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Determining Economic Factors towards Palm Oil Price of Malaysia Using Multivariate Cointegration

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ABSTRACT: Palm oil industry is an important sector in Malaysia agriculture industry as Malaysia is the second largest producer and exporter of palm oil after Indonesia. However, the fluctuations in palm oil price greatly affect the production and trade of palm oil. The aim of this paper is to determine the significant factors influencing the palm oil price in Malaysia. Monthly data is collected from the period of 2009 to 2019 from Malaysia Palm Oil Board (MPOB), Malaysia Palm Oil Council (MPOC) and Index Mundi. Multiple regression was used to determine the significant factors affecting palm oil price while the relationship between the significant factors and the palm oil price in long run term was examined by co-integration test. The findings show that there are five significant factors affecting palm oil price which are crude palm kernel oil price, coconut oil price, rapeseed oil price, export and exchange rate. Both crude palm kernel oil price and rapeseed oil price affect the palm oil price positively. On the other hand, coconut oil price, export and exchange rate have negative impact on palm oil price. The result also shows that there is not much difference in actual and estimated palm oil price except for March 2020 due to the Restricted Movement Order (RMO) in Malaysia.

KEYWORDS: palm oil price, multivariate cointegration

I. INTRODUCTION

Palm oil is a type of vegetable oil derived from the fruit of oil palm which is useful in daily life as it can be used in food, cosmetic, biofuel, animal feed and pharmaceutical. Among the variety types of oils and fats, palm oil emerged as the significant commodity in world's production and consumption [1]. The production and consumption of palm oil significantly contribute to the national economies and encourage economic growth. In Malaysia, palm oil production has contributed more than 30% of the country's total income and become the main sector in Malaysia agricultural industry as compared with rubber and timber. Malaysia currently accounts for 39% of world palm oil production and 44% of world exports [2]. The substantial contribution of palm oil in the world market made Malaysia the second largest producer and exporter of palm oil after Indonesia.

There are several economic factors contribute to the stability of palm oil price. According to the studies conducted by[3, 4, 5, 6], it was found that soybean oil price, rapeseed oil price, sunflower oil price, crude oil price, supply and demand, exchange rate are significant and cointegrated with the palm oil price. Supply and demand is said to be one of the main component in determining the palm oil price [6]. A strong market demand for palm oil and its related products will lead to the increase in production and export thus resulting in a higher palm oil price. When the supply grows much faster than its demand, definitely the palm oil will experience sliding in price.

The domestic consumption of palm oil is only 18% while the balance is exported to India, Europe, China and other countries [7]. When there is weaker export demand from these major importing countries, there will be a surplus and building up of palm oil stock hence decreasing the palm oil price. Nowadays, competition from other types of oils such as soybean oil, sunflower oil, rapeseed oil influences the price and production of palm oil[8]. As the competitor of palm oil, the consumption and demand of vegetable oils have increased over the years causing a change in price of these vegetable oils. The movement in pries of vegetable oils hence will affect the palm oil price directly.

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II. SIGNIFICANCE OF THE SYSTEM

Palm oil price in Malaysia fluctuates frequently over time. The fluctuations greatly affect the palm oil production and export of palm oil to other countries. It was claimed that this fluctuation is not affected by government but affected by the changes of economic factors. A high fluctuation in palm oil price is believed to give an impact towards country's Gross Domestic Products (GDP) as the palm oil industry contributed 4.67% to the country's GDP [9]. Hence, it is crucial in determining the economic factors affecting the palm oil prices and their relationship towards palm oil price should be investigated based on the time period examined.

The outbreak of COVID-19 pandemic in January 2020 has affected world's economy. The palm oil industry as one of the major industries in the world is also facing the crisis brought by the pandemic. This impact is mostly felt by Malaysia who is the second largest producer and exporter of oil palm. According to The Malaysian Insight in year 2020, exports of palm oil had declined significantly by 41.7% during the Restricted Movement Order (RMO) in Malaysia. China, as one of the biggest buyerof palm oil has reduced its imports of palm oil and related products. Consequently, the price of palm oil fell to RM2330 per tonne as the world demand has decreased (MPOC, 2020). It is the lowest since the global financial crisis in the year 2018. The decrease of demand has affected nearly one million of smallholders in the palm oil industry.

