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Article

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Factors Affecting the Indonesian Palm Oil Market in Food and Fuel Industry: Evidence from a Time Series Analysis

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ABSTRACT

Nowadays, the demand for palm oil has been increasing worldwide. The multipurpose use combined with a market price below makes palm oil an attractive product. Since 2006, Indonesia has been the biggest producer of palm oil in the world, replacing Malaysia as a chief producer. This study develops a simple theoretical model that integrates some of the factor that could influence the production of palm oil in Indonesia in order to establish the issue of cointegration and causality patterns. This analysis examined the relationships among Indonesian palm oil production, soybean oil price, area harvested for palm oil production in Malaysia and palm oil consumption. The finding shows that all variables positively and significantly affect Indonesian palm oil production. However, the ascent of the Indonesian palm oil industry is the result of a combination of several factors, some of which are relating to the palm oil plant itself, others to policy.

Keywords: Palm Oil, Time Series Analysis, Indonesia
JEL Classifications: C01, C22, Q17, Q18, Q41

1. INTRODUCTION

Palm oil is extracted from the oil palm Eleais guineensis. While today oil palm is grown mostly on Malaysian and Indonesian plantations, the tree was originally native to West Africa. Fruits contain two kinds of oil: Palm oil from the flesh fruit and palm kernel oil from the seeds. Over the past decade, the uses of palm oil considerably expanded. The diverse range of uses in food, cosmetics and other commodities, as well as biofuels, combined with a lower market price compared to its competitors, makes palm oil an attractive commodity (Abdullah and Wahid, 2010; Mukherjee and Sovacool, 2014; Rival and Levang, 2014; Mba et al., 2015; Azhar et al., 2017; Pacheco et al., 2017).

To date, such rapid growth in palm oil production can be mainly explained by an expansion of the plantation area (May-Tobin et al., 2012; Gerasimchuk and Koh, 2013), that is associated with a number of sustainability issues including direct and indirect land-use change, deforestation infringement of land rights and labour standards (Basiron and Weng, 2004; Fitzherbert et al., 2008; Tan et al., 2009; Choong and McKay, 2014; Rasetti et al., 2014; Aikanathan et al., 2015; Hansen et al., 2015; Saswattecha et al., 2016; Afriyanti et al., 2016). Palm oil production is fairly concentrated. Currently, more than 85% of the world palm oil productions comes from Malaysia and Indonesia. However, a significant change in oil palm industry has taken place, during the past season, when Indonesia surpassed Malaysia in production of palm oil and now is the world leader.

In Indonesia two major phases of palm oil development can be distinguished: Firstly, the government-led phase and, secondly the marked oriented phased (Euler et al., 2016; Gatto et al., 2015). Since the 1970s, the Indonesian government stimulated oil palm expansion in various ways, initially by subsidizing oil palm plantations. For a considerable time, the government played a direct role in stimulating investments in oil palm plantations through state agencies (Budidarsono et al., 2013). The policy was not implemented for solely plantation development; it was linked and assimilated into other National policy objectives: Population redistribution through resettlement schemes or transmigration, socio-economic progress and political consolidation. Since 1999 to presently, the government changed its policy by seeking to encourage private sector. During this period, the door for foreign direct investment in large-scale plantations opened.

Given that the production is rapidly increasing, especially in Indonesia, the objective of this study is to investigate the relationship between the supply of palm oil in Indonesia and its determinants by using cointegration technique and error correction model (ECM). This paper is organized as follows. Section 2 describes the palm oil market and trends. After a brief literature overview in section 3, section 4 introduces the methodology and the case study. Section 5 then discusses the results. Finally, section 6 presents our conclusions.

2. PALM OIL MARKET AND TRENDS

Palm oil has expanded significantly over the past few years. The global palm oil production increased from 17.64 million tons in 1996 to 66.87 million tons in 2017 with a boost of 279% (Figure 1). This is the highest production volume of all the vegetable oils, exceeding the second biggest oilseed crop, the soybean oil, by more than 10 million tons (USDA, 2017).

Nowadays, Indonesia and Malaysia account for 85% of world production. Although Indonesia and Malaysia are the largest producers by far (36 and 21 million tons respectively), there has also been a marked increase in palm oil production in other parts of the world. Most of the additional volume is produced by Thailand (about 2.2 million tons), Columbia (about 1.3 million tons) and Nigeria (about 1 million tons) (Table 1).

