The relationship between petroleum and crude palm oil economics essay

Economics

CHAPTER 1

INTRODUCTION

1. 0 Introduction

An investigation on relationship between petroleum and crude palm oil prices in Malaysia is the title of this study. This study applies the econometric methods such as unit root test, co-integration test and causality to investigate the relationship of these two primary commodities. Nowadays, the high petroleum price brings a big challenge for global economy and the energy consumption is very important for a country’s development and competitive. The fluctuation of petroleum price can bring the direct and indirect impact on growing or developing of global economy. The changing of the petroleum prices tracked closely by global investors because the rising of petroleum price is not good news for global economy. The resource of petroleum has a limited supply in the world, the trend and current situation can be said that this valuable natural resource will completely depleted soon. Therefore the limited supply of petroleum and high demand causes the petroleum price keep high and higher. Since the petroleum price keeps rising, people try to find alternative resources to replace this high price energy commodity. So, the crude palm oil became a most popular alternative resource for petroleum. Malaysia is a country which has producing petroleum and also importer and exporter of petroleum in global market. The business industry of petroleum in Malaysia especially oil refinery industrial need a large amount of petroleum to produce or refine different products such as diesel fuel, gasoline, and petroleum gas. Hence the movement of petroleum affects the economy performance of Malaysia.

Nevertheless, Malaysia also is a main crude palm oil distributor in the world. So, the relationship between petroleum and crude palm oil is related to Malaysia’s economy performance.

1. 1 Background of the Study

Petroleum is a primary and most basic energy commodity required by whole world. Petroleum also can be known as crude oil, it plays an important role in the global economic. Since the energy crisis in 1970s, the shortage of petroleum affected the major industrial countries in the world. The world demand for petroleum is high and the major suppliers disrupt the supply, hence the price of petroleum keeps rising and brings to a new level. Hence, people try to find alternative resources to replace this high price energy commodity. Since palm oil was introduced in Malaysia, the usage of palm oil is widely such as lubricant, bio-fuel, food and non food material, therefore palm oil become a popular commercial plantation. Since 1980, Bursa Malaysia become the largest crude palm oil future trading center, the crude palm oil become an important factor for Malaysia’s economy. Nevertheless, the crude palm oil become the alternative for petroleum because it is cheaper and can be refines to different product such as bio-diesel. So, crude palm oil price can be considered to become future direction of world economy. In the recent year, the palm oil commonly use to manufacture different product especially bio-diesel. Thus, the demand of crude palm oil increase rapidly hence causes the pricing keep rising. Hence, the relationship of petroleum and crude palm oil can affected the economy performance of Malaysia.

1. 2 Research Problem

The previous researches are not much deeply investigating the relationship between prices of petroleum and crude palm oil. By the way, the crude palm oil became the best alternative of petroleum, hence the price dynamic of both commodities track closely by global investors, farmers, and governments. Thus, there is a highly correlation relationship between petroleum and crude palm oil. As a result, " What are the effects of petroleum prices on crude palm oil prices?" became the problem statement of this study.

1. 3 Research Objective

The objective of this study is to investigate and study the petroleum price can affect the crude palm oil price or not and the price movement of these two commodities in the long-term and short-term.

1. 4 Research Questions

There are several research questions to be answer in this study: Is there any relationship between petroleum and crude palm oil prices? Do petroleum prices influence by crude palm oil prices in short-term, or long-term, or both? Is there any co-movement of petroleum price and crude palm price

1. 5 Significance of Study

Malaysia is a country which producing and purchasing the petroleum and crude palm oil distributor in global market. Hence, the price movement of these two commodities brings a huge influence on Malaysia’s economy. The result of this study can help investors to predict the price movement of these two commodities and consider the best investment strategy and take an

advantage in the trading market. Nevertheless, the result also can become a benchmark for business industry to choosing which energy commodity to buy in the long term and short term.

1. 6 Research Structure

Chapter 1

This chapter contains the background of the study, research problem, research objective, research question, and significance of study.

Chapter 2

This chapter contains the literature review and relevant study related to problem addressed in this study. This is to ensure that this study is in a correct path by recording the critical and essence of previous studies.

Chapter 3

This chapter contains the methodology and procedures applied for data collection and analysis. The data collection and the method applied in this study would be carried out in this chapter. Moreover, the procedure of this research would also be state out in this chapter.

Chapter 4

This chapter contains an analysis of the data and presentation of the results.

Chapter 5

This chapter presents a summary and discussion of the researcher’s findings, implication for practice and recommendation for future research.

Chapter 2

LITERATURE REVIEW

2. 0 Introduction

This chapter will contain the literature reviews that cover the relationship between petroleum price and crude palm oil price.

2. 1 Literature Review

Talib and Darawi (2002) described the national model of the Malaysian palm oil market and also identified the important factors that affecting the Malaysian palm oil industry from 1970 until 1999. Ordinary Least Squares (OLS) was applied to estimate the area, yield, domestic consumption, exports and imports equations. The equations were estimated with the assumption of independence among the exogenous variables and error terms with zero mean and constant variance. But, since the equations contain lagged dependent variables, OLS yields biased estimates since the residuals are auto-correlated. So, a test for the incidence of auto-correlation was used in these equations. Yet, the two stages least squares (2SLS) method is more suitable compared to OLS. The reason is some of the equations were also determined by endogenous variables. , F-statistic, t-statistic, Durbin-Watson (DW) and Durbin-h tests were used to evaluate the estimated model. The Durbin-h statistic was used to test for first-order autocorrelation when a lagged dependent variable was included as an explanatory variable in the regression. Both the OLS and 2SLS method estimates of total area equation show the values of the F-statistic, SEE and are statistically acceptable. However, the Durbin-h statistic cannot be computed due to the number in the square root formula was negative