Theobjectives in this study are to investigate the cointegrationbetween the significant economic factors and palm oil price in Malaysia from 2009-2019 and to identify the impact of COVID-19 towards palm oil price by comparing the actual and estimated palm oil price growth from Jan to April 2020. The focus in this study is to determine the significant economic factors that affecting the palm oil price in Malaysia. The factors that included in this study were believed to be influencing the palm oil price in Malaysia. However, only the significant economic factors will be identified and discussed in this study. The long run cointegration relationship between the significant economic factors will also be investigated by using several techniques and methodologies.

III. LITERATURE SURVEY

Malaysia is one of the largest countries in producing and exporting palm oil to other major countries such as United States, Taiwan, Vietnam and China. According to [10], Malaysia and Indonesia which is the largest and second largest producer and exporter of palm oil has contributed 89.6% of palm oil trade in the world. There are many studies done to determine the factors affecting the palm oil price. Based on the previous journal, the prices of palm oil have been increased due to the supply and demand of fats and oils[11]. According to the research done by [12], the total export and production of palm oil are expected to influence palm oil price in the short-run.

According to [13], also proposed that there was a linear relationship between the price of palm oil and the price of soybean oil using Non-linear Two-stage Least Squares (2SLS). Also, [14]suggested that soybean oil prices have co-integration relationship with the growth rate of palm oil prices. In a study to investigate factors affecting growth in palm oil prices, both soybean oil prices and crude oil prices are discovered to have relationship with palm oil price. Soybean oil prices had positive relationship with palm oil prices while crude oil prices had negative relationship with palm oil prices [3]. On the other hand, the study carried out by [14] found that crude oil price had a fairy weak dependence with the palm oil price using bivariate extreme value.

In the study carried out by [12], unit root test was used to test for the stationarity and all the variables showed stationarity after being differenced once. Result showed that by using Granger causality, palm oil production and total palm oil export influenced the palm oil price in the short-run. However, by using Vector Error Correction Model (VECM), there was no long-run relationship between palm oil production, total palm oil export and soybean oil price with the palm oil price. Based on the research done by [15], it was found that palm kernel oil price has a high relationship with the palm oil prices. The price trend of palm oil is affected by the supply and demand. When the export of palm oil increased, the palm oil stocks increased causing the price of palm oil to decrease. [16]has been studied and proposed that the prices of palm oil which comprised of crude palm oil and processed palm oil had a significant relationship with the palm oil stock. [17, 18]also mentioned that crude palm oil (CPO) had a strong relationship with palm oil stock where the stocks showed the trend of palm oil prices. Furthermore, previous study done by [19]discovered a long term relationship between crude palm oil (CPO) and vegetable oil using Engle-Granger method.

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There are many research studies based on the impact of biodiesel demand on palm oil prices [20]. When the demand of biodiesel getting higher, the amount of palm oil in the market would be affected thus increasing the palm oil prices. According to the research conducted by using two-stage least square method, price equation was formed to investigate the link between biodiesel demand and palm oil price. Result showed that biodiesel demand has a positive impact on Malaysia palm oil price [21]. This is supported by a study carried out to determine the impact of biodiesel production on domestic palm oil price with increasing demand and prices of palm oil in conjunction with the increasing biodiesel production [22]. Meanwhile, the copula method to analyse the dependence structure between palm oil price, crude oil price and exchange rate showed that exchange rate was significant in affecting palm oil price and crude oil price[14]. A study done by[22]argued that exchange rate had a negative impact on crude oil price. The appreciation of domestic currency led to the increase of crude oil price.[24]also mentioned that an increase in palm oil price led to the appreciation of exchange rate. Nevertheless, according to the study carried out by [25], the export of palm oil was affected by GDP and not affected by exchange rate.

In addition,[26] stated that crude oil price is significantly affected by the price of substitute such as soybean price, coconut oil price and found that vegetable oil influenced the prices of palm oil and crude palm oil. On the other hand, research done by[27]stated that the major competitions of palm oil are soybean oil, corn oil, sunflower oil, cottonseed oil, rapeseed oil and coconut oil. According to a research done in UK using multiple regression, result showed that the determinants of palm oil price included production of palm oil, export of palm oil, consumption of palm oil and land area in plantation of palm oil.