Focusing on Malaysia and Indonesia palm oil production, Figure 2 shows how a significant change in the oil palm market has taken place during the past decade.

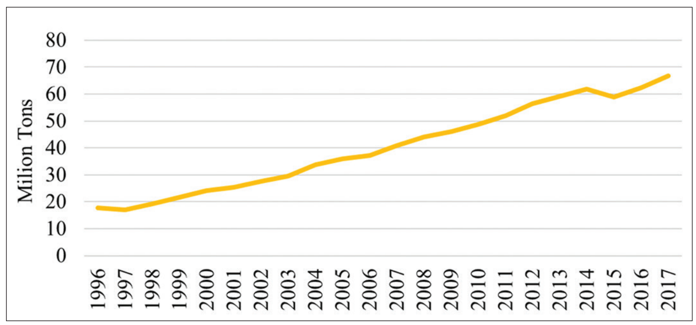
Malaysia was the world's biggest palm oil producer during the 1970s. In the 1980s, Indonesia set herself the goal of overtaking Malaysia in production. To achieve this objective, Indonesian government introduced a set of policy measures in order handed out vast areas of land for oil palm plantations to both foreign investors and domestic business groups (Santosa, 2008). As a result, the plantation area expanded. In 2006, the plantation area reached 5.23 million ha, an area that is ten times greater than in 1985. Consequently, from 2006, Indonesia has overtaken Malaysia and now it became the world's biggest palm oil producer with a production of 36 million tons. In detail, Indonesian production has more than doubled from 2006 to 2017 (+117%) and the harvested area increased from 5.2 million of hectares in 2006-9.3 million of hectares in 2017 (+78%). While in Malaysia palm oil production grew more than 37% and the harvested area increased from 3.7 million of hectares to 5.2 million of hectares over the same period (+40%) (Figure 3).

The growth of the production and the expansion of palm oil area coincide with the increase of palm oil trade. International palm oil trade is very dynamic. In the early 1960s, Africa was the world's largest exporter. From the mid-60s the market is dominated by Asia in both import and export. As shown in Figure 4, Indonesia (26,200,000 tons) and Malaysia (17,300,000 tons) are the largest palm oil exporters by far and together account for 91% of the exports in 2017. Far behind, in third position, there is Guatemala (700,000 tons) followed by Benin (505,000 tons) and Papua New Guinea (550,000 tons).

The imports are distributed over different countries. In 2017, India is the main palm oil importer (9,400,000 tons) worldwide, followed by European Union (6,500,000 tons), China (4,900,000 tons) and Pakistan (3,100,000 tons) (Figure 5). These countries cover the 55 % of global imports.

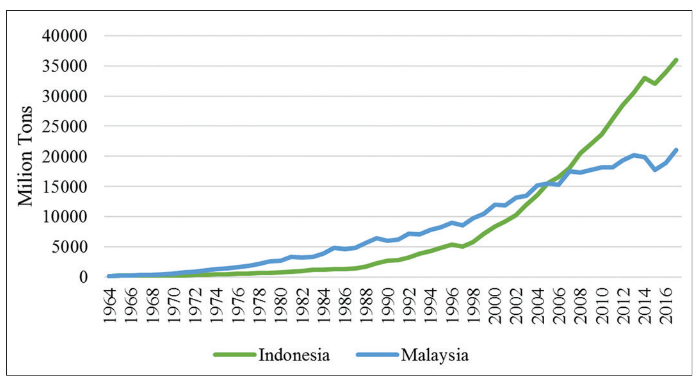
The world demand for palm oil has soared in the last two decades, firstly for its use in food and more recently as raw material for biofuels. In particular, Palm oil is the second most popular biodiesel feedstock in the EU and nearly half of that is used up by the biofuel sector (Bentivoglio et al., 2018). However, as shown in Figure 6, despite the growth in non-food use (consumption

Figure 1: Global palm oil production (1996-2017)



Source: USDA, 2017

Figure 2: Malaysia and Indonesia palm oil production (1964-2017)