number. Therefore, Lagrange multiplier (LM) was used to test for the presence of first-order autocorrelation. The results indicate that the change in either palm oil or natural rubber price is not very important in determining the total area of oil palm in Malaysia, even in the long run. Both OLS and 2SLS method estimates of yield equation are statistically acceptable. Value of is only 38% of the variation in oil palm yields during the sample period is explained by the specified variables. LM test shows that there is no significant of first-order auto-correlation. The estimation of consumption equations shows that given a 10% increase in industrial production index, the domestic consumption would only increased by 3% in the short run. The coefficient of the current palm oil price is negative while the coefficient of current price of coconut oil follows the expected sign. On the other hand, both coefficients are not statistically significant which implies that the consumption level of palm oil does not merely depend on the levels of both prices. The estimation of exports equations show that the Durbin-h and LM test reveal no evidence of serial correlation in the results. The results of the imports equations show that the coefficient of the Malaysian industrial production is found to be positive and statistically significant at 1% level. Subsequently, the estimation results of the Malaysian palm oil market model are statistically satisfactory and have identified many important factors related to yield and area of oil palm in Malaysia, as well as domestic consumption, exports, and imports of palm oil. Campiche et al (2007) have examined the evolving correspondence between petroleum price and agricultural commodities prices. This study carried out during the 2003-2007 time periods. Co-integration test such as Johansen approach and the Engle

Granger approach was also employed to analyze issues associated with non-stationary time series data, while avoiding of spurious regression. The co-integration test revealed that none of the agricultural commodity price series were co-integrated with the petroleum price during the 2003-2005 time frames. However, corn and soybean prices were co-integrated with the petroleum price during the 2006-2007 time periods. The Augmented Dickey Fuller (ADF) unit root test applied to testing series which indicated that all variables were non-stationary in levels and stationary in first differences. The Schwarz Information Criterion (SIC) indicated an optimal lag length of one. Tests for weak exogenous indicated that the petroleum price was weakly exogenous in both co-integrating relationships. A thorough understanding of the inter-relationship among the prices of agricultural commodities and fossil prices is essential for producers and policy makers to make decision. Harri, Nalley and Hudson (2009) investigate the relationship between oil, exchange rate, and commodity prices. This study carried out from January 2000 to September 2008 time periods. The ADF unit root test result confirmed the lack of stationary in levels for all series. Moreover, the presence of co-integrating relations between the crude oil with corn, soybeans, soybean oil, cotton and wheat could be determined. Besides that, AIC and SBC criteria were used to determine the lag length for the pair wise relations. The results show that the lag length is four for corn, soybeans, and soybean oil and two for cotton and wheat. This result indicates that there were longer dynamic relations between crude oil and corn, soybean oil than between crude oil and cotton and wheat. Subsequently, wheat is excluded from further analysis. Next, the presence of co-integrating relations between crude oil, corn and

exchange rates was tested. Johansen co-integrating tests were applied and the results show two cases, one where a constant is included in the error correction component but not in the autoregressive component of the Vector Auto Regression (VAR) model. The other case allows for a constant to be included in the autoregressive component of the VAR model but not in the error correction component. So, this first co-integrating relation was interpreted as the one between corn, crude oil and the exchange rate whereas the second co-integration relation as a relationship between the exchange rate and crude oil. The results was fail to reject the assumption of normality, homoscedasticity and no autocorrelation in the residuals for the three equations. Hence, the tests of weak exogenous show that the null hypothesis cannot be rejected at the 5% level of significance for crude oil when it is rejected for corn and the exchange rate. As a result, the presence of co-integrating relations between selected agricultural commodities such as corn, soybeans, soybean oil and cotton and crude oil and exchange rate was tested. The results suggest that all of these prices are interrelated. Hameed and Arshad (2009) have investigated the long term relationship between petroleum prices and vegetable oil prices from January until March 2008. The Engle-Granger two-stage estimation procedure is applied to test the co-integration among the petroleum, palm, soybean, sunflower and rapeseed oils prices. Co-integration Tests was conducted using Johansen’s maximum likelihood approach to test the relationship between petroleum oil price and each of the vegetable oils. In the short run, both tests reject the absence of a co-integrating relationship between the crude oil and vegetable oil prices series at the level of 0. 05 whereas the prices tended to move

towards this equilibrium relationships in the long run. In this study, they found that there exist long run equilibrium and unidirectional causality from petroleum price to each selected vegetable oil prices and the growing price of petroleum is significance in the vegetable oils complex. Natanelov et. al (2011) investigated any co-movement of agricultural commodities futures prices and petroleum. This study focused on price movement between petroleum futures and gold futures and series of agricultural commodities. A comparative framework is applied to identify changes in relationships through time and various co-integration methodologies and causality test are employed. The data carried out from monthly futures prices of crude oil, cocoa, coffee, corn, soybeans, soybean oil, wheat, rice, sugar, and gold starting from July 1989 until February 2010. The Augment Dickey-Fuller (ADF) test and the Philips-Perron (PP) test are used to determine whether the series are stationary. Moreover, the Johansen co-integration, causality, causality from Vector Error Correction Model (ECM) and Threshold co-integration has been used to determine the relationship between crude oil futures with each agricultural commodities futures prices. In general, they found that mature and well established commodity futures markets exhibit co-movement with crude oil in the long run. Nazalioglu and Soytas (2011) have studied the relationship between world oil prices and 24 world agricultural commodity prices accounting for changes in the relative strength of US dollar in a panel setting. The method such as panel unit root, panel co-integration and Ganger causality has been applied in this study and a panel of 24 agricultural products based on monthly prices from January 1980 until February 2010. They found that the oil prices and the exchange rate are