IV. METHODOLOGY

A. Test for Multicollinearity

Multicollinearity is a statistical phenomenon in which two or more independent variables in a regression model are dependent upon the other variables in such a way that can be linearly predicted from the other with a high degree of accuracy. When the variables involved in the regression model exists in multicollinearity, it will affect the performance of the parameter estimation such as increase the standards error, intends to delete important variables, increase the confidence region and etc. Therefore, multicollinearity test has been conducted to check whether the multicollinearity is exists among the independent variables.

There have several methods can be applied to detect multicollinearity among independent variables such as measure the R-square for each model, review scatterplot and correlation matrices, looking for incorrect coefficient signs and etc. In this research, the method that has been used to detect the multicollinearity is based on Variance Inflation Factor (VIF). This method would inflate the R-square for each model. When the value of VIF is beyond 10, it means that the independent variable holding high risk of having multicollinearity problem. If the multicollinearity problem exists in the regression models, some actions should be taken to deal with it. The step of removing the highly correlated independent variable is conducted repeatedly in this research to deal with the multicollinearity problem. When the value of VIF for a variable is more than 10, the variable will be removed to make sure that there is no multicollinearity in the regression model until there are no variables with VIF value more than 10.

B. Test for Correlation

Statistical significance which known as correlation, is the likelihood that there have relationships between two or more variables is caused by something other than chance. Statistical significance also means that there is a good chance of finding that a relationship exists between two variables. The test for statistical significance is important to test whether a variable will influence another variable. The data set of a variable will be considered as having statistical significance when the p-value is sufficiently small or less than the significance level. Due to the sufficiently small of the p-value, it is evidence to reject null hypothesis and accept alternative hypothesis and conclude that there has relationship between two variables. Otherwise, when the p-value is large or more than the significant level, it is no evidence to reject null hypothesis and accept the null hypothesis. Therefore, it is concluded that there is no relationship between the variables.
In this paper, thecorrelationtest will be applied to determine whether the observed independents variables are statistical significance relationship with the dependent variable which is palm oil price of Malaysia. The null hypothesis and alternative hypothesis states for this study are shown as null hypothesis, H_0:Thereis no relationship between the palm

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oil price and certain independent variable versus alternative hypothesis, H_1:There is relationship between the palm oil price and certain independent variable.

C. Outlier Detection

Outlier is the data point fall far always from other points and also called as unusual point in the dataset. Outlier is a big problem in many statistical analyses because outlier might have the influence to the result which could lead to bias. Therefore, before started to perform statistical analyses, potential outlier should be identified. However, there are no a strict statistical rule can use for definitively identifying outliers. There are various methods to detect outliers such as short the dataset, graphing the dataset, using z-scores test, using interquartile range, hypothesis test and etc.

In this research, method of graphing the dataset which is boxplot has been used to detect the outliersfrom statistically significant independent variables and the dependent variable. The detectedoutlier pointswill be removed to prevent the misleading to significant finding and inaccurate results in this research.

D.Augmented Dickey-Fuller (ADF) Unit Root Test

Augmented Dickey-Fuller (ADF) unit root test is a statistical test used to test the stationary of a time series. Unit root is one of a characteristic of time series which will make the time series data non-stationary and it will cause unpredictable results in time series analysis. When unit root presence in time series its mean non-stationary and differencing operations required to take action to make the time series become stationary. The model for the ADF unit root test is:

$$y_t = c + \beta t + \alpha y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$$

where

c = constant;
β = coefficient on a time trend;
p = lag order of the autoregressive process;
ε_t = residual at time t;
y_{t-1} = lag 1 of time series;
α = the coefficient of the first lag on y;
y_t = value of time series at time t.

The null hypothesis and alternative hypothesis states for ADF unit root test are shown as H_0: $\alpha = 1$versus H_1: $\alpha = 0$. The null hypothesis for this ADF unit root test is there is a unit root and assume $\boldsymbol{\alpha = 1}$while the alternate hypothesis is that the time series is stationary assume$\boldsymbol{\alpha = 0}$. When the p-value is less than significant level in order to reject null hypothesis and consider the time series is stationary. Otherwise, accept the null hypothesis and conclude that the time series is non-stationary. Moreover, when the time series consist of unit root and non-stationary at level 0, therefore it is necessary to convert the time series data into first difference to make the data to stationary.

