm oil consuming countries after Indonesia, India and the European Union, with the main competitors to palm oil in China are soyabean oil, rapeseed oil, sunflower oil and groundnut oil (MPOB, 2021). According to Oil World (2021), the main sources of China's palm oil import are from Indonesia and Malaysia, with these two largest producers commanding 99% of the total China's palm oil demand. In 2020, Malaysian palm oil export to China was 2.73 million tonnes, an increase of 9.6% from 2.49 million tonnes in 2019 (MPOB, 2021), China's palm oil consumption is mainly in the form of refined, bleached, deodorised palm olein and is often blended with other oils to meet its domestic consumer taste preference (Schleifer, 2018).

The world has also witnessed a tremendous growth in the consumption of palm oil. Over the years from 2010 to 2020, the global palm oil consumption was increased by 7.37% compound annual growth rate (CAGR) from 1.62 to 6.72 million tonnes (Oil World, 2020). This is due to the fact that palm oil is competitively priced as compared to other vegetable oils, is widely available throughout the year, unlike seasonal crops, and has ubiquitous application from edible to the oleochemicals sectors (Murphy, 2014).

Despite the fact that the information related to palm oil demand in China is very important for policy makers and exporters in Malaysia to understand the factors that shape the importing and buying pattern of edible oils and fats in China, published literature on the demand for palm oil in China is very limited and need further exploration. Thus, this article aims to investigate factors influencing



Sources: Oil World 2004; 2008; 2012; 2017 and 2020.

Figure 2. China palm oil consumption.

the demand for palm oil in China. The rest of the article is structured as follows: brief discussion on the literature review with references to palm oil consumption and trade, particularly in China. The third section describes the research methodology, followed by results and discussion. Finally, the conclusion and policy implications in the last section of the article.

LITERATURE REVIEW

Being the fastest growing vegetable oil consumed in the world, the rising importance of palm oil for global consumption has encouraged lots of research being conducted in this area. Hameed *et al.* (2016) explored factors influencing palm oil import in six Asian countries, namely China, India, Bangladesh, Japan, Pakistan and Korea by using the ARDL model. The study found that, palm oil prices, substitute oil prices and the national income of the importing countries represented the most significant determinants of palm oil demand across the studied countries. It has some similarities with that of Awad *et al.* (2007), which also found that price of substitute oils plays an important role in influencing palm oil demand. Each country has different palm oil substitute such as in Saudi Arabia and Libya, the palm oil substitute is corn oil, in Sudan is rapeseed oil, in Syria it is sunflower seed oil and in Algeria, Egypt, Iran, Jordan, Morocco, and Turkey is soyabean oil (Awad *et al.,* 2007). According to a study conducted by Zakaria *et al.* (2017) on the relationship between palm oil and soyabean oil, there is a positive influence arising from the difference in the price of soyabean oil and palm oil on China's palm oil demand, and it shows that in China, soyabean oil is a substitute for palm oil. Besides that, a study by Parveez *et al.* (2019) also showed that there is a relationship between soyabean and palm oil demand in China, where in Malaysian palm oil exports to China increased by 33.9% due to lower import of soyabean for domestic crushing because of the African swine fever and the trade war between China and the United States (US). However, in terms of price, palm oil is more competitive as compared to other competing oils (Nambiappan *et al.,* 2018).

Demand for palm oil in China remains stable as it is competitively priced over that of soyabean and rapeseed oils. The strong demand is also due to the blending of palm oil with other vegetable oils for the use as cooking oil. The demand for processed food, such as instant noodle, snacks and biscuits also contributed to the demand for palm oil (Hao and Keat, 2015). The study by Weuxun and Xiaoshu (1995) found that palm oil is mainly used in the food manufacturing industry in China, especially in the production of instant noodles and snack foods as well as in the manufacturing of margarine and shortening. In addition, this study also noted that in China, palm oil never being used as domestic cooking oil directly, yet it is used as one of the components in the blended cooking oil. According to Hao *et al.* (2018) in Southern China, palm oil is used as a major component in blended cooking oil. China also uses palm oil as an ingredient for personal care, such as facial, shower, and other liquid preparations (Pheng, 2002). In China, every region has their own food taste preference depending on