important factors that determine the long-run behavior of the agricultural commodity prices. As a result, they conclude that the impact of the oil prices on agricultural commodity prices and confirmed the impact of a weak dollar on agricultural commodity prices are positive. Saban Nazlioglu (2011) has investigated the price transmission from the world oil prices to the primary agricultural commodity prices (corn, soybeans, and wheat) with weekly data from 1994-2010. In this study, both linear and nonlinear Granger causality method that Toda-Yamamoto linear Granger causality test and Diks-Panchenko nonlinear Granger causality tests has been applied. The empirical analysis presents 3 key findings (i) the linear Granger causality analysis supports the neutrality hypothesis which means that the oil and agricultural commodity prices do not affect each other, (ii) the nonlinear Granger causality test shows that there are nonlinear causal linkages between the oil and the agricultural commodity prices, and lastly (iii) the nonlinear causality from the oil prices to corn and soybeans prices seems to be stern. The findings from this study show the key points for better understanding of agricultural commodity prices and some policy implications for government, farmers, and global investors. Ghaith and Awad (2011) have investigate the possible long-term relationship between the prices of crude oil and food commodities represented by maize, wheat, sorghum, soybean, barley, linseed oil, soybeal oil and palm oil. The period chosen for this study started from January 1980 until December 2009. Method of time series econometric techniques have been applied in this test is Unit root tests, Co-integration, and Granger causality. The results of this study reveal that there is a strong evidence of long-term relationship between crude oil and the food

commodities prices. A traditional Granger Causality is used to check whether causality exists between two product prices. The outcome suggests that there is a long-run relationship between petroleum and food commodities under examination in this study at the 0. 05 level of significance and better, except for rice at 0. 1. Error-Correction Model is presented in order to check the model. The result of ECM, the error correction term for all variables holds the correct sign which show a unidirectional causality between the prices crude oil and some of the food commodities under examination. Asari et al (2011) have analyzed the relationship between total area planted and palm oil price with production of palm oil. Time series analysis method such as Johansen co-integration, error correction model and Granger causality test were applied to estimate those relationships. This studied developed a simple theoretical model that integrates the factor that influence the production of palm oil in Malaysia by 37 observations of palm oil production, total area planted and palm oil price from 1972 to 2008. The findings show that achieved both research objectives and the production of palm oil in Malaysia can affect its price level. Moreover, the results show that there is no causality relationship between total area planted and the production of palm oil in Malaysia. In the short run, the total area planted and palm oil production does not influence each other. By the way, there is negative relationship between the production of palm oil with the total area planted and palm oil price. They believe that there are other factors that may affect the performance of the palm oil production in Malaysia. Guo et al (2011) have analyzed the price trends of petroleum and agricultural commodities prices in developing countries. This study was carried out from July 2001

until June 2011. The unit root test method Augmented Dickey Fuller (ADF) Test was used to testing series of the petroleum prices on the prices of soybeans, corn and wheat. The results show that ADF test statistics are all less than the test critical values, and the first-order differential value of the variables is stable. The results show that the time series are stable. Hence, the causality relationship between grain prices and petroleum price can be continued to test. Next, the Granger causality test has been applied to test the relationship between petroleum prices on selected agricultural commodities prices. The findings show that there are close relationship between them, and the fluctuations of agricultural commodities prices is the results of petroleum price changes. They concluded that rising price of petroleum is predictable because the scarcity of petroleum resources happening. According to the price trends of petroleum and agricultural commodities in international market, developing countries should make their own policies of bio-fuels referring to the experience of developed countries, while basing on their resources and socio-economic conditions. Sulistyanto and Akyuwen (2011) investigate the factors that affecting the performance of CPO export. This studied was carried out during the 1990-2007 periods in Indonesia. The main tool of analysis was multiple regressions with 38 years data. There are 5 variables which have significant impacts on the CPO export volume such as export financing, CPO export price, negative campaign, soybean oil and sunflower oil price. Moreover, variables which have no impacts are domestic CPO price, domestic CPO consumption, CPO production volume, and exchange rate, per capita GDP of the main importer countries, crude oil prices and deregulation policy. The export financing has positive

impact on CPO export volume, while the price has negative impact. They found that the export volume is elastic to the CPO price in the world market. The rising of CPO price can due to other factors such as crude oil price and changing of economic conditions. Until 2006, the CPO price is strongly determined by the other vegetable oil prices, especially soybean. Since 2007, the dominant factor is the demand for biodiesel and the rising of crude oil price. If compared to the other vegetable oils, the CPO is the most suitable vegetable oil to replace crude oil as the energy source. Karia and Bujang (2011) have done a forecasting of CPO prices on daily, weekly and monthly CPO price over the period of study from January 2006 to December 2010 in Malaysia. The Box Jenkins and Neutral Network were used to forecast the CPO price. The results show that neutral network achieve lower MSE as compared to ARIMA (2, 1, 1). Thus, the model of ARIMA (2, 1, 1) is not suitable to forecast daily CPO prices which in turn, the neutral network is better in forecasting daily CPO price. On the other hand, the performance of neutral network degrades when it comes to measuring the weekly and monthly data of CPO prices. Box Jenkins show much better in forecasting performance when it comes to weekly and monthly basis. In a weekly data, the Box Jenkins produces 0. 0001 of the MSE in the ARIMA (1, 1, 0) model which indicate smaller errors than neutral network with MSE of 0. 1171. In a monthly basis, the results suggest that the ARMA (1, 1) show better result as compared to ANN as 0. 0192 <0. 0318. So, ARMA(1, 1) model is more appropriate in order to forecast monthly CPO prices. Therefore, Box Jenkins only gives better prediction when the prediction deals with the little frequency of the time series data. So, it is best to conduct vague logic