E.Autoregressive Distributed Lag (ARDL) Bounds Test

Autoregressive Distributed Lag (ARDL) boundstest is a cointegration method that apply to test presence of the long run relationship between variable in a single equation time-series setup. Compare to other methods that also used to test the cointegration relationship, ARDL bounds test has many advantages over those methods. ARDL bounds test can be used to draw conclusion irrespective of whether the series are I(0) or I(1). After that, Unrestricted Error Correction Model (UECM) can be derived from ARDL bounds test through a simple linear transformation. The empirical result shows that the approach is superior and it also provide consistent results for small sample.

In this research, the ARDL bounds test is used to test the cointegration relationship between the palm oil price of Malaysia and another five statistical significant of dependent variables coconut oil price, rapeseed oil price, crude palm kernel oil price, exchange rate and export. The equation for ARDL model in this research is:

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$$\Delta PalmOP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_1 \Delta PalmOP_{t-i} + \sum_{i=0}^{p} \lambda_2 \Delta CoconutOP_{t-i} + \sum_{i=0}^{p} \lambda_3 \Delta RapeseedOP_{t-i} + \sum_{i=0}^{p} \lambda_4 \Delta CrudePKOP_{t-i} + \sum_{i=0}^{p} \lambda_5 \Delta EXCHANGE_{t-i} + \sum_{i=0}^{p} \lambda_6 \Delta EXPORT_{t-i} + \lambda_7 PalmOP_{t-1} + \lambda_8 CoconutOP_{t-1} + \lambda_9 RapeseedOP_{t-1} + \lambda_{10} CrudePKOP_{t-1} + \lambda_{11} EXCHANGE_{t-1} + \lambda_{12} EXPORT_{t-1} + \boldsymbol{\varepsilon_t}$$

The symbol Δ denoted as first differencing operator of the listed variables. For the $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$ and λ_6 are corresponded to short run dynamic while $\lambda_7, \lambda_8, \lambda_9, \lambda_{10}, \lambda_{11}$ and λ_{12} are corresponded to long run relationship.

The null hypothesis for this ARDL bounds test is no cointegration among the all variables while the alternate hypothesis is cointegration among variables. F-test will be conducted to decide whether to reject or accept null hypothesis. When the F-test value is higher than upper bound critical values, reject null hypothesis and alternate hypothesis which indicates that there is cointegration among the variables and vice versa. The null hypothesis, $H_0: \lambda_7 = \lambda_8 = \lambda_9 = \lambda_{10} = \lambda_{11} = \lambda_{12} = 0$ $(No\ cointegration)$ versus alternative hypothesis, $H_1: \lambda_7 \neq \lambda_8 \neq \lambda_9 \neq \lambda_{10} \neq \lambda_{11} \neq \lambda_{12} \neq 0$ $(Cointegration)$

Before proceed with ARDL bounds test and deciding the model, the optimal lag length should be estimated. The model selection criteria are crucial to decide theoptimal lag length for the particular model. Therefore, in this paper, Schwarz's Criterion has been applied to determine the optimal lag for the particular model.

F.Data and Variable Description

This study emphasized on the effect of possible related price of particular assets toward the palm oil price in Malaysia. The data collected for this study is the monthly time series quantitative and continuous data starting from January 2009 until April 2020 with a total number of 136 observations. The secondary data is collected from several official websites such as Malaysia Palm Oil Council (MPOC), Malaysia Palm Oil Board (MPOB), Index Mundi and X-rates for the exchange rate variable. All the first 132 observations which is from January 2009 until December 2019 will be used in the data analysis of this study while the remaining observations (January 2020 until April 2020) will only be used to estimate the palm oil price on that particular month in the year 2020 in order to identify the impact of COVID-19 towards Malaysia palm oil price. There are 13 independent variables which are Crude Palm Oil Price, Palm Kernel Oil Price, Crude Palm Kernel Oil Price, Fresh Fruit Bunches Price, Sunflower Oil Price, Soybean Oil Price, Peanut Oil Price, Coconut Oil Price, Rapeseed Oil Price, Gold Price, Exchange Rate, Import, Export and Palm Oil Price as dependent variable.

