PRICE ADJUSTMENT OF OIL PALM AND PALM OIL IN THAILAND TO THE WORLD PRICE OF THE PALM OIL MARKET

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ABSTRACT

The objectives of this study are to analyze: (1) the effects from the change of palm oil price in the world market to the prices of oil palm and palm oil in Thailand, and (2) the adjustment of oil palm and palm oil prices in Thailand to the change of the price of palm oil in the world market using monthly time series from January 2008 to September 2019. The statistics consist of the stationary test using the ADF unit root, the long-run equilibrium test using the cointegration, and the short-run adjustment to the equilibrium using the error correction model, respectively. The empirical findings show that farm-gate price is the most affected by the change of palm oil price in the world market, followed by wholesale, export, and retail prices, respectively. In line with the adjustment of the prices of oil palm and palm oil in Thailand to the change in the world palm oil price, it is found that farm-gate price has adjusted in the short-term to return the equilibrium with the highest speed at 27.883%, followed by wholesale price 22.710%, exporting price 18.792%, and retail price 15.658%, respectively.

Contribution/ Originality
This empirical study employs time series econometrics to satisfy research purposes. In conclusion, the price of palm oil in the world market influences the prices of oil palm and palm oil in Thailand by affecting the upstream market price to the middle and downstream market prices, respectively.

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1. INTRODUCTION

Oil palm is a significant economic crop to the agricultural sector of Thailand since the country is the third biggest exporter of palm oil in the world market, right next to Indonesia and Malaysia, respectively. In 2019, Thailand was able to produce palm oil in the amount of 3.18 million tons, calculated as 4.30% of world palm oil production (Office of Agricultural Economics, 2019). However, when comparing the energy crops between oil palm and other crops found that oil palm is a biofuel source which contains a low cost of production, contains the oil that can replace any other oils excellently and efficiently, as well as be able to be used as a raw material in the various industries. Apart from that, oil palm also plays an important role in fuel production (methanol) and biodiesel to use in the machinery and automobile as alternative energy of diesel fuel effectively; moreover, it is friendly with the environment as well as is a nature spare energy resource to replace the crude oil from the fossils in the future.

In the past time, the oil palm and palm oil prices in Thailand have fluctuated due to the unbalanced demand and supply of oil palm and stocked palm oil as well as the environmental factors outside the country. However, the government sector still has the policy to promote and support oil palm planting in the potential area to replace the biodiesel production and also replace the rubber tree planting or any other economic crops which have a low value. Additionally, it also contains the policy to expand the area of oil palm planting to increase the efficiency, decrease the production cost, and create the increasing value to the oil palm and palm oil. For the issue, as mentioned earlier, it causes the farmers to expand the oil palm planting areas in the country consistently. According to the information of the Office of Agricultural Economics (2020), it is found that Thailand contains the planting area for the oil palm up to 0.96 million hectares, which can produce palm oil up to 16.77 million tons. As the results of oil palm planting area expansion as mentioned together with the oil palm planting area expansion of the biggest oil palm manufactured countries including Indonesia and Malaysia, it increases the area of production, causing the increasing number of products which are released to the market, as well as the increasing stocked world palm oil; meanwhile, the needs to use the oil palm tend to reduce. Regarding the aforementioned issues, it results from the healthy trends of the consumers and the "Zero Palm Oil" measure of the European Union countries, who would like to stop using the palm oil since the saturated fat which causes heart disease is found as well as they have concerned about the environmental problems, believed that the oil palm planting areas are mostly from the deforestation. Moreover, it also causes oversupply in the market and the reduction of palm oil prices. Although Thailand has gained the share from exporting the palm oil in the world market, it is only 0.51% when compared with Indonesia and Malaysia who have gained the share from exporting the palm oil in the world market which is up to 89.46%; however, there is a significant quantity of oil palm, stocked in the country. Also, Thailand contains a higher production cost and exporting price than the competitive countries (Buddhajak, 2019). It is found that Thailand contains 380,869 tons of crude palm oil exports and products as valued as 6,661 million baht, which has been reducing from the past years in the same duration up to 19.31% and 38.32% respectively. As in the year of 2018, it contained 472,038 tons of crude palm oil exports and products or as valued as 10,799 million baht. To state the significant trading partners of crude palm oil exports and products, it includes India, Malaysia, Myanmar, Kenya, Cambodia, China, and so forth (Office of Agricultural Economics, 2019, 2020).