their culture (Reedy and Anitha, 2015). Study by Fang and Beghin (2002) using urban household survey from 1992 to 1998 found that the demand for edible oils and fats in three regions in China have positive income elasticity, indicating that an increase in income would lead to an increase in the demand for edible oils and fats expenditure. The study found that 1% increase in income would lead to an increase of 0.47%, 0.29% and 0.45% of edible oils and fats expenditure for the Northeast, Middle, Western and Southern regions, respectively. The study concluded that income is a determinant for edible oils consumption in China.

China's palm oil imports mainly comes from Indonesia and Malaysia. There are several studies carried out on Malaysian and Indonesian palm oil competitiveness. Rifin (2009) analysed the export competitiveness of the Indonesian palm oil products over that of Malaysia in the Asia, Africa and Europe regions. Results from the study showed that palm oil exported from Indonesia is more competitive than that of Malaysia in the studied countries. Rifin (2013) constructed an import demand equation using Almost Ideal Demand System (AIDS) to study the competitiveness between the Indonesian and Malaysian palm oil products in China and India. The study found that Indonesian palm oil is close to a unitary elastic on both compensated and uncompensated elasticities. Meanwhile, Malaysian palm oil was found to be non-sensitive to price changes as compared to that of Indonesian palm oil. Additionally, the study also found that instead of competing with each other, the Indonesian and Malaysian palm oil imports in China are actually complement to each other in order to increase the world demand for palm oil in the future. Salleh *et al.* (2016) also studied the comparative advantages of Malaysia and Indonesia in crude palm oil (CPO) and processed palm oil (PPO) exports to five major markets namely China, India, the European Union (EU), Pakistan and United States (US) over the period 1999 to 2014 found that Indonesia has more comparative advantages in exporting palm oil to China.

From other perspectives, there are studies discussed on the decision making of edible oils consumption. Narayanasamy and Ramasamy (2011) found that, one of the determinants influencing customer choice in buying edible oils in the market is age. Customers, who are in the age category of below 25 years, tend to make the decision to purchase edible oils based on the retailer's suggestion. With regards to the customers, in the age group of 31 to 40 years, newspaper advertisements help them to make decisions when purchasing edible oils. For those who are in the age category of above 40 years they were influenced by television advertisement. It showed that, age is one of the factors that could influence the demand for oils and fats. Besides that, Kumar (2014) found that there are also other factors influencing consumer decision in making edible oil purchases, which are brand image, price, health, consciousness and quality.

METHODOLOGY

The annual data on China's palm oil import, and vegetable oils consumption from 1980 to 2019 were collected from Oil World

TABLE 1. LIST OF VARIABLES

Variables	Source	Justification of variables
China's palm oil import	Oil World 1985, 1990, 1995, 2000, 2004, 2008, 2012, 2017 and 2020	This study used China's palm oil import as a proxy for China's intake of palm oil
China's palm oil consumption	Oil World 1985, 1990, 1995, 2000, 2004, 2008, 2012, 2017 and 2020	This study used China's palm oil consumption as a proxy for China's market
Prices of palm oil	UNCTADSTAT	This study used palm oil price to measure the impact of its price (followed by demand theory)
Price of soyabean oil and sunflower oil	UNCTADSTAT	This study used price of soyabean oil and sunflower oil to measure the impact of substitute price (followed by demand theory)
GDP of Malaysia and China	World Development Indicator (WDI)	This study used GDP as a proxy for income
China's population	World Development Indicator (WDI)	This study used population to measure the market of the countries
China's CPI	World Development Indicator (WDI)	This study used CPI as a proxy for purchasing power of the country

report 1985, 1990, 1995, 2000, 2005, 2010, 2015, 2019 and 2020. Data on prices of palm oil, soyabean and sunflower oil were annual data from 1980 to 2019, which were sourced from United Nations Conference on Trade and Development (UNCTADSTAT) and annual data for Malaysian GDP, China's population, Consumer Price Index (CPI) and Growth Domestic Product (GDP) from 1980 to 2019 were sourced from World Development Indicator (WDI). The summary of variables used in the study are as shown in *Table 1*.