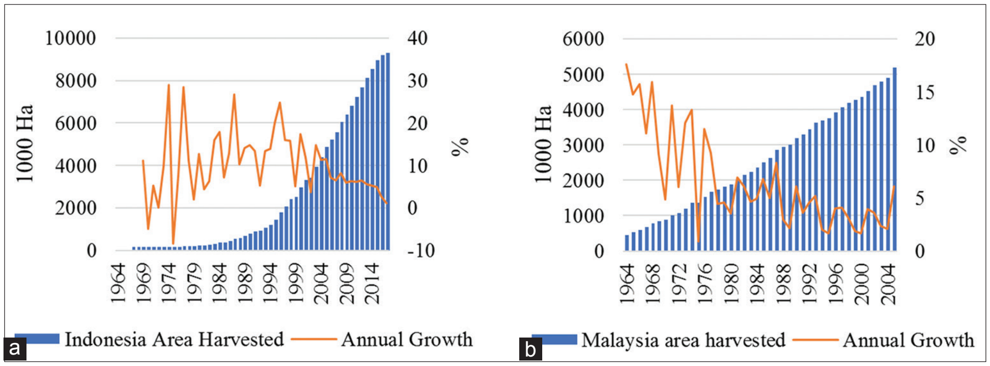
Source: Index Mundi, 2017

Table 1: Top 5 palm oil producers in 2017

Country	Production (1000 Tons)	Share %
Indonesia	36000	54
Malaysia	21000	31
Thailand	2200	3
Colombia	1320	2
Nigeria	970	1

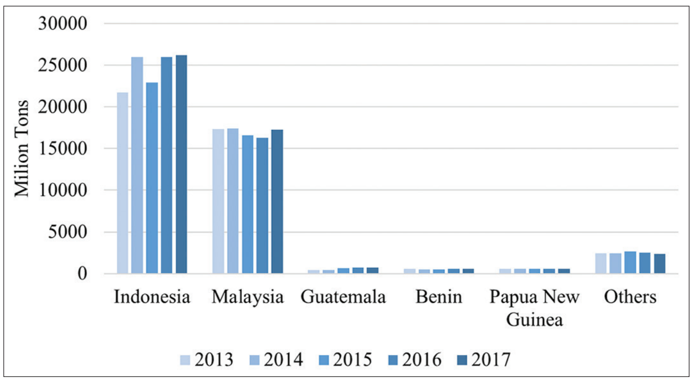
Source: Index mundi, 2017

Figure 3: (a and b) Expansion and annual growth of palm plantation area in Indonesia and Malesya



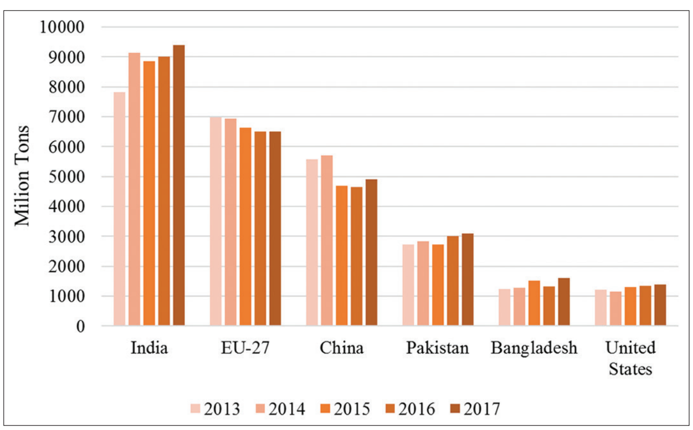
Source: Index Mundi, 2017

Figure 4: The top palm oil exporters (1000 Tons)



Source: Index Mundi, 2017

Figure 5: The top palm oil importers (1000 tons)



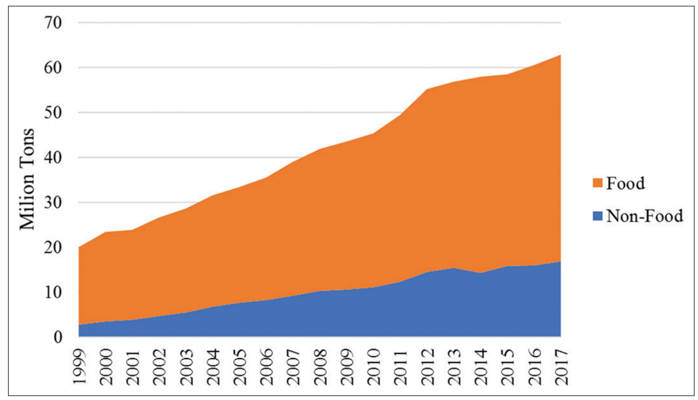
Source: Index Mundi, 2017

growing from 14% to 27%), palm oil has remained primarily utilized for food consumption.