approach in order to produce more accurate prediction when there is existence of the linear and nonlinear pattern in the time series. Ciaian and Kancs (2011) have investigated the interdependencies between the energy, bio-energy and food prices. A vertically integrated multi-output, multi-input market model with 2 channels of price transmission have been estimated by researchers and known as direct bio-fuel channel and indirect input channel. The theoretical has been test by applying time-series analytical mechanisms to 9 major traded agricultural commodity prices, including wheat, rice, corn, sugar, cotton, soybeans, banana, tea, and sorghum along with world crude oil price. The data consists of 783 weekly observations from January 1994 until December 2008. The econometric approach such as Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root test were applied. Both ADF and PP unit root tests of first differences reject the null of a unit root for the ten prices and suggest that nine agricultural commodity and crude oil prices in all three periods are integrated of order one. Moreover, the Johansen co-integration, causality from Vector Error Correction Model (ECM) and Granger causality have been used to determine the relationship between crude oil futures with each agricultural commodities price. As a result, the prices of crude oil and agricultural commodities are interdependent from the analysis and there is a long-run Granger causality from oil to agricultural commodity prices, but not vice versa. Sanders et al (2012) have examined the relationship among palm oil prices, soybean oil prices and crude oil prices. The analysis used the time series from 1980 to 2010 and employs different time series based econometric models to identify interactions among the three price series in order to shed light on the cause of the growth of palm

oil demand. Two models of oil price systems have been estimated that a simple Vector Auto Regression (VAR) model treats all three prices as stationary as well as and a Vector error Correction model (VECM) that allows co-integration among the three prices. VAR and VECM find that palm oil prices have not influence the petroleum price in the short-run. Consequently, short-run fluctuations in petroleum prices do not appear to be a reason of the boom in the palm oil productions while short-run fluctuations in the soybean oil prices do affect palm oil markets. By VECM, they found that a long-term relationship existed between prices of petroleum, soybean oil, and palm oil. Palm oil prices and petroleum prices are negatively correlated in the long run. These results show that a potentially important relationship in long and short run between soybean oil markets and palm oil markets, but this analysis show that the petroleum market is not an important driver of palm oil boom.

2. 2 Conclusion

As a conclusion, the information from previous researches can be applied into this investigation of relationship between petroleum and crude palm oil prices. The reviews related to the topic are clear and useful to answer the research questions. So, these literature reviews became the sources for this research and the findings and results are very helpful for deep investigation.

CHAPTER 3

RESEARCH METHODOLOGY

3. 0 Introduction

This chapter contains the framework of study and what method applied for this study. This investigation utilizes monthly data over the period of January 1995 to November 2012. The time series econometric techniques were applied to investigate the relationship among petroleum and crude palm oil prices. There are few tests such as unit root test, co-integration test, Granger causality test, error correction model and Vector auto regressive model for this investigation. On the other hand, the methods and data sources will be discussed in this chapter.

3. 1 Data Sources

The sample period chosen for this study extended from January 1995 until November 2012. Prices of petroleum and crude palm oil based on monthly observation collected from World Bank. The petroleum price quoted in Malaysia Ringgit (RM) per barrel and crude palm oil price quoted in Malaysia Ringgit (RM) per metric ton. The reason for choosing the data during this period because there are few important world economic event happened during this period such as economic crisis 1997, incident of terrorists attack 911 and Iraq war. These economic events cause the global financial, food, and economic crises broke out and phenomenal of prices rising for primary commodity.

3. 2 Econometric Methodology

This investigation adopted a simple econometric model to express the relationship between the petroleum price and crude palm oil price. The flow chart of this study is shown as the Figure 1.

Figure 1 The Relationship Between Petroleum & Crude Palm Oil

Long-term Relationship

Movement of Crude Palm Oil Prices

Changing of Petroleum Prices

Short-term Relationship

The variables used in this investigation are Petroleum price (PP) and crude palm oil price (CPO). This study form an econometrics model in order to show the relationship between the petroleum and crude palm oil prices under this study. This study investigates relationship between petroleum price and crude palm oil price for long-term and short-term. Subsequently, when petroleum price go up and the crude palm oil price will go up too, and vice versa. This is due to these two commodities are correlated. Specifically, the model of the study is developed as follow: PPt = b0 + b1CPOt + et (1)where PPt = Petroleum Price at time t, CPOt = Crude Palm Oil Price at time t and et = Error Terms.

3. 2. 1 Unit Root Test

The tests of unit root are performed on individual time series. The most of time series variables are non-stationary, with mean and variance non-constant (unit root). If the data contained unit root, the data are called non-

stationary, which lead to spurious regression result. Therefore, a stochastic process is said to be stationary if its mean and variance are constant over time. Dickey and Fuller (1979) have developed a test, known as Augmented Dickey-Fuller (ADF) test and Phillips Perron (1988) developed a nonparametric method of controlling for higher order serial correlation in a series can be used to test the presence of the unit root. If these time series variables are at first differenced I (1), then co-integration test should be used in order to model these long-run relationship between the variables and so on. If a time series has to be differenced " q" times to become stationary, it is integrated of order " q", denoted as I (q).

3. 2. 1. 1 Phillips-Perron Test

The Phillips-Perron (1988) suggested another method of unit root test which is known as Phillips-Perron (PP) test. PP test makes a non-parametric correction to the t-test statistic. Moreover, PP test statistic is robust with respect to unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation. However, Davidson and MacKinnon (2004) suggest that the performance of Phillips-Perron test is worse in finite samples as compared to the augmented Dickey-Fuller test.