Autoregressive Distributed Lag (ARDL) Analysis

Autoregressive Distributed Lag (ARDL) method is used to deal with the variables that have a stationary series mixture of I(0) and I(1). ARDL model is superior to the other cointegration model and provides reliable results even with a small sample size. Autoregressive Distributed Lag (ARDL) model having problem of endogeneity during estimations. Endogeneity problem can be solved by taking lags of variables and make the model dynamic as in Pesaran *et al.* (2001). Thus, this study employed the Autoregressive Distributed Lag (ARDL) bound testing approach to cointegration developed by Pesaran *et al.* (2001) to verify the long run relationship between variables. The Estimated ARDL model is as follows:

where,

α, β and δ	:	Parameters to be estimated
POimport	:	Palm Oil Import by China
CHNGDP	:	Gross Domestic Product of China
CHNCPI	:	Consumer Price Index of China
POP	:	Population of China
PCPO	:	Palm Oil Price
PSOY	:	Soyabean Oil Price
POCON	:	Palm Oil Consumption
MYSGDP	:	Malaysian Gross Domestic Product
ε_t	:	Error term

Once cointegration is established, the conditional ARDL long run model can be estimated as follows:

$$lnPOimport_t = \alpha_0 + \delta_1 lnCHNGDP_{t-1} + \delta_2 \Delta lnCHNCPI_{t-i} + \delta_3 \Delta lnPOP_{t-i} + \delta_4 \Delta lnPCOP_{t-i} + \delta_5 \Delta lnSOY_{t-i} + \delta_6 \Delta lnPOCON_{t-i} + \delta_7 \Delta lnMYSGDP_{t-i} + \varepsilon_t \quad (2)$$

Finally, the study looked at the short run dynamic parameters by estimating an error correction model associated with the previously determined long run estimates. ARDL error correction model is expressed with the following equations:

$$\Delta lnPOimport_{it} = \alpha_0 \sum_{i=1}^{p} \beta_{1i} \Delta lnCHNGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnCHNCPI_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPOP_{t-i} + \sum_{i=0}^{s} \beta_{4i} \Delta lnPCPO_{t-i} + \sum_{i=0}^{t} \beta_{5i} \Delta lnSOY_{t-i} + \sum_{i=0}^{u} \beta_{6i} \Delta lnPOCON_{t-i} + \sum_{i=0}^{v} \beta_{7i} \Delta lnMYGDP_{t-i} \quad (3)$$

$$\Delta lnPOimport_{it} = \alpha_0 \sum_{i=1}^{p} \beta_{1i} \Delta lnCHNGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta lnCHNCPI_{t-i} + \sum_{i=0}^{r} \beta_{3i} \Delta lnPOP_{t-i} + \sum_{i=0}^{s} \beta_{4i} \Delta lnPCPO_{t-i} + \sum_{i=0}^{t} \beta_{5i} \Delta lnSOY_{t-i} + \sum_{i=0}^{u} \beta_{6i} \Delta lnPOCON_{t-i} + \sum_{i=0}^{v} \beta_{7i} \Delta lnMYGDP_{t-i} + \delta_1 lnCHNGDP_{t-1} + \delta_2 \Delta lnCHNCPI_{t-i} + \delta_3 \Delta lnPOP_{t-i} + \delta_4 \Delta lnPCPO_{t-i} + \delta_5 \Delta lnSOY_{t-i} + \delta_6 \Delta lnPOCON_{t-i} + \delta_7 \Delta lnMYSGDP_{t-i} + \varepsilon_t \quad (1)$$

Where β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are the short-run dynamic coefficients of the model's convergence to the equilibrium, γ^* is the speed of adjustment parameter and ECM is the error correction term that is derived from the estimated equilibrium relationship of Equation (1).

