THE FACTORS AFFECTING THE CRUDE PALM OIL (CPO) PRICE IN TIME SERIES ANALYSIS: EVIDENCE FROM MALAYSIA

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STATEMENT OF ORIGINALITY

The work described in this Final Year Project, entitled

"The Factors Affecting the Crude Palm Oil (CPO) Price in Time Series Analysis: Evidence from Malaysia" is to the best of the author's knowledge that of the author except where due reference is made.

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ABSTRACT

THE FACTORS AFFECTING THE CRUDE PALM OIL (CPO) PRICE IN TIME SERIES ANALYSIS: EVIDENCE FROM MALAYSIA

By

Liew Pair Ni

Malaysia merupakan sebuah negara yang terkenal dengan sektor minyak dan lemak disebabkan Malaysia adalah pengeluaran dan pengeskportan minyak kelapa sawit yang kedua terbesar selepas Indonesia. Oleh itu, kertas ini bertujuan untuk menganalisis penentu harga minyak kelapa sawit di Malaysia atas kepentingan komoditi ini terhadap ekonomi nagara. Harga antarabangsa untuk minyak kacang soya, minyak kelapa dan minyak mentah telah dipilih untuk mengkaji hubungan dengan harga minyak kelapa sawit. Kajian ini menggunakan teknik analisis siri masa dan data telah diturut bermula daripada Januari 1999 hingga Disember 2018 dalam bulanan. Kajian ini menggunakan ujian kointegrasi Johansen, model pembetulan ralat vektor (VECM) dan kausalitas untuk menetapkan hubungan antara pembolehubah dalam jangka masa panjang.

Malaysia is a country which popular in the sector of oils and fats especially in palm oil due to it is the world's second largest palm oil producer and exporter after Indonesia. Hence, this study was conducted to analyze the determinants of palm oil price in Malaysia since oil palm plays a vital role in supporting the economy. The determinants such as world soybean oil price, world coconut oil price and world crude oil price was selected to indentify the relationship between the price of palm oil. This study was using the analysis of time series and the data was collected in monthly basis from January 1999 to December 2018. This study develop unit root test, Johansen cointegration test, vector error correction model (VECM) and direction of causality to test for the determinants between substitutes prices and crude palm oil price in Malaysia.

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CHAPTER ONE

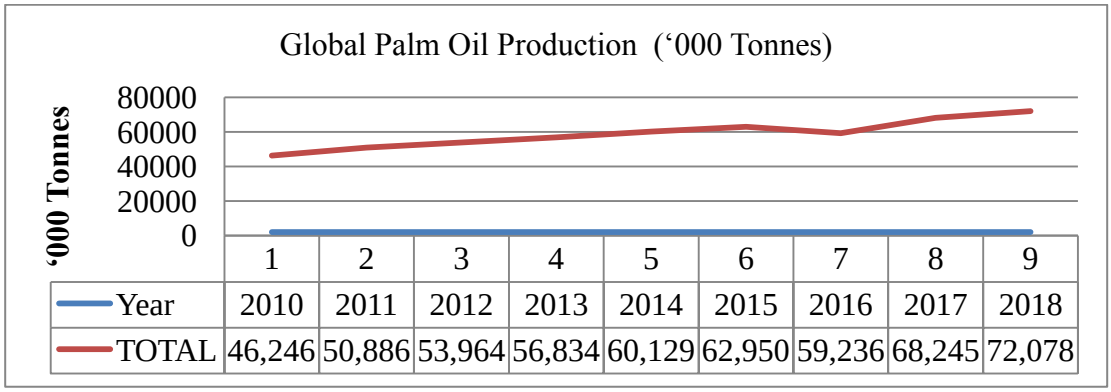
INTRODUCTION

1.1 Introduction

In the oil and fats consumption trend and market, palm oil emerged as a significant player and popular agriculture crop leaders in the terms of production. It is originate from the flesh fruit of oil palm Eleais Guineensis where contain high carotene. Hence, the oil is bright orange-red in the virgin form. The tree was originally native to West Africa and mostly grown in the plantation of Asia, Africa and Latin America such as Papua New Guinea, Brazil, Guatemala, Nigeria, and Honduras. The palm oil fruit contain two differences oil, which is the palm oil extract from the flesh and also palm kernel oil extract from the seeds. Palm oil has become a good ingredient in frying oil blends due to has high oxidation and heat resistance under high temperature for a long time. (Mba et al., 2015).

Over a few decades, the functions of palm oil substantially incrase. The various range of uses of in food, cosmetics and commodity such as the main biodiesel feedstock was transforms palm oil become a popular commodity (Abdullah and Wahid, 2010; Bentivoglio et al., 2018). Due to its performance as well as economic reason, the worldwide end users and manufacturers have incorporate large amount of palm oil as their cooking oil blends or raw material. Palm oil also used as shortenings that major application in making bakery products. Besides, the historical data show that the total global palm oil production was continues to rise from the year 2010 to 2015. However,

the amount was drop in year 2016 due to lingering effects of El Nino weather phenomenon in year 2015. The after-effect of El Nino was affected the oil yields of leading palm oil producers which is Malaysia and Indonesia (Yimie, 2017). According to Oil World Annual, Malaysia's palm oil production was fall1 3.2% from 19.962 million tons in year 2015 to 17.319 million tons in year 2016. At the same time, Indonesia's palm oil production was fall 3.4% from 33,530 million tons in year 2015 to 32,400 million tons in year 2016. After that, the global palm oil production was increase until 72,078 million tons in year 2018 and was expected to climb in the coming decade. One of the reasons causing the production of palm oil significant growth was due to the expansion in the palm oil planting area around the world.



	1	2	3	4	5	6	7	8	9
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
TOTAL	46,246	50,886	53,964	56,834	60,129	62,950	59,236	68,245	72,078

Figure 1.1.1: Global Palm Oil Production.

Source: Statista.com

The oil palm has become an essential agricultural commodity especially the nation that has dominated regional production starting from mid-1960s such as Malaysia and Indonesia (Sheil et al., 2009). According to the Food and Agriculture Organization of the United Nations (FAO), Malaysia and Indonesia was the giant in palm oil production which account around 80% of total of production around the world. Indeed,

a lot of countries are concern about the palm oil price used in industries and commercials. This because it will causes an unavoidable rising in the cost of standards living and lifestyle when the price becomes high (Harjanti, 2012).

Palm oil was consider as Nature's Gift and golden crop to Malaysia and it is a triggers economic activities that supports Malaysian economy. In 1960s, Malaysia plays an effort in agricultural diversification and focus on palm oil sector other than rubber and timber. This result Malaysia has established itself as the largest palm oil producer and exporter in the world during early decades and overcome the reliance on timber, pepper, cocoa and rubber for export earnings (Mohammad et al., 1992). However, Malaysia's crude palm oil prices are extremely unpredictable due to the uncertainty of economic tendency. The volatility of the palm oil prices can be due to various factors. For example, it can be due to the natural disturbance such as climate, the elasticity of supply and demand, and delay in supply market fundamentals in short-run. By referring to the study of Wahid, Simeh, & Nordin (2007), the developments in world palm oil prices stem from price competition, trade, consumption, oil palm investments and also the usage of the palm oil in biodiesel production. Nevertheless, it is a compelling fact that the palm oil prices continue to fluctuate when there is a change the prices of its replacement oil such as crude oil and other vegetables oil (Mohammadi at al., 2015; Songsiengchai, 2018)

1.2 Background of Study

In the year of 1870's, British had announced that palm oil as one of the agricultural commodity in agricultural industry in Malaya (Malaysia). Tennamaran Estate which located in Selangor has become the first commercial plantation of palm oil during that period of time. As of today, this commodity had contributed a lot in the Malaysian agricultural sector where same as the other plantations like rubber and timber (Fadli et al., 2011). According to Oil World Annual, Malaysia became the second largest producer of palm oil in the world after Indonesia. By referring to the table below, the total pail oil production of Malaysia in year 2018 was 19,516,000 tonnes which slightly decline compared to the 2017 at 19,919,000 tonnes. During that period, the amount of Malaysia palm oil export has faced fluctuation. At the other side, the proportion of palm oil export in Indonesia is grows from 46.98% in 2012 to 55.6% in 2017.

Table 1.2.1: Major Producer of Palm Oil in the World.

Producer of Palm Oil ('000 Tonnes)									
Country	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Indonesia	22,497	24,300	26,900	28,820	31,500	33,530	32,400	37,100	41,000
Malaysia	16,994	18,913	18,785	19,216	19,667	19,962	17,319	19,919	19,516
Thailand	1,360	1,650	1,892	2,134	2,000	2,068	1,804	2,597	2,728
Colombia	753	941	974	1,041	1,110	1,273	1,144	1,628	1,600
Nigeria	780	800	840	880	910	940	960	1,000	1,050
Guatemala	182	248	310	410	455	522	730	739	830
PNG	488	580	485	500	545	525	560	645	610
Honduras	275	320	395	425	460	480	580	695	660
Ecuador	380	495	543	495	490	535	587	583	585

Brazil	250	270	310	340	365	400	415	443	450
Cote d'Ivoire	360	371	418	396	400	390	400	400	420
Cameroon	248	254	240	249	253	260	250	265	269
Costa Rica	227	242	260	230	210	255	205	235	257
Venezuela	75	60	55	50	45	43	41	40	40
Others	1,377	1,442	1,557	1,648	1,719	1,767	1,841	1,956	2,064
TOTAL	46,246	50,886	53,964	56,834	60,129	62,950	59,236	68,245	72,078

Source: Oil World Annual.

This industry alone had created creates more job opportunities to the nation. In the light of Department of Statistics Malaysia, palm oil agriculture sector was contributed total of RM99.5 billion or 7.3 % to the Gross Domestic Product (GDP) of Malaysia at RM 1,361.5 billion in year 2018. Generally, oil palm has been a significant contributor to the Malaysia GDP at 37.9%. The contribution was followed by other agriculture (25.1%), livestock (14.9%), fishing industry (12.5%), forestry and logging (6.9%), and rubber (2.8%) (Department of Statistics Malaysia, 2019). Over the last five years, the palm oil industry has contributed 5 to 7 percent to the Malaysia's GDP in average (Nambiappan et al., 2018)

In the early year, Malaysia was depending on Europe as the main export destination of palm oil. Nowadays, Malaysia has expanded the export market worldwide which to over 150 markets where including the West Asia, Indian sub-continent, Africa and Asia countries. Dramatically, the export of palm oil increase when it is processed to other palm oil product such as biodiesel, cooking oil, and oleochemicals. In averaging,

the total export revenue gain from this industry was high at RM 64.24 billion yearly (Nambiappan et al., 2018). According to the Malaysian Palm Oil Board (MPOB), India was the top palm oil export destination of Malaysia with total export volume at 2,028,297 tonnes in year 2018, follow by China (1,917,288 tonnes), Pakistan (1,016,977 tonnes), Netherlands (1,004,006 tonnes), and others.

Generally, the Malaysian palm oil products are currently being consumed by the people aound 140 countries (Basiron, 2009). This illustrates that the importance of the agriculture industry of palm oil industry in Malaysia as well as enhancing the country's socioeconomic level. This has been proven by the contributions of Malaysian palm oil industry in year 2015. In year 2015, palm oil industry was become the fourth biggest contributor to national income where accounting for RM63 billion of Malaysia's Gross National Income (GNI). With above 60 years of experience in the palm oil industry, Malaysia has good comparative advantage in the international market and thus becomes the market leader in terms of productivity and research and development (R&D).

In addition, there are some companies active in palm oil industry such as Sime Darby Plantation, PPB Oil Palms Berhad and Kuala Lumpur Kepong Berhad. Those palm oil companies contribute high income tax to Malaysia as the increasing of area planted. In year 2009, the oil palm plantations of Malaysia is 4.7 million hectares and this amount has increase until 5.85 million hectares in 2018. However, palm oil development is highly contested. In 2010, in response to concerns towards the social and environmental issues, the government of Malaysia pledged to restrict palm oil plantation expansion. It has some impacts on the performance of Malaysia's palm oil industry.