To review the literature on price adjustment of oil palm and palm oil, Rungrennganun et al. (2015) has analyzed the factors influencing the prices of oil palm and palm oil by using the econometrics and dynamic models of the system. They found that the factors which positively affect the farm-gate price are the palm oil price in Krabi market, Surat Thani market, Chumphon market, and Bangkok market; on the other hand, the factor which negatively affects the farm-gate price is oil palm supply. Additionally, the factors which positively affect the crude palm oil price are the third-class rib smoked sheet, the crude palm oil price in the world market, as well as biodiesel price; in contrast, the factors which negatively affect the crude palm oil price is oil palm supply.

Jongsombatpibul and Pornchaiwiseskul (2016) has analyzed the relationship, comparing the crude palm oil price and soybean oil price with biodiesel price by using weekly time series from 2006 to 2013 as well as using the econometric models, including the verification of long-run equilibrium relationship with the method of cointegration, and the analysis of the causal relationship with the method of Granger causality. They found that the crude palm oil price drives the positively asymmetric price to the biodiesel price in the same direction; meanwhile, the relationships between crude palm oil price and soybean oil price contain the long-run equilibrium relationship in the unidirectional symmetric direction. As same as the study of Chatsirapob (2018) who has studied the factors affecting the price of the crude palm oil in Thailand using the monthly time series from January 2012 to December 2017 as 60 months in total as well as using multiple regression models. The result of Chatsirapob (2018) found that the farm-gate price, palm stearin price, as well as exporting refined palm oil price are all the factors that affect the prices of the crude palm oil in Thailand. However, several studies analyzed the price adjustments in various agricultural markets such as Wongwaipairoth and Limsomboonchai (2011), Jatuporn and Sukprasert (2016), and Leurcharusmee and Duangnate (2018) focused on the price integration among rubber markets of Thailand. Dawson and Dey (2002), Chien *et al*. (2011), and Chulaphan *et al*. (2012) employed time series techniques to analyze the relationship among rice market prices in domestic levels of Bangladesh, Thailand, and the Philippines respectively. Goodwin (1992), Bessler and Fuller (1993), Ghosh (2003), and Valdes *et al*. (2011) conducted price interaction among wheat markets using the cointegration approaches. Furthermore, Von Cramon-Taubadel and Loy (1996), and Ghoshray (2002) studied the price transmission among different market levels in the world using the various asymmetric models. According to the reasons as mentioned earlier, this study aims to analyze the effects from the change of palm oil price in the world market to the prices of oil palm and palm oil in Thailand as well as the adjustment of oil palm and palm oil prices in Thailand to the change of palm oil price in the world market.

2. RESEARCH METHODOLOGY

The data used in this study is the monthly time series, starting from January 2008 to September 2019 as 141 months in total. The description of the variables and accessed sources of data are presented in Table 1.

Table 1: The description of the variables

Variable	Description	Source
Y1	Farm-gate price of oil palm	Office of Agricultural Economics[*]
Y2	Wholesale price of crude palm oil	Bank of Thailand
Y3	Retail price of palm oil	Department of Internal Trade[*]
Y4	Exporting price of palm oil	Ministry of Commerce[*]
X	World market price of palm oil	World Bank

[*] belongs to the government of Thailand.
Note: The variables are converted into a logarithmic function to explain the relationship as a percentage change

The time-series data must be verified since if the data contains the attribute of non-stationarity, it will cause the problem of spurious relationships (Granger and Newbold, 1974). In other words, the occurred relationship between the variables might be spurious owing to the influence of time. Thus, the data attribute or data stationarity will be verified by using the method of the ADF unit root of Dickey and Fuller (1979, 1981), considering the lag of the suitable time period by using the Bayesian Information Criterion (BIC) method as presented in Eq. (1).

$$\Delta Z_t = \alpha_0 + \delta T + \beta_1 Z_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta Z_{t-i} + \varepsilon_t \qquad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (1)$$

When Δ is the differencing order, Z is the time series (i.e., Y1, Y2, Y3, Y4, and X respectively), β and δ is the parameter coefficient, α is the constant term, T is the time trend, t is the time period, p is the optimal lag length, and ε is the error term.

The cointegration method of Engle and Granger (1987) is used to analyze the effects of the change of palm oil price in the world market to the prices of oil palm and palm oil in Thailand. The two steps are included, which are (1) the analysis of the long-run equilibrium models to derive the residual, and (2) the verification of the residual stationarity (Asteriou and Hall, 2007; Gujarati and Porter, 2009).