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G. Effect of COVID-19 toward Palm Oil Price in Malaysia

Due to Coronavirus (COVID-19) outbreak from December 2019, the global economics included Malaysia are affected seriously. The effect of COVID-19 towards palm oil price of Malaysia could be observed by plotting the line chart with the model generated.

V. EXPERIMENTAL RESULTS

A.Result of Multicollinearity Test

Based on the result of first multicollinearity test, few variables are holding with high risk of multicollinearity since the VIF value is beyond 10 such as palm kernel oil price (155.27), crude palm kernel oil price (134.43), fresh fruit bunches price (16.30), soybean oil price (23.45) and rapeseed oil price (15.16). Therefore, variable palm kernel oil price which has the highest VIF value compared with other variables, is selected to be removed (Table 1).

Table 1: VIF Value for the 13 Observed Independent Variables

Variable	Variance Inflation Factor (VIF) Value			
	1st test	2nd test	3rd test	4th test
Crude palm oil price	1.10	1.09	1.09	1.08
Palm kernel oil price	155.27	-	-	-
Crude palm kernel oil price	134.43	12.90	12.09	7.51
Fresh fruit bunches price	16.30	16.30	13.83	-
Sunflower oil price	3.81	3.80	3.76	3.75
Soybean oil price	23.45	23.40	-	-
Peanut oil price	4.31	4.25	3.36	3.36
Coconut oil price	9.81	7.76	7.76	7.57
Rapeseed oil price	15.16	14.34	5.39	4.39
Gold price	3.85	3.84	3.70	3.70
Exchange rate	5.19	4.96	4.79	2.44
Import	1.57	1.55	1.39	1.35
Export	1.58	1.56	1.54	1.32

After removed the variable palm kernel oil price, the second multicollinearity test result showed that there are still existing of multicollinearity variablesnamely crude palm kernel oil price (12.90), fresh fruit bunches price (16.30), soybean oil price (23.40) and rapeseed oil price (14.34). Hence, with the similar reason, soybean oil price was removed and third multicollinearity test has been conducted. The result showed that the VIF value of crude palm kernel oil price and fresh fruit bunches price are greater than 10 which are 12.09 and 13.83 respectively. The variable fresh fruit bunches price was removed and multicollinearity tests are repeated. And the result showed that all the VIF values of remained variables are less than 10 which means that the independent variables are holding with low risk of having multicollinearity problem. In short, the remained independent variables with the low VIF value will be applied to determine the statistically significance relationship between the dependent variable and independents variables to achieve the achieve objective of this research.

B.Test for Correlation

Based on the result of statistical significance test in Table 2, there are 5 variables are statistically significance among 10 variables which are crude palm kernel oil price, coconut oil price, rapeseed oil price, exchange rate and export. The p-value of these 5 variables are sufficient small (smaller than 0.05) and evidence to reject null hypothesis and concluded that there is statistically significance relationship with the dependent variable. Therefore, these 5 independent variables will be conducted in the following tests for checking the outlier by using graphing boxplot technique.

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Table 2: P-value for the Independent Variables toward Palm Oil Price

Variable	P-value
Crude palm oil price	0.857
Crude palm kernel oil price	0.000
Sunflower oil price	0.120
Peanut oil price	0.665
Coconut oil price	0.001
Rapeseed oil price	0.000
Gold price	0.128
Exchange rate	0.000
Import	0.297
Export	0.002

C.Result for Outlier Test

Based on the boxplot of each observed variables in this research, there are 2 variables consists of outliers in the dataset which are coconut oil price and crude palm kernel oil price. For the variable coconut oil price, there have 3 outliers in observation 97, 102 and 104 while for the variable crude palm kernel oil price, it has 5 outliers which are in observation 25, 26, 96, 97 and 98 (Figure 1). Therefore, all of these outliers will be removed from the dataset to prevent bias. Next, the remaining dataset will be continued with the ADF unit root test to achieve the objectives of this study.