1.2.1 Price of Crude Palm Oil (CPO) in Malaysia

The palm oil price was volatile and instable among the time where similar as the other agricultural commodity. This can be due to the factors in affecting its present and forecasted levels of demand and supply. The slightly altered in the fundamental factors would causes immense on its price impact (Shamsudin, 2019). The price of palm oil has been affected by the price of alternative oils, as it is vying for a global market share of vegetable oils. Besides, the rise in the palm oil prices can be attributed to the population growth, economic growth, the biodiesel elevation, and the changing behavior of global trade. Nevertheless, it can be due to the variations in the weather or when the amount of other vegetable oils in the global market was rising.

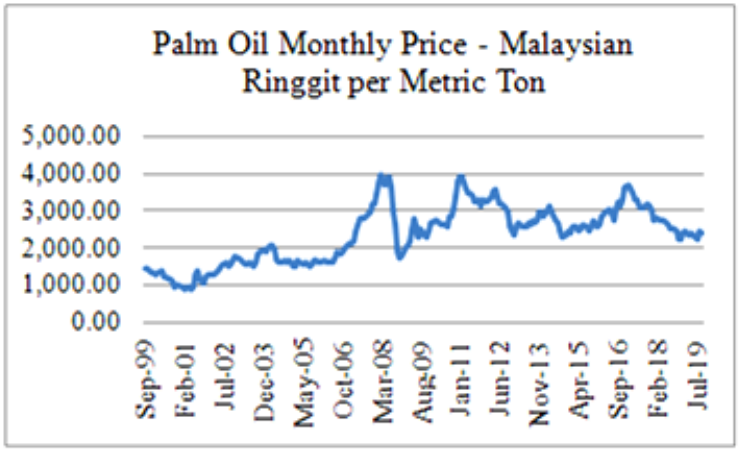


Figure 1.2.1.1: Palm Oil Monthly Price in Malaysian Ringgit per Metric Ton.

Source: Index Mundi

The figure above demonstrates the prices of crude palm oil in Malaysia fluctuating in monthly basis from year 1999 to 2019. Based on the Index Mundi historical data, the crude palm oil price was reached the highest price at RM 3,980.25

per metric ton in March 2019. However, this price was fall to RM 2242.56 per metric ton in Jul 2019 due to undesirable uncertainty. The palm oil price changes indicate that the sensitiveness of palm oil prices to market changes which can be very high up to 29.41%.

According to the Malaysia's palm oil price prospect, the price of CPO has dropped to three-year lows in year 2018 due to the weak demand in the worldwide market. Weak demand causes high stock levels in Southeast Asia which recorded at a high level around 3 million tonnes. The exports also reduce by 12.9% in monthly basis to 1,380,000 tonnes as the major importer including India, China, the European countries, and Pakistan reduce the import in Malaysian palm oil products. Consequently, the average crude palm oil price in November 2018 record at RM1,830.50 per tonne where dropped by 12% in monthly basis. In 2018, the average crude palm oil price was less than the previous year at RM2,267 per tonne against RM2,817 a tonne in 2017. The price of the palm oil can be influenced by the factor including its current stock level, market supply and demand. Besides, other compounds such as soybean oil, coconut oil , sunflower oil and others also influence the price of palm oil. Moreover, it also affect by crude oil since the related oil is used as the main source to produce biodiesel (Shamsudin, 2019).

According to the prospect of by industry analyst Dorab Mistry, palm oil price is under the benchmark to rise until RM 2,700 per tonne by March 2020. This is due to the dry weather and fertilizer cuts in the year which causes slower production in palm oil. Besides, the haze problem causing by forest fires in Indonesia, the world's biggest

producer of palm oil, had give negative impact to the palm oil fruits quality and vegetable oil production during the year. The rising of other alternative oil price such as soybean oil and coconut oil due to the slightly grow in the year also causing the price of went up in the same year (The Star Online, 2019).

In the process of trying to stabilize the palm oil price, this would allow other nations to take advantage from this initiative on the global market. In the past 20 years until recently, Malaysia was offer a competitively price for crude palm oil and other processed products in the global trade (Chuangchid at al., 2012).

1.2.2 World Soybean Oil Price

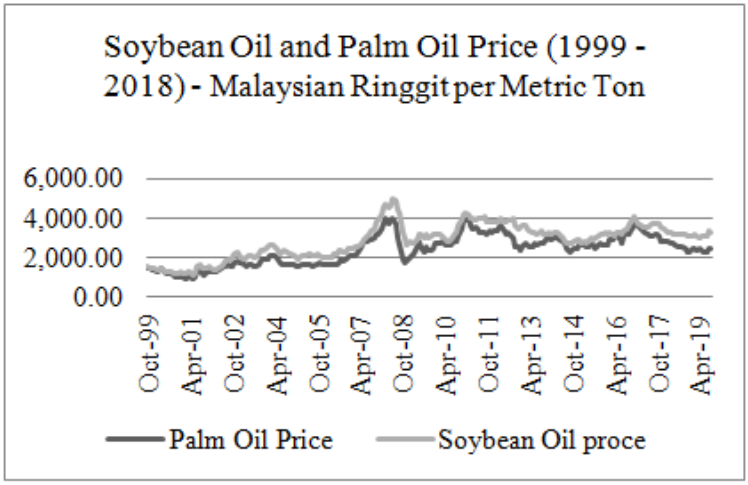


Figure 1.2.2.1: Monthly Soybean Oil and Palm Oil Price (1999 to 2018).

Source: Index Mundi

Soybean oil is one of the vegetable oil that can be used to substitute palm oil, since both are edible oil. It was derived from the pure soybean seeds which called Glycine max. It became popular because its price is low and healthful which does not contain cholesterol. Currently, the method of Hexane extraction was used in the production of soybean oil industry since it lower the cost of production and high oil recovery (Cheng, 2017). Indeed, there are many of researchers believes that the price of soybean oil and palm oil was cointegrated including Balqis, 2013; Talib and Darawi, 2002; Ab Rahman et al., 2007; Kanchymalay et al., 2017; Amira, 2015; Chuangchid et al.,2012 and others. However, the price of soybean oil also fluctuates along the time where show as the figure above from year 1999 to 2019 in monthly basis.

Soybean oil has become a major vegetable oil source especially in America and it takes around 56 % among the vegetable oil resources. United State is the main producer of soybean oil which produces approximately 33% of the total production worldwide. According to the United Department of Agriculture, China is the major producer of soybean oil around the world, follow by United State, Argentina, Brazil, EU-27 and others countries. The demand toward the crop of soybeans was rose for a number of years and the expansion plans are considered by many companies to enhance production capacity. In year 2003, the World production of soybeans was in the number at 184.49 million metric out of 317.89 million metric ton total for vegetable oil crops. This was making soybeans as the second largest oilseed crop around the world after palm oil and rivaled to the palm oil (Earl et al., 2005). Besides, it had consists 22.85% in the volume of international oil trade while palm oil consists of 45.15% (Balqis, 2013).

1.2.3 World Coconut Oil Price

In Malaysia, coconut oil was considered as fourth important agricultural crop after oil palm, paddy, and rubber that support Malaysian economy. Since coconut oil also as a types of vegetable oil, it has same used like palm oil and soybean oil in many applications especially in frying oil blends due to its performance and economic reasons. Each types of oil have practically the same content and functions. As stated by the Malaysian Palm Oil Council, the crude palm oil demand is due to the lower cost of palm oil relative to coconut oil. It mean that the related oil was become the substitute one to the others. As the price of coconut oil was climb up, the amount of crude palm oil imported by a nation also increased (Balqis, 2013).

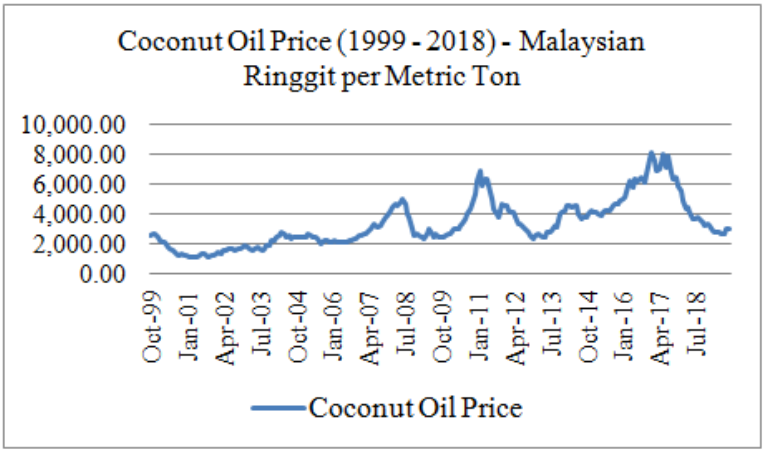


Figure 1.2.3.1: Monthly World Coconut Oil Price (1999 to 2018).

Source: Index Mundi

Figure above shows the world soybean oil price fluctuating in monthly basis from year 1999 to 2019. The coconut oil price was believes to be effect the palm oil

price. There are numerous researchers had identified the impact coconut oil price on palm oil price in empirical method such as Mohamad, 2018; Balqis, 2013; Kanchymalay et al., 2017; Talib and Darawi, 2002 and Amira, 2015.

1.2.4 World Crude Oil Price

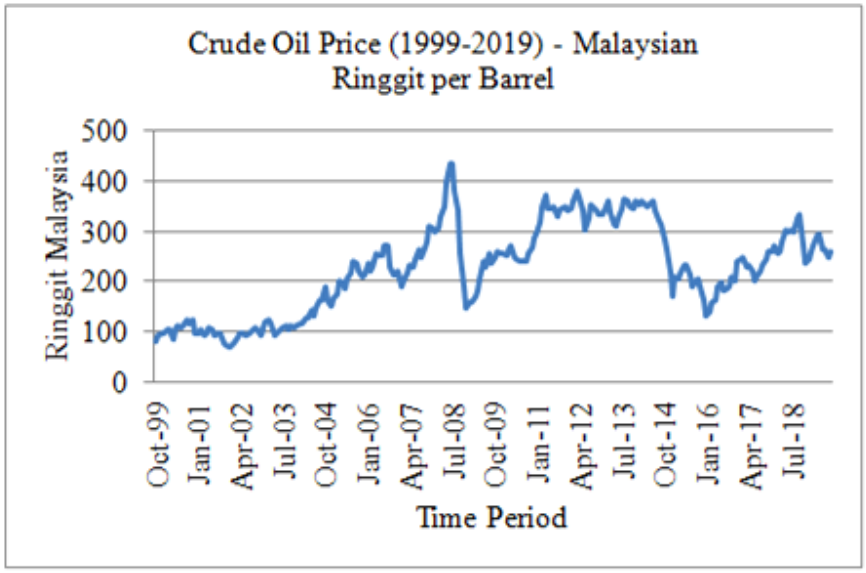


Figure 1.2.4.1: Monthly Crude Oil Price (1999-2018).

Source: Index Mundi

Crude oil also knows as liquid fuel source (fossil fuel) exist with a combination of hydrocarbons, nitrogen, sulfur, and metals such as copper, nickel, vanadium, and iron. It is located underground and extracted through drilling. Crude oil has become the feedstock for various fossil fuel products where include the transportation fuels such as gasoline, diesel, jet fuel, and petroleum. Besides, crude oil also as the fuel source to generate electricity. As stated by U.S. Energy Information Administration, crude oil as

the base for a lot of product when combined with other chemicals such as tar, asphalt, paraffin wax, lubricating oils, fertilizer, perfume, insecticides, soap, and vitamin capsules (Amadeo, 2019)

The main function of crude oil was used as fuel to power vehicles and industrial machines as well as being converted into plastics and other materials (Alecia, 2019). Hence, crude oil is an important resource necessary for every sector of the economy. Besides, surround with other sectors such as transportation, agriculture, telecommunication, and other industrial activities.

The figure above shows the price of the crude oil is volatile from year 1999 to 2018. According to Index Mundi, crude oil price stood at an average of RM 286.81per barrel in 2018. This price was higher than the previous year of 2017 at RM 233.66 per barrel in average. The highest annual average historic price is in year 2012 at RM 345.48 per barrel due to the disruptions of international supply which pushed up petroleum prices (U.S. Energy Information Administration, 2012). The Oil prices dropped from historic highs in July 2008 at RM 435.07 to RM 147.83 per barrel five months later. Consequently, the Organization of Petroleum Exporting Countries (OPEC) was lower the yield by 16 % in eight months and bring stability in global prices. This also causes the consumption and production of the largest producer Saudi Arabia dropped by 1.5 %.