The global palm oil consumption rose from 17 million tons in 1996-63 million tons in 2017, making it the most consumed oil in the world. In particular, in 2017, palm oil made up 33% of the global total vegetable oil consumption, ahead of soybean oil (30%), rapeseed oil (16%) and sunflower oil (9%) (Figure 7).

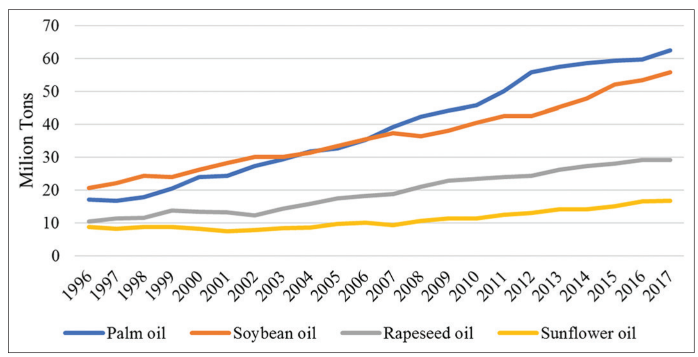
These tables and figures illustrate the transnational character of palm oil production and trade, underlining that palm oil industry has become a global one. Among the reasons for this rapid expansion, there is the high yield oil palm delivers per hectare compared to other oil crops (Figure 8) against low costs. Oil palm is the highest oil yield crop producing on average about 4 tons of oil/ha annually and 10 times more than soybean and 5 times more than rapeseed.

Figure 6: Global consumption of palm oil: Food versus no-food uses



Source: USDA-FAS (2017)

Figure 7: Word consumption of vegetable oil from 1996 to 2017

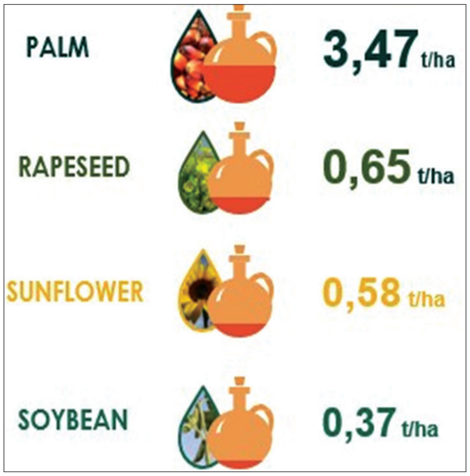


Source: USDA, 2017

In addition, palm oil is by far the cheapest vegetable oil on the world market. As shown in Figure 9, palm oil prices are normally lower than rapeseed, soybean and sunflower oil prices.

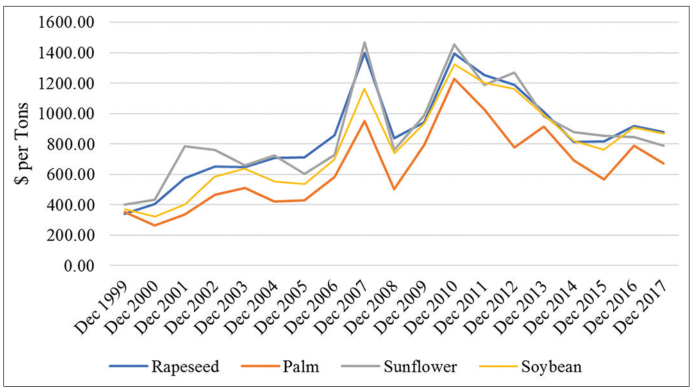
Finally, in terms of production cost, palm oil stands out as the least expensive oil to be produced per ton compared to other major vegetable oils. According to Lam et al, (2009), the production cost of palm oil is about 200 euro per ton while for rapeseed oil

Figure 8: The most productive oil crops



Source: Aidep, 2017

Figure 9: Vegetable oil price



Source: Index Mundi, 2017

in Europe, the price is more than double. Consequently, palm oil represents a more suitable and attractive candidate as the source of both energy and food compared to other vegetable oils.