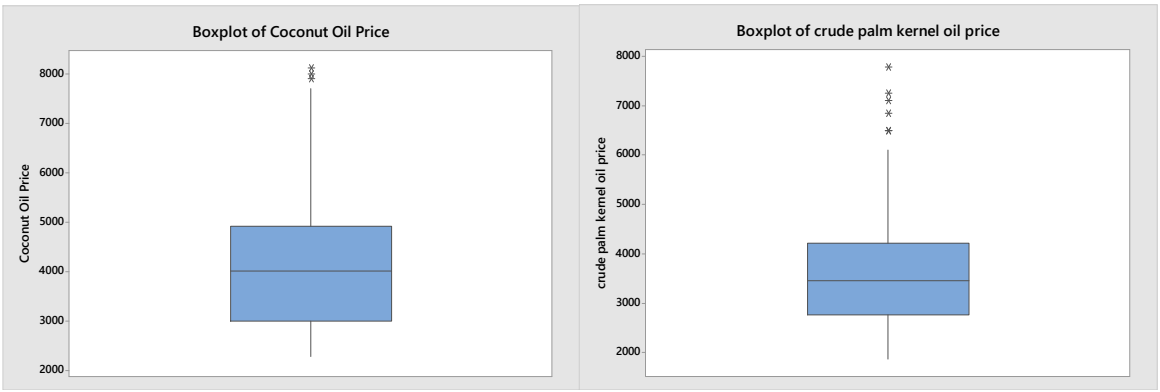

Figure 1: Boxplot of Coconut Oil Price and Crude Palm Kernel Oil Price

D. Augmented Dickey-Fuller (ADF) Unit Root Test's Results

Based on the result of ADF test (Table 3), there are only two variables are stationary on level I(0) which are palm oil price and export. Export is found to be statistically significant due to the high t-stats value (-6.4021) and low p-value (0.0000) while the palm oil price also is found its statistically significant with t-stats value of -3.1029 and p-value of 0.0228. However, the rest 4 variables rapeseed oil price, crude palm kernel oil price, exchange rate and coconut oil price are non-stationary on level I(0) since the p-values has no enough evidence to reject null hypothesis of non-stationary. Therefore, the variables are converted into level I(1) and the result showed that all 6 variables are stationary.

Table 3. Augmented Dickey-Fuller (ADF) Unit Root Test's Result

Variables	Level I(0) (t-stats)	P-value	Level I(1) (t-stats)	P-value
Palm Oil Price	-3.102915**	0.0288	-8.671408***	0.0000
Rapeseed Oil Price	-2.831745	0.0566	-8.510404***	0.0000
Crude Palm Kernel Oil Price	-1.467530	0.5468	-8.791492***	0.0000
Export	-6.402475***	0.0000	-15.15636***	0.0000

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Exchange rate	-0.908226	0.7830	-7.743642***	0.0000
Coconut Oil Price	-0.748981	0.8293	-8.287623***	0.0000

Note: *** and ** denotes rejection of null hypothesis of non-stationary at level 1% and 5% respectively

Variables palmoil price and export are remained stationary on I(1) with t-stats value -8.6714 and -15.1564 respectively with p-value 0.0000. Variable rapeseed oil price is found to be stationary on I(1) with t-stats value -8.5104 and p-value 0.0000. Moreover, variables crude palm kernel oil price, exchange rate and coconut oil price also are found to be stationary on I(1) with t-stats value -8.7915, -7.7436 and -8.2876 respectively with low p-value 0.0000. Hence, it is concluded that all the 6 variables are stationary on I(1) and it is possible to the next step with Autoregressive Distributed Lag (ARDL) bounds test to examine the existence of long run relationship among the dependent variable and independent variables which is vital in achieving the purpose of this paper.

E.Autoregressive Distributed Lag (ARDL) Bounds Test's Results

The result of ARDL bound test has shown in Table 4. In this research, the dependent variable is palm oil price of Malaysia (PalmOP) while the independent variables are coconut oil price (CoconutOP), crude palm kernel oil price (CrudePKOP), export (EXPORT), exchange rate (EXCHANGE) and rapeseed oil price (RapeseedOP). The calculated F-stats result obtained from ARDL bound test is 30.45725 which is higher than the upper bound critical value 4.15 at 1% significant level. Therefore, there are sufficient evidences to reject null hypothesis and accept the alternative hypothesis to conclude that there is long run relationship between these variables. ARDL lag selection is based on Schwarz's Criterion which resulting (1,1,0,0,0,1) model.

