

# Analysis of World Crude Palm Oil Prices on the Real Exchange Rate: A Case Study of Indonesia and Malaysia

Afief El Ashfahany, and M. Fahmi Priyatna

**Abstract**—Crude Palm Oil (CPO) is considered to be the one of important commodities for Indonesia and Malaysia. The value of CPO exports affect the availability of foreign exchange, therefore it contributes in appreciation or depreciation of the exchange rate both countries. This paper aims to analyze relationship between the value of exports toward the exchange rate fluctuations through the world CPO price changes on Rupiah and Ringgit. The method used is *Error Correction Mechanism* or ECM with monthly CPO price data (PCPO) and Rupiah ( $ER_{idn}$ ) & Ringgit ( $ER_{mly}$ ) domestic exchange rate from 1983 to 2014. This study found evidences which prove that PCPO affects Rupiah and Ringgit. As the largest producer, Indonesia is suggested to determine the price reference of CPO in accordance with the normal standard level and desired to be more beneficial for the economy, in this case the stability of Rupiah.

**Keywords**—Error Correction Mechanism (ECM), Indonesian Real Exchange Rate, Malaysian Real Exchange Rate, World CPO Price.

## I. INTRODUCTION

CRUDE Palm Oil (CPO HS 151 110 000) is known as Indonesia main export commodity of the non-oil sector. CPO exports contributed for 30% of non-oil sub-sector industry in 2012. Since 1990, Indonesia CPO exports significantly increased. The CPO export is highly increased from 4 million tons in 2000 up to 20 million tons in 2013 (BPS 2014). The largest outspreads of the palm oil producer are in the five regions, namely Riau, North Sumatra, South Sumatra, Central Kalimantan, and West Kalimantan (PASPI 2014)

Compared with the other nabaty oils, CPO has more qualities and advantages. Examples of the advantages of CPO according to Indonesian Palm Oil Asosiasi (IPOA or GAPKI) are; (1) high productivity level (2) extensive and edible product differentiation (3) CPO can be used as one of

alternatives of the friendliest environmental *fuel blending* for biodiesel (PASPI 2014). Therefore in the future, CPO can be said as the best nabaty oil product in the world.

As a leading commodity export, CPO contributes in keeping the transaction value of the trade balance. Oil trade deficit was successfully covered by the CPO trade surplus which means foreign exchange revenue is greater than expenditure. Fig. 1 shows the development of Indonesia reserves foreign exchange in line with the increasing of the CPO exports.

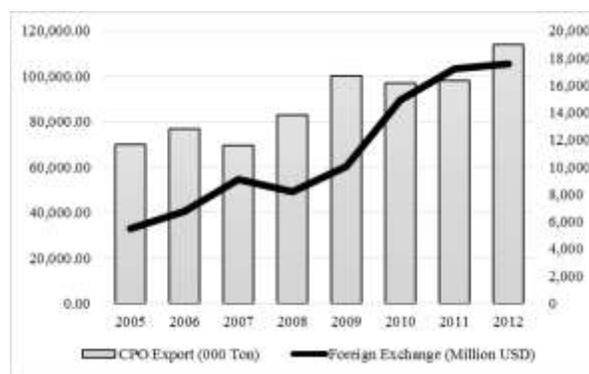


Fig. 1 Indonesian Foreign Exchange and CPO Export

The exchange rate of a country is the balance between demands and supplies of its currency, while net income is defined as an increase in the amount of foreign currency owned by the state. Foreign currency it self will be exchanged for local currency by exporters, which in turns, increase the domestic currency demand and cause an appreciation. The increase in CPO exports also cause the increase of foreign exchange earnings. By all means, the higher CPO export level, the higher the domestic currency is.

CPO's oil price (*CIF Rotterdam*) also determines profit level of CPO trade. The higher world CPO price (ranging between controlled degree of elasticity) will increase the value of CPO trade. This also implies to the increase of foreign exchange.

However, using dollar as currency-benchmark for CPO price makes Indonesia lose some opportunities as the largest CPO producer. In the other side, using Rupiah as currency benchmark for CPO price may increase Rupiah's demand as the consequence of intensive usage. This policy somehow appreciates Rupiah's value. Malaysia, the neighbour of Indonesia, has been applying this method by using Ringgit as

Afief El Ashfahany Student Department of Economics and Development Studies, Faculty of Economics and Business, Diponegoro University, Semarang, Indonesia 50275 ([afiefelashfahany@gmail.com](mailto:afiefelashfahany@gmail.com))

M. Fahmi Priyatna Student Department of Economics and Development Studies, Faculty of Economics and Business, Diponegoro University, Semarang, Indonesia 50275 ([fahmipriyatna@gmail.com](mailto:fahmipriyatna@gmail.com))

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a benchmark price of CPO.