Step 1: The long-run equilibrium analysis.

$$Y_t = \alpha_0 + \beta_1 X_t + \varepsilon_t \qquad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2)$$

Step 2: The stationary test of the residual from Eq. (2).

$$\Delta \hat{\varepsilon}_t = \beta_1 \hat{\varepsilon}_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta \hat{\varepsilon}_{t-i} + v_t \qquad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3)$$

When Y and X are the time series, which contained the stationarity of I(1) process, and v is the white noise.

The analysis of the long-run equilibrium relationship will be considered from the result of the verification of a stationary test in the second step or Equation (3). If the residual is stationary at the level stage of the data, it shows that the long-run equilibrium relationship has occurred, or it can be said that the relationship in Equation (2) is a long-run equilibrium relationship, not being a spurious relationship. On the contrary, if the result of the residual stationarity in Equation (3) is non-stationary at the level stage, it shows that the relationship in Equation (2) is not a long-run equilibrium relationship and contains the problem of the spurious result.

When the cointegration can be proved to occur, the opportunity to analyze the short-run adjustment will be opened by using the error correction model (ECM) to explain in the case of shock resulting in the relationship being diverted back into the equilibrium. The model is presented in Eq. (4).

$$\Delta Y_t = \alpha_0 + \beta_1 \Delta X_t + \sum_{i=1}^{p} \beta_2 \Delta X_{t-i} + \sum_{i=1}^{p} \beta_3 \Delta Y_{t-i} + \gamma ECT_{t-1} + \varepsilon_t \qquad \ldots \ldots \ldots \ldots \ldots (4)$$

When γ is the speed of adjustment to the equilibrium, and ECT is the error correction term or the disequilibrium term.

3. EMPIRICAL RESULTS

To analyze the effects from the change of palm oil price in the world market to the prices of oil palm and palm oil in Thailand, and the adjustment of oil palm and palm oil prices in Thailand to the change of palm oil price in the world market, there are four steps for the test including (1) verifying the stationarity of time series with the ADF unit root, (2) creating the long-run equilibrium models

to derive the residual, (3) verifying the stationarity of the residual, and (4) analyzing the short-run adjustment based on the ECM respectively.

The verification of stationarity of time series with the ADF unit root in Table 2 found that the variables of Y1, Y2, Y3, Y4, and X at the level stage provide the statistical values as (-2.067), (-2.101), (-1.679), (-3.149), and (-2.004) respectively, which cannot reject the null hypothesis (H_0: Non-stationarity). It can be concluded that at the level stage of the data, every variable is non-stationary; therefore, the first differencing order must be added to verify the stationarity again. Next, it is discovered that the variables of Y1, Y2, Y3, Y4, and X provide the statistical values as (-9.359), (-9.303), (-8.674) (-10.535), and (-7.093) respectively, which can reject the hypothesis at the 0.05 level of statistical significance. The first difference proved the stationarity of all variables.

Table 2: Results of ADF unit root test

Variable	At level		First difference	
	t-statistics	p	t-statistics	p
Y1	-2.607	0	-9.359*	1
Y2	-2.101	0	-9.303*	0
Y3	-1.679	0	-8.674*	0
Y4	-3.149	0	-10.535*	0
X	-2.004	0	-7.093*	1

* is the statistical significance at 0.05 level

The results of the long-run equilibrium relationship analysis in Table 3 found that the verification of the residual stationarity with the ADF unit root of the Y1, Y2, Y3, and Y4 models provide the statistical values as (-3.613), (-4.492), (-3.627), and (-3.839) respectively. In other words, the verification of the residual stationarity provides the rejected value to the null hypothesis of non-stationarity in every model. Moreover, the marginal effects of the long-run equilibrium relationship are as the following.

If the palm oil price in the world market (X) increases to 1%, it will affect the oil palm price or farm-gate price (Y1) to be increased to 1.025% with the 0.05 level of statistical significance, which the models contain 59.203% of the capability for the prediction.

If the palm oil price in the world market (X) increases to 1%, it will increase wholesale price of palm oil (Y2) to 0.993%, which the models contain 70.997% of the capability for the prediction. However, if it increases by 1%, it will raise the retail price of palm oil (Y3) to 0.381% at 5% level of significance, which the models contain 63.826% of the capability for the prediction.

If the palm oil price in the world market (X) increases to 1%, it will affect the exporting price of palm oil (Y4) to be increased to 0.733 with the 0.05 level of statistical significance, which the models contain 38.181% of the capability for the prediction.