There was numerous of literature regarding the impact of crude oil price towards the variables in the micro-economy and other prices of agricultural commodities. Crude

oil have many environmental disadvantages where growing with environmental. Indeed, biodiesel has become an essential alternative crude oil fuel which serves as the lifeblood use by retail and industry around the world. In generally, palm oil was the main feedstock of biodiesel. Biodiesel feedstock prices, such as palm oil, soybean oil, rapeseed oil and maize, ultimately depend on the crude oil price movement (Songsiengchai et al., 2018). It is believes that the price of crude oil has a positive correlation toward the palm oil prices. Besides, as stated by Chuangchid et al. (2012), crude oil recently growing with environmental concerns and the price was quite higher in the commodity market. The production of palm oil would increase due to high demand in palm oil market in biodiesel and this resulting in the rising of palm oil price.

1.3 Problem Statement

In the last few decades, palm oil has become an important edible oil globally. Due to its performance as well as economic reason, the worldwide end users and manufacturers have incorporate large amount of palm oil as their cooking oil blends or raw material. The palm oil market is more dependent on its cost and availability on its unique attributes in relation to other oils (USITC 1987).

Owing to the fact that palm oil is a partially hydrogenated oil which contain a significant amount of trans-fatty acids and saturated fat, palm oil was considered unhealthy where can cause cardiovascular diseases (Hinrichsen, 2016). Therefore, the use and application of palm oil has steadily decreased since the mid-90's (Ritsche, 2018).

However, the there are numerous of study such as Odia, Ofori & Maduka (2015) and Mukherjee & Mitra (2009) has conclude that palm oil as a source of dietary fat that does not pose any other danger to coronary heart disease if consumed in sufficient amounts.

Also, the cultivation of palm oil is often connected with issues of sustainability besides the issues of saturated fats (Yamada et al., 2016). Environmental damage caused by the palm oil field also affecting palm oil demand and also its price (Otieno et al., 2016). In view of this, the EU agreed to ban the palm oil use in the coming year 2020 (Vogelgesang, Kumar & Sundram, 2018). The resolution passed a single certification system for the export of palm oil and other vegetable oils in Europe. Through the Sustainable Palm Oil Certification (CSPO), various vegetable oils which including olive oil, soybean oil, sunflower oil and coconut oil can be ensured to be produced in a renewable environment. Due to issues on environmental and health concerns, the Non-Tariff Measures (NTMs) has been applied in the trade of palm oil in European Union importer countries started April 2017. NTMs is a policy measures other than tariffs which brings negative effect in palm oil national trade by reducing the quantities traded, increasing prices or both (Kursimpobukm, 2018). This can fluencies the demand on palm oil and benefit closest competitor oil in the stage of national trade.

The alternative blending liquid oils such as soybean oil and sunflower oil with fully-hydrogenated oil has become the substitutes of palm oil. This alternative oil have same used as palm oil in many applications especially both can be the edible oil in cooking and frying. This alternative oil almost having similar contents and functions as palm oil. Moreover, the level of saturated fatty acids of alternative oil such as soybean

oil has 15% lower than palm oil since it is a fully-hydrogenated oil (Hinrichsen, 2016). By referring to Slistyanto & Akyuwen (2011), soybean oil, corn oil, sunflower oil, cottonseed oil, rapeseed oil and coconut oil has become the primary rival towards the palm oil industries in Malaysia. The substitute oil price has become a underlying factor that can affect crude palm oil prices in international trade (Amira, 2015).

Furthermore, the oil yield of palm oil per ha is higher resulting in an increase in oil palm stocks. Consequently, global palm oil prices have fallen to new lows in the past three years while oil palm harvests have risen (Nambiappan et.al., 2018). According to analysis, the palm oil industry will have overcapacity in the next few years. On the other hand, trade barrier also significant such as India announced that to increase the Malaysian palm oil import tax which causes Malaysian palm oil exports to face a double blow. Moreover, the palm oil price also affected by energy prices such as international crude oil price. The increasing in the use of biodiesel responding to higher crude oil consumption where affect palm oil demand since palm oil as the feedstock of biodiesel (Chuangchid et al. (2012)

The Malaysia palm oil industry was currently facing various dilemmas. Starting from 2008, the crude palm oil price trend shows a high volatility which indicates that the palm oil prices was sensitive to the market changes. This fluctuation was dealing with uncertainties as well as risks in oil palm business and may harm the income of smallholders and affect the country's economy. Hence, it is crucial to understand the determinants of crude palm oil price and its price behavior (Khalid et al., 2018).

1.4 Research Question

In this study, there are some questions that need be answered in conducting the research. The questions are addressed as below;

i. What is the relationship between the Malaysian crude palm oil price and the world soybean oil price, world coconut oil price, and world crude oil price?

ii. Is there any short-run and long-run relationship between the Malaysian crude palm oil price and the world soybean oil price, world coconut oil price, and world crude oil price?

iii. What is the policy should be impose which support the development of the palm oil industry in Malaysia?

1.5 Research Objective

1.5.1 General Objective

The general objective of this study is to identify the relationship between the crude palm oil (CPO) price and the factor of determinants such as soybean oil price, coconut oil price and crude oil price.

1.5.2 Specific Objectives

There are several specific objectives in this study which include;

i. To determine the relationship between crude palm oil (CPO) price and soybean oil price in long-run and short-run.
ii. To examine the relationship between crude palm oil (CPO) price and coconut oil in long-run and short-run.
iii. To analyses the relationship between crude palm oil (CPO) price and crude oil price in long-run and short-run
iv. To identify the policy which support the development of the palm oil industry in Malaysia.

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1.6 Scope of Study

This study was concentrated on the Malaysia's palm oil market by study the factors affecting the Malaysia's crude palm oil (CPO) price. There are many factors affecting the Malaysia's crude palm oil (CPO), however, this study only focus on three factors which are world soybean oil price, world coconut oil price and world crude oil price. The relationship between the variables and the policy in supporting palm oil industries was indentified. Generally, this study mainly based on monthly time series which spanning from 1999 to 2019 (240 months or 20 years). All of the historical data was mainly obtained from Index Mundi. Com.

1.7 Significance of Study

The study on the palm oil industry is crucial since its plays a significant role in the economy development of Malaysia. The palm oil industry in Malaysia is currently facing various dilemmas and the crude palm oil price trend shows a high volatility which indicates that the palm oil prices was sensitive to the market changes. Hence, it is importance to understand the factors affecting the crude palm oil price and its price behavior. This study focus on the main substitutes of palm oil as the factor of determinants by using time series analysis. Meanwhile, the policy was highlighted in this study where as the tool in the palm oil development in Malaysia.

1.8 Organization of Study

Generally, this paper contained five chapters. Chapter 1 was the introduction for this paper which include the background of study, problem statement, research question, research objective, significance of study, scope of study and the summary for the whole chapter. Chapter 2 is the summarized and literature review on palm oil market price, theoretical framework, empirical evidence, hypothesis development for all variables, and conceptual framework in this study. Chapter 3 was the explanation for the methodology that will be adopted to conduct the empirical analysis. The methodology includes the research design, estimation model, measurement for dependent and independent variables, data and sample used, and diagnostic test for this study. Moreover, Chapter 4 was the result discussion for the empirical analysis where includes the ADF unit-root test, PP test, Johansen Cointegration test, VECM causality test, variance decomposition and impulse response. The last Chapter, Chapter 5, where discuss the conclusion of this study with the relevant recommendation and policy implementations.

1.9 Concluding Remarks

In summary, this Chapter mainly introduced the agriculture industry of crude palm oil (CPO) in Malaysia. Malaysia is the world's second largest producer and exporter of a palm oil, hence, the issues that would influences to the palm oil price should be managed. The world soybean oil price, world coconut oil price and world crude oil price was selected as the independents variables to determine its relationship with the crude palm oil price.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A literature review is a search and evaluative of the available scholar paper which related to the selected topic of study. There are numerous of researches study on the determinants of palm oil price and its interaction between the determinants. It is very important to review previous papers in completing this study to gain different ideas and learn from the previous mistakes. Indeed, the past studies has provide a useful insight into its characteristics and features of crude palm oil. In generally, the palm oil price was believes to be effected by soybean oil price, coconut oil price and crude oil price. The empirical results regarding to relationship of crude palm oil price and its determinants would be discussed in this chapter. Different methodologies have been applied and the strength and weakness of each methodology is being clarified.

2.2 Dependent variable

2.2.1 Price of Crude Palm Oil

Palm oil was regarded as one of the world's most successful agricultural crop leaders in the oil and fat consumption sector. According to Chuangchid et al. (2012), the factors which involved in determining the palm oil price are quite unique. Its price rise can be related to the increasing of population, instant economic growth, biodiesel output

elevated, and the changing behavior of international trade. Nevertheless, it is a variations in the weather or compelling fact that when the other vegetable oils increase on the world market. There were a number of researchers study how the crude palm oil price fluctuates such as the thesis from Bentivoglio, Finco, and Bucci (2018); Chuangchid et al. (2012); Mohamad (2018); Khalid et al. (2018); Balqis (2013); Mohammadi et al. (2015); Songsiengchai et al. (2018) and others.

2.3 Independent variables

2.3.1 World Soybean Oil Price

Based on the previous studies, there was a number of researchers believe that the price of soybean oil impacts the price of palm oil. Its price is highly correlated due to soybean oil can be used as substitute of palm oil in many applications Chuangchid (2012). According Prasetyo, Marwanti, and Darsono (2017); Balqis (2013); Mohammadi et al. (2015), they found that crude palm oil price is strongly affect by soybean oil price as both commodities are substitutes for each other. Besides, most of the studies found that soybean oil has positive relation on the palm oil cross price elasticity. As soybean oil prices increase, the customer would turn to the cheaper vegetable oil such as palm oil, leading to a move to palm oil consumption. Therefore, the production of palm oil would increase due to high demand in palm oil market. At the same time, The increase in demand for palm oil products contributes to an rise in palm oil prices. As stated by Bentivoglio, Finco, and Bucci (2018), the soybean oil price is the

most important variables in forecasting the spot price of palm oil based on its statistical result of 1% significance level on palm oil.

2.3.2 World Coconut Oil Price

The researchers concerned the effect of coconut oil prices on the price of palm oil after soybean oil. Similar to the soybean oil, its price is hightly influenced the price of palm oil since coconut oil also as the substitute of palm oil (Perera, 2013). Based on the previous studies, it is believes that there is a positive relationship between the coconut oil price and the crude palm oil price. Once the coconut oil price rises, the customer turns to the less costly vegetable oil such as palm oil. Hence, the production of palm oil would increase since the demand of palm oil is high in the market. Besides, the high demand for palm oil products also causing its price goes up. This study was done by Mohamad (2018) with grey incidence analysis, Balqis (2013); Kanchymalay et al. (2017: Talib and Darawi (2002); Amira (2015) and others.

2.3.3 World Crude Oil Price

As for the correlation between crude oil and palm oil prices, the researchers such as Hameed and Arshad (2009); Chuangchid et al. (2012); Mohamad (2018); Khalid et al. (2018); Kanchymalay et al. (2017). Daniel et al. (2012); Razak, Yahya, and Huridi (2011) and others has confirmed the relationship between this two commodity. It is believes that there is a positive correlation of crude oil price toward the price of palm

oil. By referring to Chuangchid et al. (2012), crude oil recently growing with environmental concerns and the price was quite higher in the commodity market, biodiesel has become an essential alternative crude oil fuel serves as the lifeblood of retail industries. Due to the reason of palm oil is the importance feedstock of biodiesel, the demand of palm oil would increase as the market of biodiesel expanded. Consequently, the high demand of palm oil causes an increase in the palm oil prices.

2.4 Empirical Evidence

There are numerous of studies proposed in analyzing the factors influencing the crude palm oil (CPO) prices in Malaysia and other countries. For example, this study was done by Talib and Darawi (2002) by choosing the palm oil yield, domestic consumption, exports and imports, natural rubber price, coconut oil price and also soybean oil price as the independent. In this study, ordinary least square (OLS), Durbin-h test, and Lagrange multiplier (LM) was conducted to test the annual cross price among the independent and dependent variables in the period 32 years (1968 to 1999). Generally, the study conclude that the selected independent variables are statistically acceptable towards the Malaysia's palm oil market. Besides, the researcher also identified that the other factors such as domestic consumption, exports and imports of palm oil was related to the oil palm area and yield of in Malaysia

The research regarding to the price volatility over the palm oil industry in Malaysia was also done by Ab Rahman et al. (2007) by using the daily data spanning

from January 2002 until December 2005. The Malaysian palm oil production, exports, stocks, and the price of palm oil substitutes such as soybean oil, rapeseed oil and sunflower oils was selected as the independent variables in the study. The method including Autoregressive conditional heteroskedasticity (ARCH), Generalized ARCH (GARCH and Vector Error Correction Model (VECM) was applied in order to achieve research objectives. The study has concludes that there is a positive relationship between the world crude oil price and soybean oil price. Besides, they also conclude that the bidirectional relationship exists between the crude palm oil price and soybean oil price.