RESULTS AND DISCUSSION

Autoregressive Distributed Lag (ARDL) Analysis

The result of the bound test for cointegration is shown in *Table 2*. This test is based on the Wald test or F statistic and is conducted against the null hypothesis of the existence of a long run relationship between the variables. The result of the bound test indicated the existence of a long run relationship between the variables. This is because the F statistic result is higher than the upper bound critical value at the 1% level of significance (Pesaran *et al.*, 2001).

Long Run Estimations

The empirical results of the long run models are presented in *Table 3*. The results indicated that income as measured by China's GDP has a long run positive influence on China's palm oil import. The finding also found China's GDP is elastic, indicated that palm oil is perceived by China as a normal product. The model showed that in the long run, the every 1% increase in China's GDP would increase demand for

TABLE 2. COINTEGRATION TEST BASED ON THE BOUND TEST RESULT

Significant level (%)	Upper bound value	Upper bound value
90	3.800	5.643
95	2.797	4.211
99	2.353	3.599
	4.4990**	

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

TABLE 3. ESTIMATED LONG RUN COEFFICIENTS USING ARDL APPROACH

Variable	Coefficient	t-statistic	Probability
CHNGDP	0.1107	2.8083	0.0121**
CHNCPI	0.1812	9.9397	0.0000***
POP	9.9959	5.6293	0.0000***
PCPO	-7.3135	-8.7023	0.0000***
PSOY	7.2361	7.4649	0.0000***
POCON	-2.0535	-2.4889	0.0235**
MYSGDP	-7.201	-4.68361	0.0002***

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

palm oil in China by 0.1%. The positive relationship between GDP and demand for palm oil is in line with several other studies (Talib and Zaimah, 2002; Awad *et al.*, 2007; Egwuma *et al.*, 2016; Zakaria, 2019). Furthermore, GDP also reflects to market size (Sahoo, 2012; Bahri *et al.*, 2018), market size is an important factor in determining the potential for local sales (Wang and Swain, 1995).

Since CPI represents the purchasing power of the consumers, China's CPI also has a significant influence on the demand for palm oil with positive relationship. The finding also found that the elasticity is very small. For every increase of 1% in China's CPI will lead to an increase of 0.2% on demand for palm oil. This finding is aligned with that of Papi and Lim (1997) and Abidemi and Malik (2010), which indicated that import has a positive association with CPI.

Another factor that positively influenced the demand for palm oil in China is population of China (POP). This study showed that POP has provided a long run positive influence on China's palm oil import and its elasticity is greater than one (1). It indicates that the percentage of POP is high. For every 1% increase in China's POP, demand for palm oil in China would increase by 9.9%. The result is in line with the USDA (2016) findings, which indicated that growth in China's population has increased the demand for oils and fats. It also supported by MPOC (2009) which found that one of the reasons for the increase in palm oil consumption in China is the country's population.

Next are soybean oil price (PSOY) and palm oil prices (PCPO). PSOY also has a positive and significant relationship with the demand for palm oil. The results show that PCPO and PSOY prices are elastic and the elasticity is greater than one. It indicates that China palm oil demand is highly sensitive to price changes. When PSOY increases by 1%, it will lead to an increase of 7.2% on palm oil demand. Meanwhile, PCPO had a negative and significant influence on the demand for palm oil. For every 1% increase in PCPO, it will lead to a decrease of 7.3% in the demand for palm oil. The results are in line with the demand theory, that substitute price has a negative relationship with own price. In the vegetable oils market, PSOY is a substitute to palm oil. This finding is similar to that of several other studies, such as Amiruddin *et al.* (2005); Awad *et al.* (2007) and Zakaria (2019).