Table 3: The long-run equilibrium and short-run adjustment to the equilibrium tests

Variable	Model			
	Y1	Y2	Y3	Y4
α_0	-1.941	0.044	2.422	1.016
X	1.025*	0.993*	0.381*	0.733*
R^2 statistics	0.592	0.709	0.638	0.381
ADF (Residual)	-3.613*	-4.492*	-3.627*	-3.839*
ECT_{t-1}	-0.278*	-0.227*	-0.156*	-0.187 *

* is the statistical significance at 0.05 level

As the analysis results of the short-run adjustment to approach to the equilibrium using the ECM model in Table 3, it is found that if it contains the case of shocks or changes which affect the relationship to be apart from the equilibrium, the system will adjust to approaching to the equilibrium again by considering the coefficient of ECT_{t-1}. According to the information in Table 3, it can summarise that if the case of shocks or the fluctuation of palm oil price in the world market has occurred, the oil palm price or farm-gate price, the wholesale price, the retail price, as well as the exporting price will adjust to approaching to the equilibrium with the speeds of 27.883%, 22.710%, 15.658%, and 18.792% respectively.

4. CONCLUDING REMARKS

Regarding this study, it aims to analyze the effects from the change of palm oil price in the world market to the prices of oil palm and palm oil in Thailand as well as the adjustment of oil palm and palm oil prices in Thailand to the change of palm oil price in the world market using the monthly time series data starting from January 2008 to September 2019. The empirical results found that the oil palm price or farm-gate price (Y1), the wholesale price of palm oil (Y2), the retail price of palm oil (Y3), as well as the exporting price of palm oil (Y4), have the long-run equilibrium relationship with the palm oil price (X) in the world market with the statistical significance. The results can be summarised that when the palm oil price in the world market changes or fluctuates, the oil palm price or the farm-gate price will be most affected by the aforementioned changes, followed by the wholesale price of palm oil, exporting price of palm oil, and retail price of palm oil respectively. Nonetheless, the models of exporting price of palm oil can predict/explain only 38.18% because the exporting price depends on other environmental factors out of the palm oil price in the world market; for instance, the exchange rate, the price of a substitute product, the demand and supply of oil palm, the stocked oil palm, seasons, and so on. Meanwhile, the results of the short-run adjustment analysis present that the oil palm price or farm-gate price contains the highest speed adjustment, followed by the wholesale price of palm oil, exporting price of palm oil, and retail price of palm oil respectively. Moreover, it can be noticed that the oil palm price or the farm-gate price is mostly affected from the change of the palm oil price in the world market since it is the upstream price level of the supply chain of the palm oil production which cannot be stocked; thereby, when the palm oil price in the world market has changed either increase or decrease, it will affect the oil palm price or the farm-gate price directly. However, the oil palm price or farm-gate price is the highest speed of adjustment to the change of palm oil price in the world market due to the supported policy of the government sector and promoting the pricing stability in the farm-gate level.

Consequently, the oil palm price or farm-gate price will be adjusted approaching equilibrium rapidly. Meanwhile, the retail price of palm oil is the least affected by the change of the palm oil price in the world market because it is the downstream price level of the supply chain in palm oil production, so the effects are not too strong when compared with the very upstream price level as a farm-gate price; moreover, there are a small number of the refinery to produce the readymade bottle of palm oil, together with the government sector also provides the compensation as a pricing difference to the palm oil refinery which is affected from the price control which is lower than the production cost. However, the retail price of palm oil has a slow speed adjustment to the change of the palm oil price in the world market due to government intervention by setting the maximum price control or price ceiling of the price controls and price subsidies. Also, the price of readymade palm oil will be able to be stocked and be replaced by soybean oil, lard, coconut oil, and so forth. Therefore, the adjustment of the retail price of palm oil to approach the equilibrium is quite unhurried, not too fast (Tokrisna *et al.*, 2013; Thailand Oil Palm Board, 2019).

The government sector should provide the urgent measures in short-term duration to cope with the effects from the palm oil price fluctuation in the world market, especially for the oil palm price or the farm-gate price which directly affecting the farmers; for example, the income insurance, market

intervention measures, etc. Furthermore, the government sector should not use the aforementioned measures in the long term since it will affect the great number of expenses and budgets as well as will distort the market mechanism, which is not good to both the supply chain of oil palm production and the whole system of palm oil. Additionally, the government sector should also provide the long-term measures to cope with the effects of the palm oil price fluctuation in the world market; to illustrate, the government sector should promote the planting of other crops to replace the oil palm planting or even promote the integrated farming system, the reduction of the production costs, the administration of the domestic stocked palm oil to be effective, as well as to promote and to develop the use of palm oil as a raw material to produce alternative energy.

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