In the research on palm oil boom in Southeast Asia, Sanders, Balagtas and Gruere (2012) indentify the price cointegration of the world crude palm oil price with the factors. In this paper, soybean oil and crude oil as the independents variables. Based on the empirical result by using Vector Autoregression (VAR) Model, Augmented Dickey-Fuller (ADF) test, and Ordinary least squares (OLS) model among the monthly data, the findings considered that the relationship between Malaysian palm oil, soybean oil and crude oil prices has co-integrated into the pattern. Besides, the study also concludes that the fluctuation in crude oil price does not significant in affecting the short-run production of palm oil and its price. However, it is significant in long-run. In contrast, the fluctuation in soybean oil price is significant in affecting the production of palm oil as well as its price in both short-run and long-run.

Besides, in the study of Chuangchid et al. (2012), the soybean oil price and crude oil price was selected to study the factors affecting palm oil price based on extremes value approach. The methodology such as bivariate extreme value and bivariate was

apply to examine the relationship among the variables. This study found that the rate of growth between the price of palm oil and the price of soybean oil is in extreme dependence. Besides, it also found that the dependence of growth rate between the palm oil price and crude oil price is relatively weak or can be considered as independence in extremes.

The research also done by Balqis (2013) by choosing other vegetables oil price as the independent variables which include soybean oil, coconut oil, sunflower oil, and olive oil. The data from year 2010 to 2012 in monthly basis was used. After testing for the Multicollinearity, Heteroskedasticity, Autocorrelation, Misspecifications, he concludes that the performance of palm oil price is greatly influenced by the prices of its substitutes which including all the variables selected in the study. There is a significant positive relationship between the soybean oil price, coconut oil price, sunflower oil price and olive oil price towards the crude palm oil price. Besides, there was a discount or premium difference between crude palm oil prices and their substitutes during the fluctuation of crude palm oil prices.

Some of the researcher analyze change rate as the major factor affect the commodity price such as Ashfahany & Priyatna (2015). They indentify the relationship between the world crude palm oil prices and the real exchange rate and the relationship of palm oil price between the two main palm oil producer and export countries (Malaysia and Indonesia). By applying the Augmented Dickey-Fuller (ADF) test and Error Correction Mechanism (ECM), they found that there is a significant negative relationship between the CPO price and the exchange rate of Indonesia and Malaysia in

short-term. This means that fluctuation of the Ringgit and Rupiah value would give impact to the price of palm oil in global market.

Furthermore, by using the system dynamics analysis, Mohammadi et al. (2015) analyze the determinants of palm oil price in Malaysia by using Root Mean Square Percent Error (RMSPE) and Theil's inequality test. The factors such as soybean oil price, world CPO price, biodiesel production, and Indonesia palm oil plantation was selected. This paper finds that there is a positive relationship between the price of palm oil and the price of soybean oil, where the rise in the price of soybean would drive the price of CPO if demand for CPO also increases. Besides, it found that there is a weak relationship between the price of palm oil and the production of biodiesel due to the reason of low production in biodiesel in Malaysia. Moreover, the palm oil production by Indonesia has give impact on world as well as Malaysian CPO price. The Malaysian CPO price has become depress when Indonesia increase in production and lower the world CPO price.

Moreover, Amira (2015) by choosing soybean oil, coconut oil, and sunflower oil as the independents variables. In her study, a diverse methodology was use to indentify the relationship between the variables which include Augmented Dickey-Fuller (ADF) test, Phillips-Peron (PP), Variance Inflation Test, Breusch - Godfrey LM Test, White Test, Multiple Linear Regression, Johansen Cointegration Test and Granger Causality Test. Based on empirical result, it found that the price of soybean oil, coconut oil and sunflower oil has a substantial relationship with the price of crude palm oil. Besides,

there is a unilateral relationship between the sunflower and coconut oil and bilateral relationship was not exist in the model.

According to the research by Kanchymalay et al. (2017), soybean oil price, coconut oil price, and crude oil price also selected in forecasting the Malaysia's CPO price using Multivariate Time Series. In this study, the method of multi-layer perception, support vector regression, and Holt Winter exponential smoothing techniques was used. The result shows that there is a significant positive correlation between the price of palm oil and crude oil. Besides, there is a high positive correlation between the palm oil price and soybean oil price in short run. Moreover, except for the price of olive oil, the price of coconut oil, rapeseed oil and sunflower oil also has a short-term relationship with palm oil.

Bentivoglio, Finco, and Bucci (2018) used the yearly data from year 1987 to 2017 in examine the factor affecting the palm oil price in Indonesia. The variables such as price of soybean oil, area harvested for palm oil production in Malaysia, and consumption of palm oil was selected to test the relationship between the Indonesia's palm oil price. By using the Dickey-Fuller (ADF) test, Johansen test, and Granger causality test, they found that all the independent variables are significant and positive related to the palm oil production capacity in Indonesia in long-run at 1 % level of confidence. Besides, the Indonesian palm oil production was highly affected by the palm oil production of Malaysia followed by world soybean oil price and palm oil consumption.

By using the analysis of the grey incidence, Mohamad (2018) describes the factors influencing the Malaysia's palm oil prices by selecting soybean oil price, crude oil prices, rapeseed oil prices, palm kernel oil price, and coconut oil prices as the exogenous variables. The result shows that there is a significant positive relationship between the price of coconut oil and palm kernel oil with the price of crude palm oil. However, the soybean oil price, rapeseed oil price and Brent crude oil price show a negative relationship toward the crude palm oil price of Malaysia. Besides, this study concludes that the kernel oil prices was the factor which give the huge impact to the price of palm oil, followed by coconut oil price, soybean oil price, rapeseed oil price and Brent crude oil price.

In addition, Khalid et al. (2018) was using econometric approach to forecasting the CPO price in Malaysia. Soybean oil price, stock of palm oil, and crude petroleum oil price was selected as the independent variables in the study. By testing the monthly data using Autoregressive Distributed Lag (ARDL), Autoregressive Integrated Moving Average (ARIMA), and Autoregressive Integrated Moving Average with exogenous inputs (ARIMAX), they find that the most significant variables that affect the CPO price are the crude petroleum oil and the stock of palm oil. The results also show that the spot price of palm oil is highly influenced by all of the selected variables.

Last but not least, a cointegration analysis of Thailand's crude palm oil price was done by Songsiengchai et al. (2018) by selecting the world soybean oil price and world crude oil price as the determinants. In this previous study, Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) unit root tests, Johansen cointegration test, error

correction model, and Granger causality test was used to test its relationship between the variables. The result indicated a considerable positive relationship between Malaysia's CPO price and Thailand's CPO. However, there is a significant negative relationship between the world CPO price and world crude oil prices, towards the CPO price of Thailand.

2.5 Concluding Remarks

Based on the literature review, there were numerous of studies had look into the impact of soybean oil price, coconut oil price, and crude oil price on crude palm oil (CPO) value in the trading market. These studies not only focus in Malaysia itself but also other palm oil production and exporting countries in global market. Overall, most of the has believe that the price of soybean oil, coconut oil, and crude oil are significant factor which would affect the price of crude palm oil in market based on their statistical evidence. Hence, a research design will be develop in next chapter to examine either the current study has the same result with the majority of past studies findings.

Table 2.5.1: Summary Table of Literature Review.

Author	Data	Methodology	Findings
Basri Abdul Talib & Zaimah Darawi. (2002)	Period: 1968 to 1999 (Yearly data) Country: Malaysia Source: Index Mundi • Ministry of Primary Industries, Malaysia • PORLA • PORIM • Malaysian Palm Oil Board (MPOB) • Oil World • International Monetary Fund (IMF) Variable: • Yield • Domestic consumption • Exports and Imports • Natural rubber price • Coconut oil price • Soybean oil price	• Ordinary least square (OLS) • Durbin-Watson (DW) • Durbin-h tests • Lagrange multiplier (LM)	• The study found that the selected independent variables are statistically acceptable towards the Malaysia's palm oil market. • Besides, the researcher also identified that the other factors such as domestic consumption, exports and imports of palm oil was related to the oil palm area and yield of in Malaysia.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Ayat K Ab Rahman, Faizah Mohd Shariff, Ramli Abdullah, & Nurul Hufaidah Sharif. (2007)	Period: January 2002 to December 2005 (Daily data) Country: Malaysia Source: • Malaysian Oil Palm Statistics by MPOB • Oil World Variable: • Production, • Exports • Stocks of palm oil • Price of Substitutes (prices of soyabean, rapeseed and sunflower oils)	• Autoregressive conditional heteroskedasticity (ARCH) • Generalized ARCH (GARCH) • Vector Error Correction Model (VECM).	• The study found that there is a bidirectional between the CPO price and soybean oil price. • There is a positive relationship between export of Malaysian palm oil and the domestic price of CPO. • Besides, the study has conclude that there is a positive relationship between the world CPO price and soybean oil price.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Daniel J. Sanders, Joseph V. Balagtas, Guillaume Gruere. (2012)	Period: January 1960 to February 2011 (Monthly data) Country: Malaysia Source: World Bank Variable: • Soybean oil • Crude oil	• Vector autoregression (VAR) model. • Augmented Dickey-Fuller (ADF) test • Ordinary least squares (OLS)	• There was a cointegrating relationship between the prices for palm oil, soybean oil, and crude oil in Malaysia. • The fluctuation in crude oil price does not significant in affecting the production of palm oil as well as its price in short –run. However, it is significant in long-run. • The fluctuation in soybean oil price is significant in affecting the production of palm oil as well as its price in both short-run and long-run.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Kantaporn Chuangchid, Aree Wiboonpongse, Songsak Sriboonchitta & Chukiat Chaiboonsri. (2012)	Period: July 1988 - January 2012 (daily data) Country: World Source: Ecowin Variable: • Soybean oil price • Crude oil prices	• Bivariate Extreme Value • Bivariate Block Maxima • Bivariate Block Maxima • Bivariate Threshold Exceedances	• This study found that the growth rate between the palm oil price and soybean oil prices has some dependence in extremes. • Besides, it found that the dependence of growth rate between the palm oil price and crude oil price is relatively weak or can be considered as independence in extremes.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Balqis Navilla Bt Zainal. (2013)	Period: 2010 to 2012 (Monthly data) Country: Malaysia Source: Index Mundi Variable: • Soybean Oil Price • Coconut Oil Price • Sunflower Oil Price • Olive Oil Price	• Multicollinearity • Heteroskedasticity • Autocorrelation • Misspecifications	• The performance of palm oil price is greatly influenced by the prices of its substitutes which including all the variables selected in the study, • There is a significant positive relationship between the soybean oil price, coconut oil price, sunflower oil price and olive oil price towards the crude palm oil price. • The discount or premium gap was exists between the price of crude palm oil and its substitutes during the fluctuation in crude palm oil price.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Afief El Ashfahany, & M. Fahmi Priyatna. (2015)	Period: 1983 to 2014 (Monthly data) Country: Indonesia and Malaysia Source: Federal Reserve Economic Data (FRED).and UNCTAD Variable: • Real exchange rate of Malaysia • Real exchange rate of Indonesia	• Augmented Dickey-Fuller (ADF) test • Error Correction Mechanism (ECM)	• The study found that there is a significant negative relationship between the CPO price and the exchange rate of Indonesia and Malaysia in short-term. • This means that fluctuation of the Ringgit and Rupiah value would give impact to the price of palm oil in global market.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Sahra Mohammadi, Fatimah Mohamed Arshad, Bilash Kanti Bala, & Abdulla Ibragimov. (2015)	Period: 1982 to 2012 (Yearly data) Country: Malaysia Source: Index Mundi Variable: • Soybean oil price • World CPO price • Biodiesel production • Indonesia palm oil plantation	• Root Mean Square Percent Error (RMSPE) • Theil's inequality test	• This paper found that there is a positive relation between the palm oil price and soybean oil price. • Besides, it found that there is a weak relationship between palm oil price and biodiesel production due to the reason of low production in biodiesel in Malaysia. • The palm oil production by Indonesia has give impact on world as well as Malaysian CPO price.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Siti Amira Sahira Roslan. (2015)	Period: January 2004 to December 2014 (Monthly data) Country: Malaysia Source: The Economics and Industry Development Division (EID) Variable: • Soybean Oil • Coconut Oil • Sunflower Oil	• Augmented Dickey-Fuller (ADF) test • Phillips-Peron (PP) • Variance Inflation Test • Breusch - Godfrey LM Test • White Test • Multiple Linear Regression • Johansen Cointegration Test • Granger Casaulity Test	• This study found there is a significant relationship between the price of soybean oil, coconut oil and sunflower oil with the price of crude palm oil. • The result show that there is a unilateral relationship between the sunflower and coconut oil and bilateral relationship was not exist in the model.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Kasturi Kanchymalay N. Salim, Anupong Sukprasert, Ramesh Krishnan, & Ummi Raba'ah Hashim. (2017)	Period: January 1987 to February 2017 (Monthly data) Country: Malaysia Source: Index Mundi Database Variable: • Soybean oil price • Sunflower oil price • Rapeseed oil price • Coconut oil price • Olive oil price • Peanut oil price • Crude oil price • Exchange rate	• Multi-layer Perception • Support Vector Regression • Holt Winter Exponential Smoothing Techniques	• There is a significant positive correlation between the price of palm oil and crude oil. • There is a high positive correlation between the palm oil price and soybean oil price in short run. • The price of coconut oil, rapeseed oil and sunflower oil also has short run relationship with palm oil price except the price of olive oil.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Deborah Bentivoglio, Adele Finco, & Giorgia Bucci. (2018)	Period: 1987 to 2017 (Annual data) Country: Indonesia Source: Index Mundi Database Variable: • Soybean oil price • Area harvested for palm oil production in Malaysia • Palm oil consumption	• Dickey-Fuller test (ADF) • Johansen test • Granger causality test	• This study found that the all the independent variables are significant and positive related to the palm oil production capacity in Indonesia in long-run at 1 % level of confidence. • The Indonesian palm oil production was highly affected by the palm oil production of Malaysia followed by world soybean oil price and palm oil consumption.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Norhayanti Mohamad. (2018)	Period: 25/10/2012 to 13/11/2013 (Daily data) Country: Malaysia Source: Index Mundi Database Variable: • Soybean oil price • Crude oil prices • Rapeseed oil prices • Palm kernel oil price • Coconut oil prices	• Grey Incidence Analysis • Grey Incidence degree	• There is a significant positive relationship between the price of coconut oil and palm kernel oil with the price of crude palm oil. • However, the soybean oil price, rapeseed oil price and Brent crude oil price show a negative relationship toward the crude palm oil price of Malaysia. • Kernel oil prices was the factor which give the huge impact to the price of palm oil, followed by coconut oil price, soybean oil price, rapeseed oil price and Brent crude oil price.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Norlin Khalid, Hakimah Nur Ahmad Hamidi, Sharmila Thinagar, & Nur Fakhzan Marwan. (2018)	Period: 2008 to 2017 (Monthly data) Country: Malaysia Source: Bloomberg Database Variable: • Soybean oil price • Stock of palm oil • Crude petroleum oil price	• Autoregressive Distributed Lag (ARDL) • Autoregressive Integrated Moving Average (ARIMA) • Autoregressive Integrated Moving Average with exogenous inputs (ARIMAX).	• The most significant variables that affect the crude palm oil price are the stock of palm oil and the crude petroleum oil. • The spot price of palm oil is highly influenced by stock of palm oil, crude petroleum oil price and soybean oil price.