Besides that, palm oil consumption (POCON) and Malaysian GDP also have a negative influence on the demand for palm oil in China. The study also shows that the POCON and Malaysian GDP are elastic, which indicates that the percentage of POCON and Malaysian GDP is high. Any changes in these two variables will have a significant impact on China's palm oil consumption. The model indicated that in the long run, every 1% increase in POCON and Malaysian GDP, China's palm oil import will decrease by 2.05% and 7.3%, respectively. This result is in line with that of several studies conducted regarding the relationship between income and demand for palm oil such as study by Hameed *et al.* (2007), which found that income of Algeria, Egypt, Iran Jordan, Morocco and Turkey is a significant determinant of palm oil demand. Meanwhile, a study by Egwuma (2016) found Nigeria's income significantly influence demand for palm oil and study by Zakaria (2019) also found that income of Bulgaria and Greece significantly influence demand for palm oil in these countries.

Short Run Error Correction Models

The short run error correction model (ECM) from ARDL model is presented in *Table 4*. Most of the variables were found to be significant in the short run. It is found that, lagged palm oil import, consumer price index of China, population of China, and soyabean oil price had positive relationships with palm oil import for China. Lagged palm oil price, population of China and palm oil consumption had negative relationships with palm oil import for China. The error correction terms (ECT (-1)) are negative and highly significant. It showed that there was causality in at least one direction. The ECT coefficient is -0.6, which indicated higher rate of convergence to the equilibrium.

Table 5 shows the result of Breusch-Godfrey and Breusch Pagan Godfrey test for serial correlation and Heteroskedasticity respectively. The Breusch Godfrey test result indicates that there is no problem of serial correlation in the data because the P Value of F statistics is higher than 0.05 and the results of Breusch Pagan Godfrey P value is also greater than 0.05, which confirms the validity of Heteroskedasticity in our data.

CONCLUSION

Factors such as price, population, income, and preference influenced the demand for palm oil. This study focussed on the China's market. The empirical results demonstrated that there are long run relationships among the variables. GDP of China, consumer price index of China, price of soyabean oil and population of China have long run positive influence on China's palm oil import. Meanwhile, other factors in the study showed negative significant influence on China's market for Malaysian palm oil imports is palm oil price, palm oil consumption and the Malaysian GDP. The information gathered is very important for industry players towards planning their market strategies in terms of expanding their market share in China. The findings of this study could also assist the government in terms of strategic planning for palm oil exports, especially to China.

TABLE 4. ERROR CORRECTION REPRESENTATION FOR THE SELECTED ARDL MODEL

Variable	Coefficient	t-statistic	Probability
ΔPOimport(-1)	0.1325	1.4151	0.1751
ΔPOimport(-2)	0.0793	1.0100	0.3266
ΔPOimport(-3)	0.4912	6.0126	0.0000***
ΔCHNGDP	0.0194	1.2507	0.2280
ΔCHNCPI	0.0710	6.4645	0.0000***
ΔPOP	50.1468	5.0112	0.0001***
ΔPOP(-1)	-26.2654	-2.6023	0.0186**
ΔPCPO	-2.4192	-7.8193	0.0000***
ΔPSOY	2.7358	8.0012	0.0000***
ΔPSOY(-1)	-0.3361	-2.6797	0.0158**
ECT	0.5605	-9.4955	0.0000***
Diagnostic test			
R-squared	0.919467		
R-bar squared	0.885911		
Durbin Watson	2.616313		
Schwarz criterion	-0.552725		

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

TABLE 5. SERIAL CORRELATION AND HETEROSKEDASTICITY TEST

Variable	Coefficient	t-statistic	Probability
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.719068	F-statistic	0.2127
Obs* R-squared	6.526407	Obs* R-squared (2)	0.0383**
Heteroskedasticity Test: ARCH			
F-statistic	1.711889	F-statistic	0.1977
Obs* R-squared	3.380368	Obs* R-squared (2)	0.1845

Note: *Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

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