3. 2. 1. 2 Augmented Dickey-Fuller Test

Augmented Dickey-Fuller (ADF) unit-root tests used to test the order of the integration of the series of the two variables. In order to transform those time series data which are non-stationary form into stationary form, an easy way is to difference the time series data by using the ADF t-statistic. ADF test is the wider version of the standard DF test which is used to solve the

problem of autocorrelation in the standard DF test. By adding various lagged dependent variables, DF test can be augmented. The optimal number of lags which is a necessary condition for further testing can be determined by using Akaike criteria (AIC). The Akaike Information Criterion (AIC) is computed as: AIC = (2)where l = log likehood. The AIC is used in the model selection and the smaller values of the AIC, the better. According to Ghaith and Awad (2011), an augmented Dickey-Fuller (ADF) test is applied to all series under examination. First the encompassing ADF test equation is used: t = 1 + 2 t + Yt-1 +jYt-j + ut (3)Where Yt is the series under examination at time t, and ut is the error term. Moreover, according to McLeod and Hipel (1978) the test regression (2) with three different combinations: t = 1 + 2 t + Yt-1 +jYt-j + u1t (4)t = 1 + Yt-1 +jYt-j + u2t (5)t = Yt-1 +jYt-j + u3t (6)The testing starts by testing if = 0 using t statistic critical value in Fuller (1976), not standard t distribution. If the test is rejected then when stop; otherwise the testing is continued for the presence of a trend by the F test φ3 with H0: 2 = = 0 if it is significant, then the standardized normal is used to test again. On the other hand, it is estimated again without the trend and repeats the same procedure and stop the test when rejected the null hypothesis. If it is not, go with F statistic φ1 for testing the presence of a constant and a unit root.

3. 2. 2 Johansen Co-integration Test

Johansen Co-integration Test is applied in order to check for the absence of co-integration between the two commodities. Johansen (1991) test has both the estimation and hypothesis testing performed in a unified framework and is utilized. Co-integration is an econometric asset of time series variables and there is a correction along variable which show the relationship between

variables, and with this specific relationship, there will be a series of residuals. If residual are stationary and has a pattern, then the two variables are co-integrated and there is a long-term relationship between the two variables (when residual is normal, the long-term and short term relationship are same). If residuals are random walk, then the two variables are not co-integrated. If trace and max-eigen value statistics are smaller than their critical values, then there is no co-integration between these two commodities prices, and vice versa. Before conducting this test, the lag interval with the lowest AIC value will be chosen for the Johansen Co-integration Test. Next, Granger causality test would be applied in the further analysis. Granger causality test would be used to test the short-term relationship between petroleum and crude palm oil prices while Vector Error Correction Model would be used to test the long-term relationship between these two commodities.

3. 2. 3 Granger Causality Test

Granger causality is a statistical concept of causality that based on prediction (Granger, 1969). The Engle-Granger tests are statistical procedures that can be to estimate if two time series are co-integrated. If a variable Y said Granger causes variable X the direction can be denoted as (Y ☾ X) and F-test shown significantly. Any non-stationary series that are co-integrated may diverge in the short-run, but they must be linked together in the long-run (Hameed and Arshad, 2009). Consequently, co-integration suggests that there must be Granger causalities in at least one direction, and at least one of the variables may be used to forecast the other. The causality relationship can be determined by estimating the following:(7) and(8)where

and are the prices of crude palm oil and petroleum respectively. The null hypothesis of the Granger Causality Test is: m (9)which means the crude palm oil price does not Granger-cause the petroleum price.(10)That means the petroleum price does not Granger-cause the crude palm oil price. If the null hypothesis is accepted, then there is no causality relationship between these variables which means that the petroleum and crude palm oil prices are independent to each other. Thus, if the null hypothesis is rejected, so there is one-directional causality between these variables. If both the hypothesis is rejected, this indicates that there is a bi directional causality between these variables. Next, VECM model will be used to test the long-term relationship between the petroleum and crude palm oil prices.

3. 2. 4 Vector Error Correction Model

A vector error correction method (VECM method) is a restricted vector auto-regression (VAR) designed for use with non-stationary series that are known to be co-integrated (Gillbert, 1986) and (Hendry and Ericsson, 2001). A better understanding of any non stationary among the time series can lead by VECM. The co-integration equation is known as the error correction method (ECM model) since the deviation from long-term equation is corrected gradually through a series of partial short-term adjustments (Engle and Granger, 1991). The VECM model is written as:(11)where is in the form of nx1 vector, and are the estimated parameters, is the difference operator and is the reactional vector which explains unanticipated movements in and (error correction term). As a result, VECM would be able to separate the short-term from long-term relationships.

CHAPTER 4

DATA ANALYSIS

4. 0 Introduction

This chapter contains a variety of tests to modify the time series data to find the appropriate model to explain the relationship between petroleum and crude palm oil prices. The relationship between petroleum and palm oil can attract the global investors or government to pay attention because the price movement of both commodities directly or indirectly related to the performance of global economy. The time series econometric method such as Granger Causality test and Vector Error Correction Model (VECM) were applied to testing the relationship between petroleum and crude palm oil by software Eviews6.

4. 1 Unit Root Tests

Firstly, unit root test must be conduct to check the time series data are stationary or not in order to create an econometric model. The Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests were applied to the unit root test. The result of petroleum price in level of ADF unit root test is shown in Table 1.

Table 1 ADF test for Petroleum Price in Level

t-StatisticProb*ADF test statistic-1. 5205400. 5214Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985The Table 1 shows that the t-statistic of ADF test is -1. 520540 and it is bigger than the critical value that -3. 461030, -2. 874932, -2. 573985 at 1%, 5%, 10% level of significance. The MacKinnon (1996) one sided p value (*) is 0. 5214 which

means that petroleum price has a unit root (non stationary) and do not reject the null hypothesis.

Table 2 PP test for Petroleum Price in Level

t-StatisticProb*PP test statistic-1. 3379720. 6119Test Crtical Value: 1% Level-3. 4608845% Level-2. 87486810% Level-2. 573951Next, the result of Philips-Perron test on petroleum price in level is shown in Table 2. The PP test statistic is -1. 337972 which is bigger than the critical value of -3. 460884, -2. 874868, and -2. 573951 at significance level of 1%, 5%, and 10%. The results just have a little bit difference compare with the ADF test. However, 0. 6119 of p-value show that petroleum price has a unit root and do not reject the null hypothesis. Both results show that the time series of petroleum price is a non stationary data. Hence, the time series of petroleum need a further testing in different order.