3. A BRIEF LITERATURE REVIEW

Several researchers have examined the impact of different variables on palm oil price, export and production. Most of previous research studied factors affecting palm oil prices and palm oil export (Lubis, 1994; Hasan et al., 2001; Sulistyanto and Akyuwen, 2011; Ab Rahman, 2012; Nor, et al., 2014; Sahra et al., 2015; Hassan and Balu, 2016). While, in the previous literature, there are relatively few studies, which focus on the main reasons that contributed to the increase in palm oil production, and most of the existing studies are related to Malaysia palm oil industry. Thus, the objective of this paper is to investigate the relationship between palm oil production and its determinants in the Indonesian palm oil industry using times series analysis.

From 1980s to the year 2000s, Malaysia produced about half of the world palm oil production thus, making Malaysia the world largest producer and exporter of palm oil during this period. In 2006, even though Malaysia continued to produce a large amount of palm oil, Indonesia became the world largest producer and exporter of palm oil, replacing Malaysia as a chief producer. Nowadays, the growth of palm oil production can be attributed to many factors. In the following lines, we reviewed some of the most recent articles that study the factors influencing the production of palm oil. With different analytical methods and approaches, these studies attempt to explain the factors behind the return and growth of palm oil production. The findings are mixed, but they are complementary and mutually supportive.

According to Casson (1999) the palm oil growth was determined by several factors, especially by the efficiency and high yield of the harvest combined with low production cost, a promising domestic and international market and government policy, which supports the development of the palm oil industry. According to Chuangchid et al. (2012) the growth of palm oil production could be attributed to the demand of local consumers as well as a low price that is affordable to buy. Asari et al. (2011) used a time series analysis method to examine the influence of total area planted and the price of palm oil on the production of palm oil in Malaysia. They found that the production of palm oil in Malaysia can influence its price level. On the other hand, there is no causality relationship between total area planted and the production of palm oil in Malaysia. As a result, the total area planted and palm oil production does not influence each other's in the short run. In the long run, there is a negative relationship between the production of palm oil with the total area planted and the palm oil price.

Alias and Tang (2005) examined the relationship between the supply of Malaysian palm oil and its determinants by using Johansen cointegration technique and ECM. The results showed that the palm oil production is responsive to its relative price, government's support and interest rate, both in the long run and short run. Egwuma et al. (2016) adopted the ARDL estimation technique to study the determinants of palm oil demand in Nigeria. The authors found that palm oil price and the income lever are important determinants of palm oil demand. Abdullah (2003) showed that maturity of area planted, total area planted, replanting and yield influence the supply of palm oil in Malaysia. Concerning with Carter et al. (2007), the demand for palm oil and its products increases quite steeply, partly due to emerging demand as a relatively cheap biofuel, and partly due to its price advantages in edible applications. Zuikarnain (2008) studied the factors affecting the demand of Malaysian palm oil by using the ordinary least square method and multiple regression model. The results showed that palm oil prices, population and soybean oil prices are significant.

4. METHODOLOGY AND DATA COLLECTION

An extensive literature has applied econometric methods for analyzing time series data to establish the relationships among variables (Banerjee et al., 1993; Peri and Baldi, 2010; Onwusiribe and Okpokiri, 2015; Bentivoglio et al., 2014, 2016; Khobai and Le Roux, 2018). The main objective of the article is to investigate whatever there are long-run and short-run relationships among Indonesian palm oil production and its determinants by using cointegration technique, ECM and Granger causality test. The variables, selected for this study, were based on the factors that could affect palm oil production in Indonesia. For our analysis, we used annual data from 1987 to 2017 for Indonesian palm oil production (POP_{ind}), soybean oil price (SOPRICE), area harvested for palm oil production in Malaysia (POMAREA) and palm oil global consumption (POCONS). In particular, soybean oil was selected because of it is the most important edible oil on the market, and leading competitor with palm oil on the global market. Indeed, palm oil competes head on with soybeans in key markets, from the food industry to biodiesel. While soybean production has been ramping up globally, palm oil has been increasing even more. On the other hand, Malaysia is the main competitor with Indonesia in terms of palm oil production. Indonesia and Malaysia are turning out to be competitors because of their low cost of production. Cheap supply of labour and availability of expansive land are also helping Indonesia to topple Malaysia in this sector (Alam et al., 2015). Finally, palm oil consumption was taken into account due the rapidly increase to fill both food and energy market demand. Despite the growth in the non-food uses over the last decade, palm oil has remained primary used for food consumption. The food industry is responsible for 72% worldwide usage of palm oil. Palm derived ingredients used in personal care and cleaning products are responsible for 18% of worldwide usage (USDA, 2017). Biofuel and feedstock is responsible for 10% of worldwide palm oil usage. Data were gathered from Index Mundi database. The general long-run model can be written as follows:

$$POP_{ind} = f\,(SOPRICE,\ POMAREA,\ POCONS) \tag{1}$$

These variables are then transformed into the linear logarithm form. To investigate our issues, we firstly test for unit roots vs. stationarity. Then, we tested for nocointegration vs. cointegration. Finally, the vector error correction model (VECM) and Granger causality analysis are applied. The stationary or otherwise of a series can strongly influence its behaviour and properties. A stationary time series is one whose statistical properties such as mean, variance, autocorrelation, etc. are all constant over time. Unit roots are one cause for no stationarity. The unit root test is frequently employed for testing the stationarity. The test first poses the null hypothesis that the given time series has the unit root, which means that the time series is non-stationary, and tests if the null hypothesis is to be statistically accepted or rejected in favor of alternative hypothesis that the given time series is stationary. The most popular stationarity tests are Dickey and Fuller's DF-test and ADF test (Dickey and Fuller, 1979), Phillips-Perron test (Phillips and Perron, 1988), KPSS test (Kwiatkowski et al., 1992). These tests utilize two different approaches. Stationarity tests, such as the KPSS test, the Dickey-Fuller test and its augmented version the augmented Dickey-Fuller test (ADF), consider as null hypothesis H_0 that the series is stationary. While in the Phillips-Perron test (PP), the null hypothesis H_0 is that the series possesses a unit root and hence is not stationary. Macroeconomic time series studies are based on the assumption that the time series is stationary. Time series studies, however, show that many time series are not stationary in their levels but stationary in differences. When a non stationary series is differenced "d" times to make it stationary then this series contains "d" unit roots and is said to be integrated of order "d" that is I(d). In other words, if we have two non-stationary time series X and Y that become stationary when differenced (these are called integrated of order one series, or I(1) series) such that some linear combination of X and Y is stationary (I (0)), then we say that X and Y are cointegrated. Thus, while neither X nor Y alone hover around a constant value, some combinations of them do, so we can think of cointegration as describing a particular kind of long-run equilibrium relationship. On the basis of the theory that integrated variables of order one, I(1), may have a cointegration relationship, it is crucial to test for the existence of such a relationship. Similarly, to unit-root testing, the econometric literature offers many different cointegration tests.

In literature there are several estimations of cointegration relations. However, Engle-Granger (1987) and Johansen (1988) procedures are the most commonly used approach. Between these two procedures, Johansen cointegration technique is more powerful (Sjö, 2011). This test permits more than one cointegrating relationship so is more generally applicable than the Engle-Granger test which is based on the Dickey-Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) cointegrating relationship (Bilgili, 1998). The Johansen test is used to test the existence of cointegration and is based on the estimation of the ECM by the maximum likelihood, under various assumptions about the trend or intercepting parameters, and the number k of cointegrating vectors, and then conducting likelihood ratio tests. ECM relates the long-run equilibrium that is implied by cointegration with the short-run dynamic adjustment to describe how the variables react when they deviate from the long-run equilibrium. In particular, Johansen adopted a two-step procedure as follows: Firstly the lag order is determined by an appropriate information criterion (Akaike (AIC) (1973), Hannan and Quinn (1979) and Schwarz (1978) information criteria (IC)) or a sequence of likelihood ratio test, and then the cointegration rank is determined on the lag chose in the first step. Finally, the VECM used to construct Johansen test can be written in the following general form:

$$\Delta x_t = \alpha\left(\beta' x_{t-1} - \beta_0 - \beta_1 t\right) - \gamma_0 - \gamma_1 t + \sum_{j=1}^{k} \Gamma_J \Delta x_{t-j} + \varepsilon_t$$

$$\Delta x_t = \alpha\left(\beta' x_{t-1} - \beta_0 - \beta_1 t\right) - \gamma_0 - \gamma_1 t + \sum_{j=1}^{k} \Gamma_J \Delta x_{t-j} + \varepsilon_t \tag{2}$$