Table 4: ARDL Bounds Test's Result

ARDL Model	Calculated F-Statistic	Significant Level	Critical Values of Lower Bound	Critical Values of Upper Bound
ARDL (1,1,0,0,0,1) PalmOP, CococutOP, CrudePKOP, EXPORT, EXCHANGE, RapeseedOP	30.45725***	1%	3.06	4.15
		5%	2.39	3.38
		10%	2.08	3

Note: *** denotes significant in 1% significance level.

The Table 5 showed the result of residual diagnostics for ARDL model (1,1,0,0,0,1). Non-existence of heteroscedasticity, serial correlation and normally distribution are the criteria for a reliable ARDL model. Therefore, heteroscedasticity test, normality test and Breusch-Godfrey Serial Correlation LM Test have been computed to test the model. Based on the result, the model (1,1,0,0,0,1) is fitted since all of the three tests have meets with the requirement and fulfilled with the criteria.

Table 5: Residual Diagnostics for ARDL Model (1,1,0,0,0,1)

Types of Residual Diagnostics	Result	Conclusion
Histogram Normality Test	Jarque-Bera (0.2903), p-value (0.864914)	Accept Null Hypothesis (Model is normally distributed)
Breusch-Godfrey Serial Correlation LM Test	p-value Chi-Square(12) (0.8873)	Accept Null Hypothesis (No serial correlation in the model)
Heteroscedasticity Test: ARCH	p-value Chi-Square (12) (0.8651)	Accept Null Hypothesis (No heteroscedasticity detected in the model)

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Table 6 shows the result of ARDL Long Run Coefficient for the 5 independent variables toward a dependent variable. There have 3 independent variables are negative relationship with palm oil price Malaysia which is coconut oil price, export and exchange rate since they have negative coefficient values with -0.088413, -0.0000489 and -171.2970 respectively. While the independent variable of crude palm kernel oil price and rapeseed oil price have positive relationship with palm oil price Malaysia with coefficient 0.341087 and 0.147384 respectively. The regression equation model for these observed variables are shown below:

$$PalmOP = -0.088413CoconutOP + 0.341087CrudePKOP - 0.0000489EXPORT - 171.2970EXCHANGE + 0.147384RapeseedOP$$

Table 6: ARDL Long Run Coefficient (Dependent variable=PalmOP)

Regressor	Coefficient	Standard Error	t-stats	P-value
CoconutOP	-0.088413	0.073933	-1.195857	0.2343
CrudePKOP	0.341087	0.056008	6.089927	0.0000
EXPORT	-0.0000489	0.000059	-0.829483	0.4086
EXCHANGE	-171.2970	151.3999	-1.131421	0.2604
RapeseedOP	0.147384	0.104671	1.408063	0.1620
C	4.955484	10.01210	0.494949	0.6216

F.Impact of COVID-19 towards Palm Oil Price

By using the model generated, the effect of COVID-19 towards palm oil price in Malaysia is illustrated in Figure 2. The damage caused by COVID-19 can be observed by the gap between the actual and estimated palm oil price. Obviously, the price of palm oil in Malaysia decreased significantly from January 2020 to February 2020. However, the actual price of palm oil in March 2020 had the biggest difference with estimated one which indicated COVID-19 affected the palm oil price of Malaysia the most in that month.

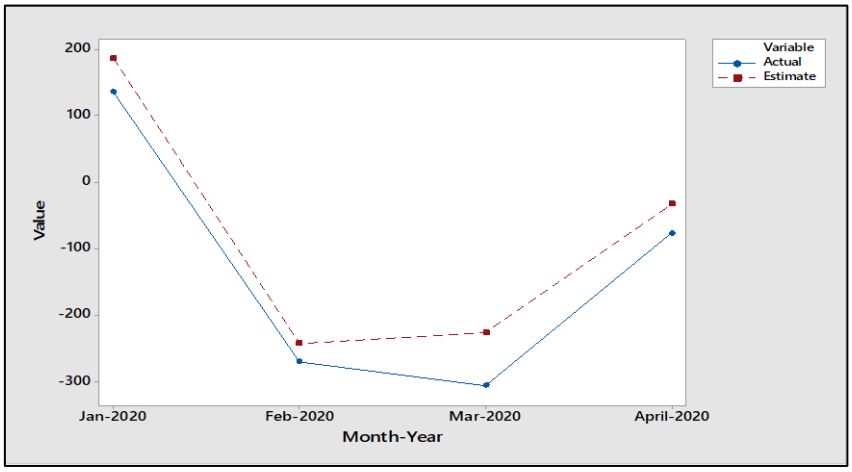

Figure 2: Comparison of actual and estimated palm oil price from January to April 2020