Table 2.5.1: Summary Table of Literature Review (continue)

Author	Data	Methodology	Findings
Patchaya Songsiengchai, Shaufique F. Sidique, Marcel Djama, & W.N.W. Azman- Saini. (2018)	Period: 1996 to 2015 (Monthly data) Country: Thailand Source: • World Bank Database • Department of Internal Trade, Ministry of Commerce, Thailand Variable: • World soybean oil price • Malaysian CPO price • World crude oil price	• Augmented Dickey-Fuller (ADF) test • Phillips-Perron (PP) unit root tests • Johansen cointegration test • Error correction model • Granger causality test	• This study found that there is a significant positive relationship between the CPO price of Malaysia and the CPO of Thailand. • However, there is a significant negative relationship between the world CPO price and world crude oil prices, towards the CPO price of Thailand.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter mainly explore to the methods to be applied in order to achieve the research goals set in Chapter 1 of the research. This chapter was contained seven sections from 3.1 to 3.7. Typically, this Chapter will cover the research design, theoretical framework, hypothesis development, estimation methods, and data and sample of the study.

3.2 Research Design

To complete the research, the application of Eviews 9 was used to measure all the result in modeling testing. This software support researchers in wide range of task such as expose to econometric tools, models building and data estimation for measuring the outcome. In this study, the collected data for both dependent and independent variables would be diagnosed by using Eview 9 in unit root test and cointegration test. Besides, the data will be conduct to analyze the Vector Error Correction Model (VECM) and Normalized Equation. Moreover, the Granger Causality test will be use to identify the cause among the variables. Variance Decomposition and Impulse Response will be to describes the reaction of the system.

3.3 Theoretical Framework

There are numerous variables and factors which affect the price of crude palm oil in Malaysia. However, this study is focusing on 3 factors as explanatory variables, and their impact towards crude palm oil prices will. This framework of study will be constructing for future understanding. The dependent and independent was being developed and listed as below;

(a) Independent variable

i. World Soybean Oil Price

ii. World Coconut Oil Price

iii. World Crude Oil Price

(b) Dependent variable

i. Price of Crude Palm Oil (CPO)

Diagrammatically, the relational framework among the variable can be illustrated as below;

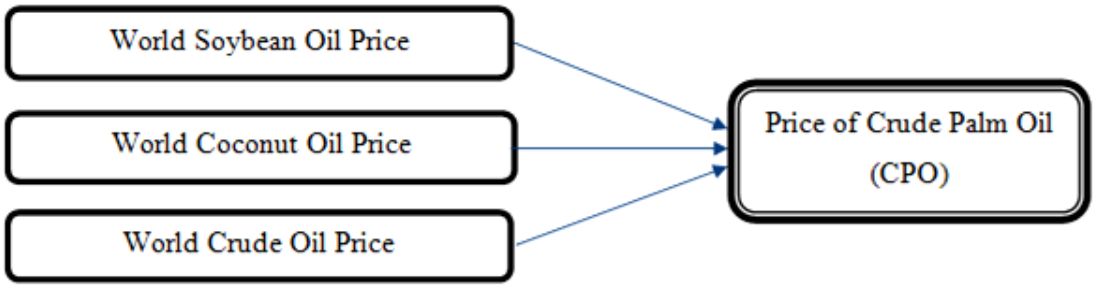

Figure 3.3.1: The Framework of Relationship among the Variables.

3.4 Hypothesis Development

There are three different null hypothesis (H_0) and alternative hypothesis (H_1) was constructed in this study to address the research question stated in Chapter 1. When the null hypothesis is rejected, there is a significant relationship exists between independent and dependent variable. However, There is no significant relationship exists between independent and dependent variable when the null hypothesis was not rejected. (Greener, 2008).

Generally, the hypothesis between the crude oil price (CPO) and soybean oil price, coconut oil price and crude oil price was developed as below;

Hypothesis 1: World Soybean Oil and Crude Palm Oil Price (CPO)

H_0 : There is no significant relationship between prices of soybean oil and price of CPO in Malaysia.

H_1 : There is a significant relationship between prices of soybean oil and price of CPO in Malaysia.

Hypothesis 2: World Coconut Oil and Crude Palm Oil Price (CPO)

H_0 : There is no significant relationship between prices of coconut oil and price of CPO in Malaysia.

H_1 : There is a significant relationship between price of coconut oil and price of CPO in Malaysia.

Hypothesis 3: World Crude Oil and Crude Palm Oil (CPO) Price

H_0 : There is no significant relationship between prices of crude oil and price of CPO in Malaysia.

H_1 : There is a significant relationship between price of crude oil and price of CPO in Malaysia

3.5 Estimation Models

The model for this study is expressed as below:

$$\boldsymbol{LGCPO_t = \beta_0 + \beta_t LGSBO_t + \beta_{2t} LGCCO_t + \beta_{3t} LGCOP_t + \varepsilon_t} \quad (3.1)$$

Where;

CPO = Logarithm of crude pail oil price in Malaysia

SBO = Logarithm of world soybean oil price

CCO = Logarithm of world coconut oil price

COP = Logarithm of world crude oil price

β_0 = Constant term

β_{xt} = Reaction coefficient

ε = Idiosyncratic error term

There are several scientific methodologies will be conducted in this study to testing the relationship between the variables in both long-run and short-run. By referring to the previous studies and the behavior of each scientific test, the unit root test

such as Augmented Dickey and Fuller (ADF) and Philip-Perron (PP) was used to identify the stationary of each series. Besides, Johansen and Juselius (1990) cointegration test was used to identify the long run relationship between the series. In testing the short run relationship among the variables, Granger causality based on a VECM framework was used. The other test such as variance decomposition and impulse response also selected in this analysis.

3.6 Methodology

3.6.1 Unit Root Test

3.6.1.1 Augmented Dickey-Fuller (ADF) Unit-Root Test

Augmented Dickey-Fuller test (ADF) is an upgraded version of the original Dickey-Fuller test for larger and more complex range of time series models. ADF test is introduced by David Dickey, Wayne Fuller and Said and Dickey (Unit Root Tests, n.d.). Generally, this test will be use to determine whether the variables are stationary or is it contains a unit root. Generally, the ADF test consists of three null hypotheses in difference form. Generally, the null hypothesis for LGCPO can be written as below;

$$\Delta LGCPO_t = \rho LGCPO_{t-1} + \Sigma_{t-1}^{m} \alpha_t \, \Delta LGCPO_{t-1} + \varepsilon_t \quad (3.2)$$

$$\Delta LGCPO_t = \beta_1 + \rho LGCPO_{t-1} + \Sigma_{t-1}^{m} \alpha_t \, \Delta LGCPO_{t-1} + \varepsilon_t \quad (3.3)$$

$$\Delta LGCPO_t = \beta_1 + \beta_{2t} + \rho LGCPO_{t-1} + \Sigma_{t-1}^{m} \alpha_t \, \Delta LGCPO_{t-1} + \varepsilon_t \quad (3.4)$$

Where β_1 denotes as intercept, β_2 represent the coefficients, t defined as times series trend, m as the lagged term number and ε_t represent the residual. The model with pure random is show as model (3.2), model (3.3) is the model with intercept and model (3.4) is the model in the form of intercept and trend. Besides, the hypotheses for the ADF unit roots test can be written as:

H_0 : δ = 0 (Unit root exist/ Shock will persist / Non-stationary)

H_1 : δ < 0 (Unit root does not exist/ Shock will die off / Stationary)

In ADF test, the variable's t-statistics were used to check its stationarity. When the t-value of variable is greater than ADF critical t-value, the null hypotheses will be rejected and indicated that the data is stationary. While the ADF critical t-value is larger than the t-value from the result, the null hypotheses will be fail to reject and indicate that the data is non-stationary. The significance of variables is based on the critical value at the significance level of 1%, 5% and 10%.

3.6.1.2 Phillip-Perron (PP) Test

$$x_t = \alpha_0 + \beta_{xt-1} + \mu_t \tag{3.5}$$

The equation of PP test can be expressed as above, where x_t denotes the times series of represented variables, μ_t represent innovation term, and *t* represent the number of observation. Besides, the hypothesis for PP test can be written as bellow;

$H_0 : \beta = 1$ (Unit root exist/ Shock will persist / Non-stationary)

$H_1 : \beta < 1$ (Unit root does not exist/ Shock will die off / Stationary)

Similarity with ADF test, PP test is a unit root test used to examine the null hypothesis in time series analysis where the stationary of series. The null hypothesis indicates there is non-stationary in the series where the variable is contains unit root or shock. In contrast, the alternatives hypothesis implies that the unit root was not exists in the series and the variable was considered as stationary. The significance of variables is based on the critical value at the significance level of 1%, 5% and 10%.