Where x_t is a p x 1 vector of variables observed at date t, α is a p x r matrix of coefficients (where r is the cointegrating rank of the system), β is a p x r matrix of coefficients which defines the r cointegrating vectors in the system, β_0 is an r x 1 vector of intercepts for the cointegrating vectors, β_1 is an r x 1 vector of coefficients which allow for linear deterministic trends in the cointegrating vectors, Υ_0 is a p x 1 vector of intercepts in the equations which make up the VECM, Υ_1 is a p x 1 vector of linear trend coefficients for the VECM and Γ_j, j=1..., k, are sequences of p x p matrices which define the lag structure of the VECM (Turner, 2009).The existence of a long run relationship between the variables does not show which variable causes the other. As a result, the Granger causality is applied to find the direction of causality among the variables (Konya, 2004). The concept of Granger causality is based on the idea that a cause cannot come after its effect. More precisely, variable X is said to Granger-cause another variable, Y, if the current value of Y (y_t) is conditional on the past values of X (x_{t-1}, x_{t-2}..., x_0) and thus the history of X is likely to help predict Y (Granger 1969,1986).

5. RESEARCH FINDINGS

Statistical analysis was performed with Rats32s (Regressions Analysis of times series) statistic software package. The empirical analysis stage of the research starts by testing all series for the null hypothesis of unit root using ADF test. The unit root test results are given in Table 2.

As shown in Table 2, ADF test fails to reject the null hypothesis of unit root, suggesting that all the variables are non-stationarity at the 1% significance level.

The second step in this methodology is to test for the existence or absence of co-integration. The main goal of a co-integration test is to examine if two or more series are linked to form an equilibrium relationship. The Johansen procedure was applied to the series in order to estimate the number of cointegrating relationships. Moreover, it is essential at the onset of cointegration analysis, that we should solve the problem of optimal lag length. A lag- structure analysis based on the Schwarz criterion (SC) and Hannan Quinn information criterion was conducted yielding a consistent estimate of the lag length. The results suggest an optimal lag order of 5. The following table reports our cointegration test using Johansen's maximum likelihood method.

According to the finding in Table 3, the value of trace statistics is smaller than 5% critical value when r is three. It implies that three cointegrating relations exist between all variables. However, our focus was only on POP_{ind} as the dependent variable. Thus, we present only one VECM. By normalizing with respect to the Indonesian palm oil production, this statistical cointegration relationship can be estimated with the following equation:

$$ln\,POPind = +\,0.330\,lnSOPRICE + 1.058\,lnPOMAREA + 0.678\,lnPOCONS - 6.027 \quad (3)$$

All the parameter coefficients appeared to be statistically significant at the 1% confidence level. The parameters indicate that the Indonesian palm oil production (POP_{ind}) is positively related to soybean oil price (*SOPRICE*), area harvested for palm oil production in Malaysia (*POMAREA*) and palm oil consumption (*POCONS*) in the long run. As all variables are logarithmic, we may interpret coefficients in term of elasticity. Therefore, we may say that an increase of 1% in soybean oil price is associated with an increase of 0.330% in Indonesian palm oil production. The positive relationship between palm oil production and soybean oil prices is plausible, given that palm oil has become one of the leading vegetable oils in the world market, sharing this role with soybean oil. Besides, the increased demand of these oils for biofuels production brings on a new source of demand for both oils in the international market. Therefore, according to Hassan and Balu (2016), when the price of soybean oil rises, demand for palm oil will increase in tandem. The coefficient of area harvested for palm oil production in Malaysia is also significant, and its value is 1.058 showing that an increase of 1% of the harvested area, will increase Indonesian palm oil production by 1.058%. Malaysia is the main competitor with Indonesia in terms of palm oil. Palm oil has been a key contributor to the Malaysian economy for the several decades. Malaysia used to be the largest palm oil exporter in the world before being displaced by Indonesia in the past few years. Finally, an increase of 1% in palm oil consumption is associated with an increase of 0.678% in Indonesian palm oil production. In particular, palm oil is a feedstock for food and biofuel. As a result, global consumption has been increasing. In summary, Indonesian palm oil production elasticity with respect to palm oil production in Malaysia is more elastic compared to palm oil production elasticity, with respect to soybean oil price and palm oil consumption.

The third stage of our study involved the constructing standard Granger-type causality tests augmented with a lagged error-correction term, where the series are cointegrated. The existence of a cointegrating relationship among variables suggests that there must be Granger causality in at least one direction, but it does not indicate the direction of temporal causality between the variables. The null hypothesis that x does not Granger-cause y, is tested with the use of the F-statistic. The results from the Granger causality tests are presented in Table 4. We test for all possible directions of causality. The arrow indicates the direction of Granger Causality.