Table 3 ADF test for Petroleum Price in First Difference

t-StatisticProb*ADF test statistic-9. 7560410. 0000Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985Table 3 show that the ADF test statistic is -9. 756041 which is smaller than the critical value of -3. 461030, -2. 874932 and -2. 573985 at 1%, 5% and 10% level of significance. The zero p-value shows that ADF test is significant at 1% level and rejected the null hypothesis. The result show that time series of petroleum price in first difference is stationary.

Table 4 PP test for Petroleum Price in First Difference

t-StatisticProb*PP test statistic-9. 7076810. 0000Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985Table 4 shows that the PP

test statistic is -9. 707681 which is smaller than the critical value of -3. 461030, -2. 874932, and -2. 573985 at significance level of 1%, 5%, and 10%. The zero p-value shows that PP test is significant at 1% level and rejected the null hypothesis. The result show that time series of petroleum price in first difference is stationary. Since both ADF and PP result are similar, so the time series of petroleum price can be determined is a stationary data at first difference level.

Table 5 ADF test for Crude Palm Oil Price in Level

t-StatisticProb*ADF test statistic-2. 1779850. 2150Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985Next, the similar ADF test applied on time series of crude palm oil price in level. The table 5 shows that the t-statistic of ADF test is -2. 177985 and it is bigger than the critical value that -3. 461030, -2. 874932, -2. 573985 at 1%, 5%, 10% level of significance. The null hypothesis which are crude palm oil has a unit root should not rejected because the p-value is 0. 2150.

Table 6 PP test for Crude Palm Oil Price in level

t-StatisticProb*PP test statistic-1. 9814630. 2949Test Crtical Value: 1% Level-3. 4608845% Level-2. 87486810% Level-2. 573951The table 6 shows that the PP test statistic is -1. 981463 which is bigger than the critical value of -3. 460884, -2. 874868, and -2. 573951 at significance level of 1%, 5%, and 10%. Since the p-value is 0. 2949, therefore do not reject the null hypothesis. The time series of crude palm oil price in level is non stationary.

Table 7 ADF test for Crude Palm Oil Price in First Difference

t-StatisticProb*ADF test statistic-9. 8243230. 0000Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985The table 7 shows that the t-statistic of ADF test is -9. 824323 and it is smaller than the critical value that -3. 461030, -2. 874932, -2. 573985 at 1%, 5%, 10% level of significance. The null hypothesis which are crude palm oil in first difference has a unit root should rejected because the p-value is zero.

Table 8 PP test for Crude Palm Oil Price in First Difference

t-StatisticProb*PP test statistic-9. 7202800. 0000Test Crtical Value: 1% Level-3. 4610305% Level-2. 87493210% Level-2. 573985The table 8 shows that the t-statistic of PP test is -9. 720280 and it is smaller than the critical value that -3. 461030, -2. 874932, -2. 573985 at 1%, 5%, 10% level of significance. The null hypothesis rejected because the p-value is zero. The result of PP test shows that time series of crude palm oil in first difference is a stationary data. Both petroleum and crude palm oil prices can be determined stationary at first difference level after a couple of testing. The time series of petroleum and crude palm oil prices are to be co-integrated since both reach the requirement at the same first difference level. The movement of petroleum and crude palm oil prices is shown in the Figure 2 from January 1995 until November 2012 and details will be discusses at section 4. 2.

4. 2 Movement of Petroleum and Crude Palm Oil Prices

The movement of petroleum and crude palm oil prices from January 1995 until November 2012 is shown in the Figure 2 at below. From the Figure 2, the movements of petroleum and crude palm oil prices before year 2001

have an inverse pattern between the two commodities. Before year 2001, the two commodities prices are in different direction which means when petroleum price go up and crude palm oil price go down. The movements of petroleum and crude palm oil prices within 2001-2007 tend to move same direction but still not obviously. Yet, both commodities prices have a co-movement after year 2007 and obviously move to a high price. So, the prices of petroleum and crude palm oil have same direction and tend to move together. However, the relationship of petroleum and crude palm oil still need a further testing to determine by Co-integration tests.

Figure 2 Co-integration Betweens Petroleum and Crude Palm Oil

4. 3 Johansen's Maximum Likelihood Approach

The Johansen's Maximum Likelihood approach applied to testing the relationship on petroleum oil and crude palm oil prices. The result will be represented as Table 9 in different type of tests, data trend and lag interval. The Akaike Information Criterion (AIC) have 3 ranks that start from rank 0-2 and 5% level selected for the test, the lowest value of AIC is the best choice for lag interval.

Table 9 Lag Interval Test Result

Data TrendTest TypeLag IntervalAICRank 0Rank 1Rank 2NoneNo Intercept or Trend1 11 21 31 420. 793420. 765220. 669120. 673520. 795320. 777220. 681120. 689620. 832020. 814120. 719020. 7276NoneIntercept and No Trend1 11 21 31 420. 793420. 765220. 669120. 673520. 793120. 782920. 678420. 681620. 825420. 815120. 712520. 7158LinearIntercept and No

Trend1 11 21 31 420. 809120. 781420. 684020. 688020. 800620. 790820. 683820. 686720. 825420. 815120. 712520. 7158LinearIntercept and Trend1 11 21 31 420. 809120. 781420. 684020. 688020. 7595*20. 7198*20. 6553*20. 6603*20. 761720739020. 665720. 6703QuadraticIntercept and Trend1 11 21 31 420. 827820. 800320. 702820. 706920. 768820. 729220. 664620. 669720. 761720. 739020. 5665720. 6703Table 9 shows that lag interval result for different assumption of data trend and type of test. Assuming no deterministic trend in the data with no intercept or trend in CE, the lowest AIC values of 20. 6691, 20. 6811, and 20. 7190 at Rank 0, Rank 1 and Rank 2 are determined using lag interval 1 3. Assuming no deterministic trend in the data with intercept and no trend in CE, the lowest AIC values of 20. 6691, 20. 6784, and 20. 7125 at Rank 0, Rank 1 and Rank 2 are determined using lag interval 1 3. Assuming for linear deterministic trend in the data with intercept and no trend in CE, the lowest AIC values of 20. 6840, 20. 6838, and 20. 7125 at Rank 0, Rank 1 and Rank 2 are determined using lag interval 1 3. Assuming for linear deterministic trend in the data with intercept and trend in CE, the lowest AIC values of 20. 6840, 20. 6553 *, and 20. 6657 at Rank 0, Rank 1 and Rank 2 are determined using lag interval 1 3. Assuming for quadratic deterministic trend in the data with intercept and trend in CE, the lowest AIC values of 20. 7028, 20. 6646, and 20. 6657 at Rank 0, Rank 1, and Rank 2 are determined using lag interval 1 3. According to the result, the ranking of AIC for all five deterministic trend assumptions of test show that lag interval of 1 3 given the lowest AIC. Therefore, lag interval of 1 3 will be used in the Johansen Co-integration Test and the result of this approach will be shown as Table 10.