VI. CONCLUSION AND FUTURE WORK

At the end of this study, the objectives of this study are achieved which can be observed from the results mentioned. Statistical analysis such as correlations test, ADF unit root test and ARDL bound test were conducted to determine the significant factors influencing palm oil prices in Malaysia and ensure the reliability of the cointegration model formed. Before that, a few assumption tests such as multicollinearity test using Variance Inflation Factor (VIF), outlier test using boxplot, normality test, correlation test and heteroscedasticity test have been performed to ensure that data collected is suitable for the analyses and accurate result can be obtained from the data. Therefore, conclusion and inference can be drawn based on the result.

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There are five factors have been identified which will affect the palm oil prices in Malaysia. The factors are coconut oil price, crude palm kernel oil price, rapeseed oil price, export and exchange rate. ADF unit root test shows that all the five significant variables including the dependent variable, palm oil prices are stationary at first differences. ARDL bound test indicates that there is a cointegration between palm oil prices of Malaysia and coconut oil price, crude palm kernel oil price, rapeseed oil price, export, exchange rate in the long run. The calculated F-statistics is higher than the critical value of upper bound at 1% significant level. An optimal ARDL (1,1,0,0,0,1) model is obtained based on Schwarz's Criterion.

The result of long run coefficient based on ARDL model shows that there is positive effect of crude palm kernel oil price and rapeseed oil price towards palm oil price of Malaysia. In other words, increasing in price of crude palm kernel oil and rapeseed oil could lead to increment in palm oil price of Malaysia. Over the few decades, the demand for vegetable oils become more prominent as vegetable oils can be used as substitutes in food sector and this causes the storage of these commodities to fulfil the high demand. Hence, the boom in palm oil prices is also driven by the high demand in food market. Rapeseed oil as the fuel for biodiesel in Europe also brings up the demand for vegetable oils in energy market.

Next, the long run coefficient shows the negative impact of coconut oil price, export and exchange rate towards palm oil price. India as the biggest importing country of palm oil from Malaysia has increased the import of palm oil and palm kernel oil due to their domestic demand. The increasing export of these edible oils is depressing the coconut oil market in Malaysia as the production of palm oil is expanding in a rapid pace compared to the production of coconut oil. The low demand of coconut oil in Malaysia's exporting country leads to a drop in price of coconut oil while the higher demand of palm oil thus allows for the increasing palm oil price. The negative impact of exchange rate on palm oil price suggests that depreciation (increase in exchange rate of USD to MYR) of exchange rate in Malaysia leads to the decrease in palm oil price as depreciation makes exports cheaper. Hence, the palm oil price is lower when the domestic currency of Malaysia depreciates. Followed by the lower palm oil price due to the depreciation in domestic currency, the amount of export of palm oil will increase as depreciation stimulates export.

Due to the effect of COVID-19 pandemic, the palm oil industry is affected due to the uncertainties in world economy. Based on the results of constructed model, the price of palm oil dropped dramatically in the first two months of 2020 which was due to the damage caused by COVID-19. During the pandemic, the demand of palm oil has reduced, production is suspended and trade is disrupted in Malaysia. However, a noticeable gap is observed between the actual and estimated palm oil price in March due to the Restricted Movement Order (RMO) in Malaysia. This is because the export and import were temporarily terminated due to border closure. Indirectly, the price of palm oil was affected. Nevertheless, there was an improvement observed in April 2020. This is because Government of Malaysia implemented Economic Stimulus Package with the aim of improving the economics of Malaysia by allowing the industrial production to re-operate with Standard Operating Procedure (SOP) in order to prevent spreading of COVID-19 at the same time.In summary, it is important to recognise the factors influencing the palm oil price and address the potential problems to increase the volume of palm oil export and stabilize the fluctuations in palm oil price especially when facing sudden change in economic condition.

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