Table 4 presents the p-value (significant at the 5% level) for Granger Causality tests. We found that the direction of causality was from Indonesian palm oil production (POP_{ind}) to both area harvested for palm oil production in Malaysia (POMAREA) and palm oil consumption (POCONS). While, it is found that soybean oil price (SOPRICE), area harvested for palm oil production in Malaysia (POMAREA) and palm oil consumption (POCONS) do not granger cause Indonesian palm oil production (POP_{ind}). Thus, we can conclude that Indonesia palm oil production influences the

Table 2: Results of unit root test[1]

Variabile	ADF
POP Ind	0.586 (1)
SOPRICE	−0.287 (8)
POMAREA	0.826 (0)
CONS	0.233 (1)

Source: Author's computation using Rats32s, 2018

Table 3: Results of Johansen test for cointegration

p-r	r	Eig.Value	Trace	Trace*	Franc95	P	P*
4	0	0.979	185747	38895	53945	0.000	0.532
3	1	0.897	85272	19573	35070	0.000	0.752
2	2	0.529	26138	5973	20164	0.006	0.944
1	3	0.223	6564	1923	9142	0.156	0.788

Source: Author's computation using Rats32s, 2018

1. All variables are in natural logs. ADF regressions include a constant and a time trend. Lag lengths are in parentheses. The 1% critical value for ADF test is −2.58

Table 4: Granger causality tests

Direction of casuality	P
POPind→SOPRICE	0.1327
SOPRICE→POP_{ind}	0.2919
POP_{ind}→POMAREA	0.0129
POMAREA→POP_{ind}	0.7823
POP_{ind}→POCONS	0.0272
POCONS→POP_{ind}	0.8566

Source: Author's computation using Rats32s, 2018

level of palm oil production in Malaysia and palm oil consumption in the short run and not vice versa.

6. DISCUSSION AND CONCLUSION

The production, trade, and market share of palm oil have grown remarkably in the last two decades. From 1996 to 2017, the global production of palm oil grew from 17.64 million tons to more than 66 million tons, with an increase of 279%. Nowadays, Indonesia is the bigger producer of palm oil in the word. On average, more than 70% of Indonesia's palm oil and palm oil products are exported. However, the rise of Indonesia palm oil is only a relatively recent phenomenon. This study developed a simple theoretical model that integrates some of the factor that could influence the production of palm oil in Indonesia in order to establish the issue of cointegration and causality patterns. In particular, this analysis examined the relationships among Indonesian palm oil production, soybean oil price, area harvested for palm oil production in Malaysia and palm oil consumption. In the long-run, the finding showed that soybean oil price, area harvested for palm oil production in Malaysia and palm oil consumption positively and significantly affect Indonesian palm oil production.

Furthermore, we could say that Indonesian palm oil production is relatively more elastic compared to area harvested for palm oil production in Malaysia than with regard to both soybean oil price and palm oil consumption. In addition, the causality test suggested that Indonesia palm oil production influences the level of palm oil production in Malaysia and palm oil consumption in the short run and not vice versa. However, more studies are needed to improve the information reported in this paper by integrating other factors that might move the production of palm oil.

This study only focused on three variables. Indeed, the ascent of the Indonesian palm oil industry is the result of a combination of several factors, some of which are relating to the palm oil plant itself. Thus, oil palm is an exceptionally productive crop, yielding 10 times as much soybean and five times rapeseed. In addition, palm oil is highly versatile. It can be used for either food or non-food applications in a wide variety of products. In particular, the demand of palm oil can be linked primarily to the growth in biodiesel production stimulated especially by European government policies. For biodiesel, the main raw material cultivated in Europe is rapeseed. However, it becomes increasingly difficult for European rapeseed oil to compete with palm oil imported for biodiesel uses, given its low relative price. Other factors are more closely related to the Indonesian domestic and also import policy. Finally, against this backdrop, it is also worth noting that Palm-oil boom raises sustainability concerns. Although the emerging palm oil sector in Indonesia offered opportunities to rural economic development, the palm oil industry progress has serious consequences for biodiversity loss, climate change and natural resources management. So, identifying strategies for sustainable palm oil production represents an important and necessary step forward. Sustainable development of oil palm agriculture implies maximizing its socio and economic benefits.

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