Table 10 Johansen Co-integration test Result

Data TrendTest TypeTest StatisticsHypothesized No. of CE(s)NoneAt most 1NoneNo Intercept or TrendTrace5. 48540. 0024Critical Value12. 32094. 1299Max-Eigen5. 48300. 0024Critical Value11. 22484. 1299NoneIntercept and No TrendTrace10. 85632. 8126Critical Value20. 26189. 1645Max-Eigen8. 04372. 8126Critical Value15. 89219. 1645LinearIntercept and No TrendTrace10. 00171. 9580Critical Value15. 49473. 8414Max-Eigen8. 04361. 9580Critical Value14. 2653. 8414LinearIntercept and TrendTrace23. 87327. 8060Critical Value25. 872112. 5179Max-Eigen16. 06717. 8060Critical Value19. 387012. 5179QuadraticIntercept and TrendTrace23. 8317 *7. 7665 *Critical Value18. 39713. 8414Max-Eigen16. 06527. 7665 *Critical Value17. 14763. 8414The Table 10 shows that the results of Johansen co-integration test from different assumption compare in trace and max-eigen value with 5% significant level of critical value. The result show that quadratic deterministic trend in the data with intercept and trend in CE have both 23. 8317 and 7. 7665 of trace test statistic value with none and at most one co-integration hypothesis which bigger than critical value that 18. 3971 and 3. 8414. Meanwhile, 7. 7665 of max eigen value is bigger than the 3. 8414 of critical value on at most one co-integration only. Yet, the max eigen value is smaller than critical value that 16. 0652 <17. 1476. The other 4 assumption show that there are no co-integration and both trace and max eigen value smaller than the critical value. The result show that the petroleum and crude palm oil prices tend to move towards long run equilibrium in this assumption. Next, Granger Causality Test will be proceeded to test the causality between these two commodities prices and the results will be shown in section 4. 4

4. 4 Granger Causality Test

By using Granger Causality Test, we can determine whether there is causality between the petroleum and crude palm oil prices or not. Besides that, the short-term relationship between petroleum and crude palm oil can be investigated by this method. The optimal lag is taken from the Johansen Co-integration Test in section 4. 3. Therefore, an optimal 3 lag interval will be applied. The Granger Causality test result will be shown in Table 11.

Table 11 Granger Causality Test

Null HypothesisObsF-StatisticProb. Palm Oil does not Granger Cause Petroleum2124. 679700. 0035Petroleum does not Granger Cause Palm Oil0. 036820. 9905The first result shows that the F-statistics are large and the probability value is 0. 0035. The null hypothesis of palm oil does not Granger-cause petroleum should be rejected which means crude palm oil price does granger-cause petroleum price. Therefore, there is a short-term relationship between these two commodities prices. The second result shows that the F-statistics are small and the probability value is 0. 9905. The null hypothesis of petroleum does not Granger-cause palm oil should not be rejected. These results suggest that crude palm oil price is not influenced by the price of petroleum. Hence, the crude palm oil price shows unidirectional relationship. From the Johansen Co-integration test, the results suggest that the petroleum and crude palm oil prices tend to move towards long run equilibrium. Next, the Vector Error Correction Model (VECM) will be applied for further testing and discusses in section 4. 5.

4. 5 Vector Error Correction Model

According to the Johansen Co-integration Test result, the petroleum and crude palm oil prices tend to move towards long run equilibrium. Therefore, a further analysis on the long-term relationship between petroleum and crude palm oil by VECM proceeded. An optimal lag interval of 1 1 is used in this method. Table 12 shows the VECM test result when dependent variable is Petroleum price.

Table 12 VECM Test Result D(Petroleum)

Dependent Variable: Petroleum PriceVariableCoefficientStandard ErrorT-statisticC0. 7794070. 946830. 82317Petroleum Price0. 3159930. 066584. 74575Crude Palm Oil Price0. 0131400. 006631. 98252R-Squared0. 181958Adj. R-Squared0. 170216Sum sq. resids39617. 72S. E. equation13. 76802F-statistic15. 49608Log likelihood-858. 7752Akaike AIC8. 101175Schwarz SC8. 164298Mean dependent1. 244038S. D. dependent15. 11434The result shows that the value of R2 is 0. 181958 which means 18% variation of petroleum price explained by the crude palm oil price. Estimation reveals that the explanatory variable which crude palm oil price is the most important explanatory variable with t-statistic of 1. 98 is statistically significance at the 0. 05 level. Therefore, there is a long-term relationship between petroleum and the crude palm oil price. Next, the result of crude palm oil as dependent variable shows in Table 13.

Table 13 VECM Test Result D(Palm Oil)

Dependent Variable: Palm Oil PriceVariableCoefficientStandard ErrorT-statisticC2. 8542889. 859030. 28951Petroleum Price-0. 4556510. 69332-0.