When the t-statistic from the result is greater than the critical value at level of 1%, 5% or 10%, the null hypothesis is rejected (significance) and it is indicate that the series is stationary (shock off). In contrast, When the t-statistic is less than critical value at level of 1%, 5% or 10%, the null hypothesis is failed to reject (insignificance) and it is mean that the variable is non-stationary (shock exist).

3.6.2 Johansen Cointegration Test

In time series analysis, cointegration test is used as a key property to indentify the long term equilibrium of the variables (Hjalmarsson and Osterholm, 2007). After the

variables are stationary in unit root where it is stationary after the first different I (1), the test is follow by Johansen Cointegration Test to indentify the connection of crude palm oil prices and the independent variables in long run. The regression of Johansen Cointegration can be expressed as below;

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k=1} + \mu + \theta D_t + \varepsilon_t \quad (3.7)$$

Where, $\Gamma_1 = -1 + \Pi_1 + \Pi_2 + \ldots + \Pi_i$ for $i = 1, 2, k-1$ and $\Pi = -1 + \Pi_1 + \Pi_2 \ldots + \Pi_i$ for i as an identify matrix. Besides, the Γ_1 is represent adjustment parameters in short term, Π consist of relationship of X variables in long-term equilibrium and break into the product of two n by r matrix α and β. Hence, $\Pi = \alpha\beta$. β is a matrix comprise r cointegration vectors whereas α represent as adjustment parameter of the speed.

Johansen test consist two types of test where are trace and max-Eigen and the inferences was different. The regression of trace test can be described as below;

$$T_{trace} = -T \Sigma_{i=r+1}^{N} \text{In} [(1 - \Gamma_i)]^2 \quad (3.8)$$

Where T denotes the number of observation, N represent the number of variables, and Γ_i is the largest estimated Eigen value. Generally, the hypotheses for trace can be written as;

$$H_0 : R = 0$$

$$H_1 : R \leq 0$$

The null hypothesis indicates that the model does not have a cointegration factor whereas the alternative hypothesis indicates that the model has a cointegration factor. When the calculated value is greater than the critical value, the null hypothesis is rejected, this indicates that the cointegration factor in the model. On the other side, the null hypothesis is fail to reject when the computed value is less than the critical value, and this indicates that there is no cointegration factor in the model.

Besides, the regression of max-Eigen test can be described as below;

$$T_{max} = -T \ln(1-\lambda_{r-1}) \tag{3.9}$$

Where T represent the number of observation and λ_{r-1} is the largest estimated Eigen value. The hypotheses for max-Eigen can be written as;

$$H_0 : r = r^* < k \text{ (no cointegrating vector)}$$

$$H_1 : r = r^*+1 \text{ (cointegratinf vector exist)}$$

The null hypothesis implies that the model has no cointegration factor in the long run while the alternative hypothesis suggests that the model has a long run cointegration factor. If the measured Eigen value exceeds the critical value, the null hypothesis is rejected, and the model has the long-run cointegration factor.. In contrast, when the calculated value of the Eigenvalue test is less than the critical value, the null hypothesis is not rejected, this means that the model does not have a long-run cointegration factor.

3.6.3 Vector Error Correction Model (VECM): Granger Causality Test

After the test of Johansen Cointergration, the VECM Granger Causality test is conducted in determining the short-run relationship and the direction among each variables. It can be used to measure the acceptability of one time series in predicting another time series. To avoid the problems of misspecification, the Vector Error Correction Model (VECM) was used in conducting the test (Clarke, 2006).

Generally, the null hypothesis is rejected (significant) when the p-value of variable is smaller than the significance level variables at 1%, 5%, 10% level. Hence, it can be conclude that the contingent palm oil price variable can be inferred by independent variables such as soybean oil, coconut oil and crude oil prices. In the other hand, the null hypothesis is failed to reject (insignificance) when the p-value of variable is smaller than the significance level variables at 1%, 5%, 10% level. Therefore, the causality link between the independent variable and dependent variables in the model did not exist. The null hypothesis and alternative hypothesis for the causality test was show in table in the following page;

Table 3.6.3.1: The Null and Alternatives Hypotheses of Granger Causality.

Null Hypothesis, H_0	Alternative Hypothesis, H_1
Dependent Variables =ΔLGCPO	
LGSBO does not Granger Cause LGCPO	LGSBO does Granger Cause LGCPO
LGCCO does not Granger Cause LGCPO	LGCCO does Granger Cause LGCPO
LGCOP does not Granger Cause LGCPO	LGCOP does Granger Cause LGCPO
Dependent Variables =ΔLGSBO	
LGCPO does not Granger Cause LGSBO	LGCPO does Granger Cause LGSBO
LGCCO does not Granger Cause LGSBO	LGCCO does Granger Cause LGSBO
LGCOP does not Granger Cause LGSBO	LGCOP does Granger Cause LGSBO
Dependent Variables =ΔLGCCO	
LGCPO does not Granger Cause LGCCO	LGCPO does Granger Cause LGCCO
LGSBO does not Granger Cause LGCCO	LGSBO does Granger Cause LGCCO
LGCOP does not Granger Cause LGCCO	LGCOP does Granger Cause LGCCO
Dependent Variables =ΔLGCOP	
LGCPO does not Granger Cause LGCOP	LGCPO does Granger Cause LGCOP
LGSBO does not Granger Cause LGCOP	LGSBO does Granger Cause LGCOP
LGCCO does not Granger Cause LGCOP	LGCCO does Granger Cause LGCOP

3.6.4 Variance Decomposition

The statistical method of variance decomposition is a classical multivariate analysis in a wide set of variables for uncovering simplifying structures. In the study of time series analysis, the variance decomposition was uapplied to characterize the vector autoregression (VAR) model when equipped as a forecast error variance decomposition (FEVD). It implies the amount of knowledge contributing to other variables in an autoregression for each variable. Besides, this method also used to

estimates the number of the forecast error variances for the variables in a regression which can be explained by exogenous shocks to the other variables (Lutkepohl, 2010).

3.6.5 Impulse Response Function (IMFs)

In addition, the impulse response or same as called impulse response function (IRFs) is conducted to illustrate the beyond-sample dynamic relationship and aim to show the response of a variable towards the shock itself or the other variables in the system over time. It is a signal processing of a dynamic system when it was presented with a brief of input signal or "impulse" (Lutkepohl, 2010). The impulse response analysis in this study was carried out for a 50 years horizon.

Generally, impulses that treated as exogenous in this study are world soybean oil price, world coconut oil price, and world crude oil price. This impulse response would be response to any dynamic system and also external change in other variables. The impulse response determines the reaction of a invariant system liner time for all frequencies due to the impulse function includes all the frequencies (Lutkepohl, 2010).

3.7 Data and Sample

This study focused on Malaysia's palm oil price by study its determinants using the key sources of a quantitative data, where the data can be measured, verified and finalized in statistics (Goertzen, 2017). The data for dependent as well as independent variables was obtained from the Index Mundi,

https://databank.worldbank.org/source/world-development-indicators. The data for each variable was collected in monthly basis from January 1999 to December 2018 (20 years) due to the data accessibility for each variable from the main source. Indeed, the data for the palm oil price, world soybean oil price, and world coconut oil price are estimate in unit of Malaysian Ringgit per Metric Ton whereas the world crude oil price is estimate at Malaysian Ringgit per barrel.

In regression models, the instability and structural change of each parameter need to be analyzed because of the data is in the time series form. Hence, the analysis software of Eviews 9 will be use to process the data in this research.

3.8 Concluding Remarks

As conclusion, this chapter outlined the research design, theoretical framework, hypothesis and methods, and the characteristic of the data of this study. The scientific test that would used to examine the data was explain clearly based on the research objectives which included ADF unit-root test, PP test, Johansen Cointegration test, VECM causality test, variance decomposition and its impulse response. The results from each test will be presented and discussed in the next chapter.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

This chapter mainly discussed and analysis on the results of econometric tests that had discussed in previous chapter. The data which has been collected was being tested by using the analysis software of Eviews 9 in ADF unit-root test, PP test, Johansen Cointegration test, VECM causality test, variance decomposition and its impulse response. Meanwhile, the summary result of Eview was being discussed and interpreting by following.

4.2 Unit Root Test

4.2.1 Augmented Dickey-Fuller (ADF) Unit-Root Test

Table 4.2.1.1: The Result of Augmented Dickey-Fuller (ADF) Unit Root Test.

Variables	ADF	
	Level	1^{st} difference
LGCPO	-2.489867	-10.7815
	(0.3330)	(0.0000)***
LGSBO	-2.368350	-11.25287
	(0.3953)	(0.0000)***
LGCCO	-3.427649	-11.64928
	(0.0502)*	(0.0000)***
LGCOP	-2.489867	-12.04730

	(0.3330)	(0.0000)***

Notes: ***, ** and * denotes rejection at 1%, 5% and 10% significance level.

From the table above, the null hypothesis of the four variables which are crude palm oil price, soy bean oil price, coconut oil price, and crude oil price cannot be rejected at 1%, 5% and 10% of significance level since the probability is greater than 0.01, 0.05 and 0.1, so they are-non stationary at level. After the first difference of ADF conducting, all of the variables become stationary. Both of the variables was rejected at the significance level of 1% since each probability is less than 0.01.

4.2.2 Phillip-Perron (PP) Test

Table 4.2.2.1: The Result of Phillip-Perron (PP) Unit Root Test.

Variables	PP	
	Level	1st difference
LGCPO	-2.5871	-11.0576***
	(0.2867)	(0.0000)
LGSBO	-2.13437	-11.2038***
	(0.5236)	(0.0000)
LGCCO	-3.059112	-12.1705***
	(0.1187)	(0.0000)
LGCOP	-1.96194	-11.8031***
	(0.6186)	(0.0000)

Notes: ***, ** and * denotes rejection at 1%, 5% and 10% significance level.

Same as the Augmented Dickey-Fuller (ADF) test, the table above show the null hypothesis of the four variables which are crude palm oil price, soy bean oil price, coconut oil price, and crude oil price are-non stationary at level. The null hypothesis cannot be rejected at 1%, 5% and 10% of significance level since the probability is greater than 0.01, 0.05 and 0.1. After the first difference of ADF conducting, all of the variables become stationary. Both of the variables was rejected at the significance level of 1% since each probability is less than 0.01.

4.3 Johansen Cointegration Test

After the ADF and PP unit root testing, the independent variables are stationary in the first difference which implies that they are integrated of order one and also called I(1) series. Therefore, a cointegration test is necessary to perform for testing a long run relationship exist between the crude palm oil price (CPO) and the factors such as soybean oil price (SBO), coconut oil price (CCO) and crude oil price (COP). If the model has a long-term relationship, it is given the fact that the series drift apart or move either upward or downward. In this case, a Johansen cointegration test is applied as a prominent cointegration tests for the series.

Table 4.3.1: The Results of Unrestricted Cointegration Rank Test in Trace and Maximum Eigenvalue.

k = 1, r = 1

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None*	0.1659	69.5009	47.8561	0.0001**
At most 1	0.0634	26.3410	29.7971	0.1188
At most 2	0.0286	10.7482	15.4947	0.2275
At most 3	0.0160	3.8412	3.84147	0.0500**
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.
None*	0.1659	43.1600	27.5843	0.0002**
At most 1	0.0634	15.5928	21.1316	0.2495
At most 2	0.0286	6.9070	14.2646	0.5002
At most 3	0.0160	3.8412	3.84147	0.0500**

Notes: Asterisks (**) denote statistically significant at 5% significance level. The k is the lag length and r is the cointegrating vector(s). Chosen r is the number of cointegrating vectors that are significant under both tests.

Based on the result above, there are similarity between trace test and Max-Eigen statistics. Rejecting the null hypothesis (r = 0) at a significant level of 5 percent in both tests can be concluded that this model contains only one cointegrating vector, which means that there is a long-term relationship between the variables. Besides, both trace test and Max-Eigen statistic indicates that there is two cointegrating equation at the 5% of significance level. The decision criteria is to reject the null hypothesis if the p-value of Trace and Max-Eigen statistics is greater than 5 % significant level, otherwise the null hypothesis will not be rejected.

4.4 Vector Error Correction Model (VECM): Normalized Equation

Table 4.4.1: The Result Vector Error Correction Estimates.

Cointergrating Equation	CointEq1
LGCPO(-1)	1.0000
LGSBO(-1)	-1.1345
	(-11.1418)
LGCCO(-1)	-0.0542
	(-2.0479)
LGCOP(-1)	-0.1184
	(-2.0900)
c	1.0586

Based on the table above, the equation of log export can be express as below:

$$LGCPO = -1.0586 + \underset{(-11.1418)}{1.1345}\, LGSBO + \underset{(-2.0479)}{0.0542}\, LGCCO + \underset{(-2.0900)}{0.1184}\, LGCOP + \varepsilon \qquad (4.1)$$

From the equation above, the independent variables such as soybean oil price, coconut oil price, and crude oil price are significant in this study. The null hypothesis can be rejected because the t-statistics value are exceed the critical value of 1.96 at 5% significant level. As the price of soybean oil, coconut oil, and crude oil raises up 1 percent, the price of crude palm oil would increase by 1.1345, 0.0542 and 0.1184 respectively. The result indicated that the soybean oil price, coconut oil price, and crude oil price have positive relationship to the coconut oil price. This result supports the

findings of studies such as Mohamad (2018); Balqis (2013); Kanchymalay et al. (2017); Talib and Darawi (2002) and Amira (2015); Prasetyo, Marwanti, and Darsono (2017); Balqis (2013); Mohammadi et al. (2015); Chuangchid (2012) and others which indicated that coconut oil price, soybean oil price, and crude oil price positively affecting the crude oil price.

4.5 Vector Error Correction Model (VECM): Granger Causality Test

The Johansen cointegration tests indicates that there is an existence of one cointegrating vectors among the five variables which are LGCPO, LGSBO, LGCCO, and LGCOP in this study. Therefore, the VECM granger causality test was used to indentify the direction of causality effect among the variables. The probability value of the dependent variables of VECM represent the short run casual effect, whilst the coefficient and t-statistics in error correction term (ECT) refers to a stable long-run relationship and speed of adjustment towards long run equilibrium. The ECT that posses three condition which is less than 1, negative value, and statistically significant in this study is -0.1921. This indicates that the speed of adjustment is 19.21%.and it will take around 5.2 years to the long run equilibrium to be adjust. Meanwhile, the summary result of Granger causality with ECT based on VECM was presented in the table of next page.

Table 4.5.1: The Summary Result of VEC Granger Causality.

Dependent Variables	χ^2-statistic (*p* value)				ECT	
	ΔLGCPO	ΔLGSBO	ΔLGCCO	ΔLGCOP	Coefficient	T-Statistic
LGCPO	-	3.3975 (0.6389)	3.3906 (0.6400)	13.8500 (0.0248)**	-0.0394	-0.5529
LGSBO	4.4760 (0.4831)	-	0.7457 (0.9804)	6.9584 (0.2238)	0.1285	2.2696
LGCCO	2.1967 (0.8213)	4.0798 (0.5380)	-	9.7887 (0.0814)*	-0.9501	-0.1101
LGCOP	15.0411 (0.0102)**	4.6762 (0.4567)	3.0233 (0.6964)	-	-0.1921	-2.0933

Notes: The χ^2-statistics test the joint significant of the lagged values of the independent variables and the significance of the error correction terms(s). Δ is the first different operator. Asterisks (**) and (*) denote the rejection of the hypothesis at the 5% and 1% of significance level.

The decision rule is the null hypothesis can be rejected if the probability is smaller than the critical value at 1% and 5% of significance level, which mean that there is a granger causality relationship. Meanwhile, the result above suggesting that there are three causalities exists among the variables. The null hypothesis of LGCOP was rejected at 5% and 1% of significance level when LGCPO and LGCCO as the dependent variable respectively. Besides, the null hypothesis of LGCPO was rejected at 5% significance level when LGCOP as the dependent variable.

Diagrammatically, the Granger causality result of LGCPO, LGSBO, LGCCO, and LGCOP can be illustrated as the figure.

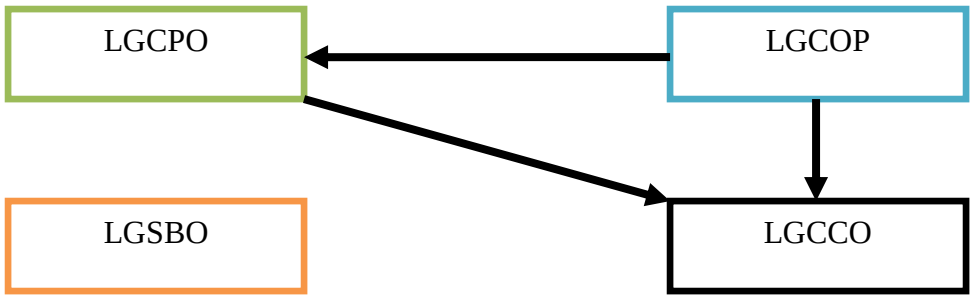

Figure 4.5.1: The Granger Causality Result of LGCPO, LGSBO, LGCCO and LGCOP.

The figure above show there are only three unidirectional or one way of granger causality from LGCOP to LGCPO, LGCOP to LGCCO and also LGCPO to LGCCO, whilst the other variables do not have the granger causality between each other.

4.6 Variance Decomposition

Table 4.6.1: The Result of Forecast Error Variance Decompositions for 50 Years.

Horizon	Due to Innovation in:			
Years	ΔLGCPO	ΔLGSBO	ΔLGCCO	ΔLCOP
	Quarterly Relative Variance in ΔLGCPO			
1	**100.0000**	0.000000	0.000000	0.000000
4	**97.35209**	0.942652	0.890881	0.814382
8	**96.27045**	1.641773	1.007296	1.080481
12	**95.93486**	1.971179	0.950702	1.143264

20	**95.72061**	2.307729	0.822232	1.149425
30	**95.67172**	2.500941	0.721297	1.106046
40	**95.67109**	2.593037	0.670765	1.065110
50	**95.67551**	2.639195	0.647443	1.037849
Quarterly Relative Variance in ΔLGSBO				
1	57.41241	**42.58759**	0.000000	0.000000
4	66.81890	**33.04996**	0.033999	0.097142
8	77.78734	**22.00294**	0.024127	0.185591
12	82.95117	**16.79539**	0.018469	0.234968
20	86.97476	**12.75864**	0.013076	0.253521
30	88.61897	**11.12606**	0.017025	0.237946
40	89.23531	**10.51566**	0.026031	0.223000
50	89.50044	**10.25030**	0.034975	0.214282
Quarterly Relative Variance in ΔLGCCO				
1	40.99809	0.193833	**58.80808**	0.000000
4	52.49429	0.166516	**46.21523**	1.123970
8	60.50126	0.176358	**36.75787**	2.564507
12	65.05360	0.246433	**31.09600**	3.603972
20	69.81608	0.469773	**24.95630**	4.757850
30	72.61314	0.726645	**21.41453**	5.245688
40	74.02922	0.894692	**19.75245**	5.323642
50	74.78597	0.992005	**18.93322**	5.288803
Quarterly Relative Variance in ΔLGCOP				
1	3.011114	0.013312	0.018365	**96.95721**
4	21.80053	0.273620	0.079262	**77.84659**
8	37.37051	0.176750	0.093695	**62.35905**
12	47.15887	0.170483	0.139834	**52.53082**
20	58.19653	0.396076	0.241684	**41.16571**
30	64.26749	0.728897	0.336014	**34.66760**

40	66.86376	0.947723	0.392728	**31.79579**
50	68.04623	1.068651	0.424906	**30.46022**

Note: the column in bold represent the impact of their own shock.

Through the VECM Granger Causality result, it is not possible to determine the relative strength of the degree of exogeneity among the variables. Hence, the variance decomposition technique is applied to distinguish the relative endogeneity or exogeneity of the variables. The variable which mostly explained by its own shock is considered as the exogeneous variable, whilst the variable which least explained by its own stock can be considered as the endogenous variable. The result of forecast error variance decompositions of the variables for 50 years is shown in the table above. It implies that LGSBO is the most endogenous variable with 10.25% of the variation explained by its own shocks. The most exogenous variable observed is LGCPO which 95.68% of the variation is explained by its own shocks.

The result indicates that when LGCPO is shocked, almost 4.32% of the forecast error variance is explained by LGSBO (2.64%), LGCCO (0.65%), and LGCOP (1.03%) at the end of 50years. When LGEXP is shocked, the impact towards itself is down trend, while the affects towards LGSBO is uptrend. LGCCO and LGCOP show an uptrend in the first 30 year and decline until the estimation years of 50.

When LGSBO is shocked, the result suggesting that there is 89.75% of the forecast error variance is explained by LGCPO (89.50%), LGCCO (0.04%), and LGCOP (0.21%) at the end of 50 years. The impact towards itself is downtrend from

42.59% in year 1 to 10.25% in year 50. While LGCPO show uptrend, LGCCO and LGCPO show an unstable trend in the estimation year of 50.

Besides, there is about 81.07% of the forecast error variable is explained by LGCPO (74.79%), LGSBO (0.99%), and LGCOP (5.29%) when the LGCCO is shocked. The impact towards itself is downtrend from 58.8% in year 1 decrease to 18.93% in year 50. However, the impact toward other variables such as LGCPO and LGSBO show an uptrend during the period of years. The variable of LGCOP show an uptrend from 0% in year 1 to 5.32% in year 40 but a little bit decrease in the end of 50 years to 5.29%.

When the shocked happen in the last variable LGCOP, the results show that there is 69.54% of the forecast error variable explained by LGCPO (68.05%), LGSBO (1.07%), and LGCCO (0.42%) while 30.46% is the impact of their own shock. Same as the previous variable, the impact towards itself is downtrend in this 50 years from 96.96% in year 1 decrease to 30.46% in year 50. Besides, the results show an uptrend impact toward LGCPO, LGSBO, and LGCCO.

4.7 Impulse Response Function (IMFs)

The analysis of the Impulse Response Function (IMFs) is carried out to illustrate the dynamic relationship beyond sample and aim to show the response of a variable towards the shock itself or the other variables in the system over time (Lutkepohl, 2010).

Meanwhile, the result of IMFs for a 50 years horizon from Eviews was attached in Appendix Figure 1.

Based on the analysis shown in Appendix Figure 1, it suggesting that the response of crude palm oil price towards its own shock and the shock in world soybean oil price, world coconut oil price are positive, whilst the responses towards world crude oil price is negative. Next, in the response of world soybean oil price, the result shows that the response towards its own shock and crude palm oil price are positive. Meanwhile, the response of world soybean oil price towards world coconut oil price and world crude oil price is negative. However, the shock of world coconut oil price and world crude oil price was rise a bit and become positive after 20 years. In the response of world coconut oil price, the result shows that there are positive trend towards its own shock, crude palm oil price and world soybean oil price, but only world crude oil price get a negative trend in the expected 50 years. Last but not least, the result shows that the response of world crude oil price towards its own shock and crude palm oil price are positive for a 50 years horizon. In the other hand, the response of crude oil price towards world soybean oil price and world coconut oil price shows negative impact. However, the world soybean oil price increase and become positive after 8 years

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CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Summary of the Study

This study established a simple theoretical model for investigating the factors affecting the Malaysia's crude palm oil (CPO) prices. As palm oil plays an important role in supporting the economy of Malaysia, this study is crucial in policy making for industry of palm oil. Factors such as the world soybean oil price, world coconut oil price and the world crude oil price were selected to identify the relation with the prices of crude palm oil.

The study found that there is one cointegrating vectors in the model and this indicates that the long run relationship exist between the variables in the model. Each variables play significant role in causing the behavior of each other. The direction of causal effect among the variables was investigated by using the VECM Granger Causality test. The analysis found that LGCOP Granger Cause LGCPO, LGCOP Granger Cause LGCCO and also LGCPO Granger Cause LGCCO. The stimulation results indicate that crude palm oil price was significantly influence by other competing oil including soybean oil and coconut oil. Besides, palm oil demand can be related to increasing in biodiesel production. Hence, crude oil or petroleum was significant since biodiesel use as substitute of crude oil. The price of coconut oil, soybean oil, and crude oil is found that positively affecting the crude oil price. Particularly, the increase in the price of coconut oil, soybean oil, and crude oil significantly causing the demand of

crude palm oil expand. High demand in crude palm oil leads to the increase on its price which with means to the theory of demand.