65720Crude Palm Oil Price0. 4094970. 069015. 93360R-Squared0. 150455Adj. R-Squared0. 138260Sum sq. resids4295475S. E. equation143. 3615F-statistic12. 33800Log likelihood-1357. 839Akaike AIC12. 78722Schwarz SC12. 85034Mean dependent4. 127512S. D. dependent154. 4345The result shows that the value of R2 is 0. 150455 which means 15% variation of crude palm oil price explained by the petroleum price. Estimation reveals that the explanatory variable which petroleum with t-statistic of -0. 65720 is not statistically significance at the 0. 05 or 0. 01 levels. Therefore, there is no long-term relationship between crude palm oil price and the petroleum price. This indicates that the crude palm oil price is not influenced by petroleum price in the long-run. However, crude palm oil price is a factor influence the crude oil price in the long-run.

CHAPTER 5

DISCUSSION AND CONCLUSION

5. 0 Introduction

This chapter will contain the summary of the findings and results of the investigation on relationship between petroleum and crude palm oil prices. There are a few of time series econometric methods were applied to this study which are Augmented Dickey-Fuller (ADF) unit root test and Phillips-Perron unit root test, Johansen’s Co-integration Test, Granger-Causality Test and Vector Error Correction Model.

5. 1 Discussion and Conclusion

This study consist with the topic discusses the phenomena tracked by the global investors. It discuss about the relationship between petroleum and

crude palm oil prices in the long-term and short –term. The time series data carried out from January 1995 until November 2012. The time series of each variable must be stationary in order to testing the relationship between petroleum and crude palm oil. Both the ADF and PP test results show that the petroleum and crude palm oil prices time series are stationary in the first difference level, I(1). Therefore, the null hypothesis of being non-stationary should be rejected at the first difference. This result indicates that the petroleum and crude palm oil prices are said to be co-integrated. The price movement of petroleum and crude palm oil shows that the negative relationship before year 2001 which means petroleum price go up and crude palm oil price go down. The movements of petroleum and crude palm oil prices within 2001-2007 tend to move same direction but still not obviously. After 2007, the co-movement exist between petroleum and crude palm oil prices. The high petroleum price lead primary commodities prices boom, and bring the new high price level to the global economy. Hence, a further analysis on relationship between petroleum and crude palm oil is very important. The Johansen Co-integration Tests will be applied to testing the relationship between these two commodities and existence or absence of co-integration. An optimal lag interval needs to be conducted to the Johansen Co-integration tests. So, the optimal lag interval is determines by the lowest Akaike Information Criterion (AIC) value. By comparing the AIC values with different lag intervals, the lag interval of 1 3 is found to have the lowest AIC value for the all five deterministic trend assumptions. These assumptions include of no deterministic trend in the data with no intercept or trend and with intercept and no trend in CE, linear deterministic trend in the data with

intercept and no trend and with intercept and trend in CE and lastly the quadratic deterministic trend in the data with intercept and trend in CE. Hence, an optimal lag interval of 1 3 will be applied to conduct the Johansen Co-integration Test. The results suggest there is a long run relationship between these two commodities prices but it only occurs in quadratic deterministic trend rather than the other four trends as mentioned in section 4. 3. The Granger Causality test applied to testing the short-term relationship between petroleum and crude palm oil prices. Hence, the Granger Causality test will test the causality between these two commodities with optimal lag length which lag 3. By the way, the result shows that there is only unidirectional relationship between petroleum and crude palm oil. The co-integration test that two time series are co-integrated, then there should be Granger causation at least in one direction (Ghaith & Awad, 2011). Therefore, the result show that crude palm oil Granger-cause petroleum only thus crude palm price oil can influences the petroleum price in the short-term, but not the reverse. The Vector Error Correction Model (VECM) applied to testing the long-term relationship between petroleum. The results suggest that there is a long-term relationship between these two commodities prices when the dependent variable is petroleum price meanwhile when the dependent variable is crude palm oil price there is no long-term relationship between these two commodities prices. Subsequently, the petroleum price affected by crude palm oil price in the long-term but crude palm oil price did not influence by petroleum price. By the way, the existence of positive relationship between the petroleum price and crude palm oil price in long-term can be determined in this study. As a result, the crude palm oil price is

a main factor cause fluctuation of petroleum price and brings a big influence on petroleum price in the long-term and short-term. The results in this study are no consistent with the research done by Hameed & Arshad (2009). According to Hameed & Arshad (2009), petroleum price was not influenced by the price of any of the vegetable oil including palm oil in the long run. The reason of different result might due to the time series data, different software or econometric method. By the way, the results of this study consistent with the research done by Ghaith & Awad, (2011).

5. 2 Recommendation for Future Study

The findings of relationship between petroleum and crude palm oil in this study is very important for producers, traders, consumers because the volatility is a significant risk to them. The result of this study brings the important information for investors to make trading strategy or investment. By the way, the information from this study is important for future market especially the speculation or hedging activities. For future study, it is recommended to increase more variables related with petroleum and can be explained influence the pricing of petroleum. Because the more variable can form the model with higher R-square, hence the dependent variables can easier to be explained by the independent variables. Besides that, the time series or sample size should be increased hence the probability will be more accurate. Moreover, the time period should be separated into three periods which are before, during and after global financial crisis. With this separation of periods, the relationship between crude oil and crude palm oil prices might can be seen and described more clearly and precisely.

5. 3 Limitation of the Study

The several time series econometric methods have been applied in this study which is applied on many fields of study such as business, finance, economic, and even agriculture also. By the way, these methods were applied completely with perfectly perform in this study. Actually, this study does not have considered any separate structural breaks for the whole time period. Moreover, there are no diagnostic tests such as Normality Test, White Test and also Autocorrelation Test applying in this study. Nevertheless, this is a study with only two variables therefore causes the dependent value cannot be explain by the independent variable clearly and precisely. Hence, the econometric model cannot be explain completely because the low value of R-square between the dependent variable and independent variable.