5.2 Policy Implications

The palm oil global production, trade, and its market share have grown from 1996 to 2017 (Bentivoglio et al., 2018). As second largest producer and exporter of palm oil in the world, Malaysia export in average 85% of palm oil production and relies greatly to the palm oil export market. Concurrently, the ability of palm oil to compete with the other substitute oils and other producers has becomes an issue to policy makers mainly in the views of enhancing total export and Government revenues to support the National Development Policy.

The price of palm oil is highly versatile due to its many applications such as become cooking oil blends, as feedstock or process as other product. To ensure the ability and competitiveness of Malaysia palm oil in the global market, there is much investment and other positive actions have been taken by the Government to promote the industry. This includes encouraging the participation of smallholders in cultivating oil palms, combining the favourable endowment and other supportive government policies which helped growing in palm oil and palm oil products demand in the international market (Pletcher 1991).

Based on the empirical result from this study, the policy implications and recommendations are discusses as below:

5.2.1 Palm Oil Certification

Market regulation across the palm oil industry was always controlled by the government to assure the palm oil sustainable in the market. Starting from year 2020, the Ministry was confirmed that the Malaysian Sustainable Palm Oil (MSPO) standard or certification has become mandatory in every palm oil industry to improve their standards of management as well as production. Besides, it helped the smallholders in access to existing and new markets. The mandatory timeline was given where the plantation industries with the RSPO certification is by 31 Dec 2018 and those without RSPO certification is by 30 June 2019 while the smallholders is by 31 Dec 2019 (Controlunion Certification, n.d.). In this certification program, the government helps the industries which facing the difficulties in meeting the various certification requirement especially the smallholders. The government has contributes near RM 135 per hectare to audit the costs in helping the palm oil holders when applying for certification (Food and Agriculture Organization of the United Nation, 2019).

5.2.2 Ban Anti-Palm Oil Labels

The initiative to ban anti-palm oil labels was taken to protect the competitiveness and reputation of palm oil in international stage. This initiative includes to neutralize the imported food product from overseas which carrying “palm oil free” labels and sell in

domestic market. The negative labels, phrases or symbols against palm oil where displayed on the imported products was prohibited since these negative perception impressing palm oil-based products. For example, a peanut butter product was labeled "palm oil-free" even though palm oil is not an essential ingredient in peanut butter (Tong, 2019). Indeed, it is a marketing gimmick targeted to the European market to paint a negative picture on palm oil and not supported from accurate scientific facts. Meanwhile, Indonesia, the world's biggest palm oil producer, also applying this regulation to protect its palm oil industry where to banned the food carrying label "palm oil-free" (Yusof & Daim, 2019). Besides, The Ministry of Primary Industries of Malaysia was advised palm oil companies to be participating in the Pro-Palm Oil Campaign by adding “pro-palm oil” label on product packages besides of distributing in controlled prices. This initiative aimed to increase the consumer awareness on the palm oil perceived benefit (Food and Agriculture Organization of the United Nation, 2019).

In my opinion, the government should strengthen the regulation of banning any items carried ‘palm-oil-free’ label where believes would bring negative perception on palm oil. This includes to ensure the Malaysian supermarket chain comply with this regulation and not selling those product carried ‘palm-oil-free’ label. Penalties such as fines should given to the supermarket if violate on this regulation.

5.2.3 Export Policy

Malaysia stepped up its effort to in enhancing the palm oil export in the national market by penetrate new markets and maintained old markets such as China, India, Turkey, Pakistan and others. According to The Edge Markets (2019), the government Africa, Central Asia and South Asia was set as new potential import market for Malaysia palm oil. These include the market in Egypt, Morocco, Tunisia, Libya, Benin, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Sri Lanka. According to the Malaysian Palm oil Board, the export duty of crude palm oil is variable based on its price range and normally between 3% to 8%. In some period, the government reduced the export tax to zero (tax-free) on crude palm oil to help boosting export such as during April and May 2019. Besides, the long term contract was created where giving the credit facility to the palm oil importing countries under the scheme of Palm Oil Credit and Payment Arrangement (Pocpa). This policy extend the credit term of the importers and mainly to protect the Malaysia palm oil in oil and fat market (Mohammad, Fatimah, & Abdul, 1992).

In my opinion, the long term export strategy should be used to protect the market shares of the palm oil in oil and fat market. For example, the government should lower the crude palm oil export duties especially during the economy downturn. Free-trade export in crude palm oil also should impose to enhance the import.

5.2.4 Environment Policy

In Malaysia, the palm oil sector is heavily regulated under up to 15 laws and regulations where regarding to the social and environmental aspects. Based to Malaysia Palm Oil Council (MPOC), the palm oil industries should adhered the laws and regulations including the Land Acquisition Act 1960, Environmental Quality Act 1974, Environmental Quality 1978 or Clean Air Regulations, Pesticides Act 1974 or Pesticides Registration Rules, Occupational Safety and Health Act 1977, and Protection of Wildlife Act 1972. Other than that, the industry also entitled to the requirements by Hazard & Critical Control Points (HACCP) and the Environmental Impact Assessment (EIA). Besides, the palm oil industry shall concern and aware on the current environmental issues by actively pursuing ISO 14000 standard series discussions and formulations especially on climate change, life cycle analysis (LCA), ecolabeling & design for the Environment, environmental communications, and environmental management system (EMS). Additionally, the government was also working on new initiatives to promote forest restoration activities under the environment policy.

In my opinion, the government should make sure the industry comply with the law and regulation and applying good agricultural practices to reduce the environmental issues on palm oil.

5.2.5 Sector Support

Due to the sector of palm oil was important in driving the Malaysian economy, it is highly supported by the government to ensure the sustainability in term of subsidiary and soft loan. As stated by the Food and Agriculture Organization of the United Nation (2019), Malaysia government was reported in provide cash injection RM 6.23 billion to state-own oil palm agency, Federal Land Development Authority (FELDA) to help in its financial troubles. This subsidiary mainly used for write off debt interest for FELDA's small settler and enhance the agricultural development technology. Besides, in the national budget 2020, The Government has proposed an RM550 million RM palm oil replant loan fund for the oil palm sector to increase productivity and marketability. Under this loan, the fund will be extended to collateral-free palm oil smallholders at a rate of 2 per cent per annum with a 12-year tenure. Additionally, total RM27 million was alloacated to support the efforts of the Malaysian Palm Oil Board (MPOB) in the international palm oil market and to combat anti-palm oil campaigns (Tan, 2020). Indeed, the sector support was important to facilitate the investment in the research and development of oil palm.

In my opinion, the government should strongly support the palm oil sector in terms of investment or cash injection. Investment for research and development (R&D) and technology is a key component in achieving responsible of palm oil production by improving the plantation yield. For example, to improve the quality of seedling to become more disease resistance and can harvest more palm oil to relieving the pressure on forest deforestation with using less land.

5.2.6 B20 Biodiesel

Recently, the government plans to step up the use of palm oil in biodiesel through B20 biodiesel. According to The Malaysian Palm Oil Board (MPOB), palm oil can be use as palm-oil based feedstock for aviation bioduel where approved by the International Civil Aviation Organization (ICAO). B20 biodiesel was expected to be implemented by the end of year 2020 to help in increase the demand of Malaysian palm oil. However, the government was delayed the plans for nationwide rollout of B20 biodiesel due to the outbreak of Covid-19 around the world (Biofuels International, 2020). In point of fact, this policy has become a good initiative in ensuring the sustainability and the shares of palm oil in the oil and fat market.

In my opinion, palm oil has an advantage to be used in biodiesel production and has a potential to attract more consumers in the future. Therefore, the government and policy makers should may use this information in order to enhance the growth of palm oil industry in the future.

To summarizes, the government should maintain and strengthen the policies which listed above. Furthermore, the industry should concern and review the price of competing oil for pricing strategy. For example, the price of soy bean oil and coconut oil in the national trade. Moreover, the industry should aggressive in marketing and promotion campaign in new potential and current markets to enhance the boosting the demand on palm oil. Besides, the industry should comply with the law and regulation by applying good agricultural practices to ensure the sustainability of palm oil. Indeed, the

industry should consider good harvesting and processing methods mainly for environmental concerns.

5.3 Suggestion for Further Research

The price of crude palm oil (CPO) of Malaysia is fluctuates where influences by not only its substitute oil but also the competitor supplying the same oil and other economic components such as exchange rate (Nambiappan et al., 2018). Therefore, the suggestion for future study is to include more determinants such as the Indonesia and Thailand palm oil price, exchange rate and others to testing the relationship among each determinant. Other than that, it is reco mmended that the further study on the pandemic of Covid-19 towards the palm oil trade.

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APPENDIX

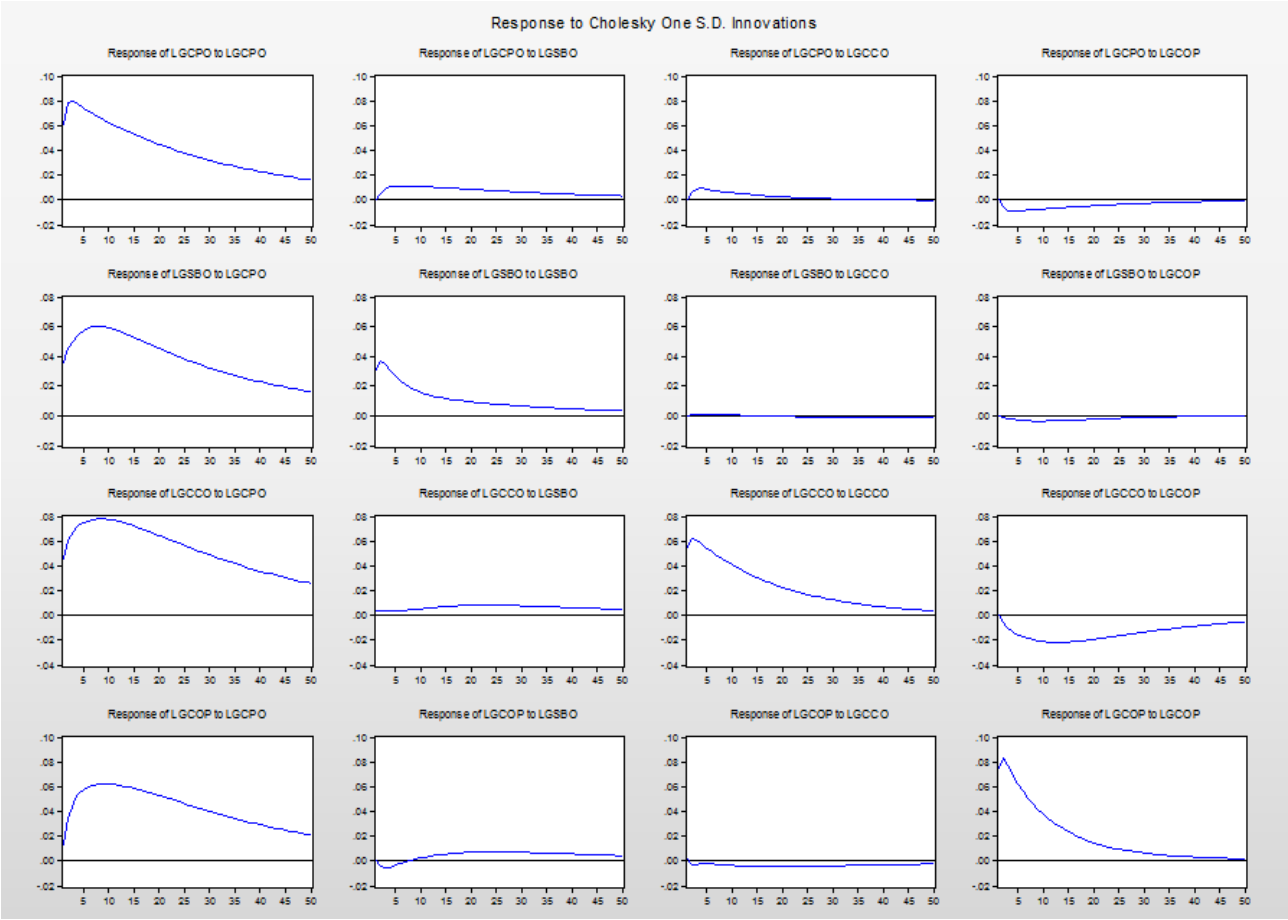

Figure 1: The Result of Impulse Response Function (IMFs) in 50 years.