This paper examines the impact of CPO world prices on Rupiah and Ringgit based on empirical evidence. Econometric analysis *Error Correction Mechanism* or ECM is introduced to analyze the effect of two variables time series in short term and long term. This study uses monthly world palm oil price data (PCPO), Rupiah exchange rate (IDR/USD) and Ringgit exchange rate (RM/USD) from 1983 to 2014.

This result of the study will be used as consideration for making policy for both two countries due to standard normal level of palm oil prices. Based on this consideration the two countries should strict to determine the CPO price with local currencies.

## II. MATERIAL

When another studies of palm oil explore environmental-externalities and palm as export commodity; Ratana, Achasani, and Andati estimated impact of exchange rate on exports of vegetable oils (especially export of CPO) using VAR analysis/VECM. It shows the decreasing of the exchange rate has a significant effect in the long term, the depreciation will lower the domestic palm oil prices and increasing exports of CPO (Ratana, Achsani and Andati 2012). Previous researcher, Wisnarti found an evidence that CPO exports to India are not determined by the exchange rate, but it is determined by the GDP percapita, consumption and prices of CPO (Wisnarti 2009). The study of Wisnarti reinforces Abdullah study which shows the CPO export is determined just by the price of CPO (Abdullah, 2011).

Studies on the impact of primary export in case palm oil prices on the exchange rate is still limited. Studies on primary commodity exports to the real exchange rate in advance was conducted by Sebastian Edward using two stage least squares (TSLS). Results of the study found that there was enough evidence increasing in coffee price as the primary commodity exports, appreciate real currency in Colombia (Edwards and Ahamed 1986). A similar study has been conducted by Aprina in Indonesia. Her discovery strengthens Sebastian Edward's research, the rise of palm oil commodity prices appreciate Rupiah exchange rate (Aprina 2014).

The result study from Aprina complements study on the impact of primary commodity exports on domestic exchange rate movements. Earlier, Chen and Rogoff (2003) proved the existence of the relationship between exchange rate and commodity exports in Australia and New Zealand. Cashin, Cespedes, and Sahay (2004) with additional evidence strengthens the case studies in developing countries. Frankel (2007) added minerals as major export commodities in South Africa that affects the state of domestic rate (Aprina 2014).

## III. DATA AND METHODS

This study uses monthly data world price of crude palm oil (PCPO USD/ton) and exchange rate (ER) of Indonesia Rupiah (IDR/USD) and Malaysia Ringgit (RM/USD) from 1983 to 2014. Data of PCPO (*Palm oil \*, in bulk, Malaysia/Indonesia, 5% FFA, CIF NW European ports*) is obtained from

UNCTAD and the data exchange rate is obtained from the Federal Reserve Economic Data (FRED). The analysis tool used is an *Error Correction Mechanism* or ECM.

ECM is a time series econometric model which is used to determine the long-term and short-term time series between two variables. ECM was first introduced by Sargan and popularized by Engel and Granger (Gujarati 2003). In the ECM model, there is an important theorem known as the *Granger Representation Theorem* which states if the variables X and Y are cointegrated, then the relationship between X and Y can estimated by the ECM.

Cointegration is a condition in which the residual from regression between X and Y is stationary. When the residual is stationary, it can be said that a regression of X and Y is a regression in the long-term equilibrium. However, in the short term there might be an imbalance. Then, the correction mechanism is required to view the balance in the short term by using residual variable in previous one period known as an *Error Correction Term* or ECT variable ( $U_{t-1}$ ). This correction mechanism is exactly what is called ECM.

The application of ECM in this study starts from the testing of stationary data through the unit root test Augmented Dickey Fuller (ADF test). Once known the stationary data condition, then the data is transformed into the same stationary level.

The next stage is variables regression of World CPO Price or PCPO and Exchange Rate or ER which is stationary at the same level degree. Equation of PCPO and ER in long-term condition is defined as Equation (1).

$$ER = \alpha_0 + \alpha_1 PCPO + u_t \quad (1)$$

The residuals ( $u_t$ ) of regressed PCPO and ER, afterwards be used in cointegration test.

Cointegration test is conducted through the Engle-Granger test (EG) as expressed in Equation (2).

$$\Delta u_t = \delta_1 u_{t-1} + v_t \quad (2)$$

The final stage is regressing PCPO and ER in the form of ECM by including additional variables  $U_{t-1}$  as a correction variable which is expressed in Equation (3).

$$\Delta ER = \beta_0 + \beta_1 \Delta PCPO + \beta_2 u_{t-1} + \varepsilon_t \quad (3)$$

## IV. RESULT AND DISCUSSION

### A. Stationarity Test

The importance of stationarity data-testing is to avoid misinterpretation caused by spurious regression. Based on the ADF test, all data time series are not stationary in level degree (except PCPO). Furthermore, by transforming the data in the form of the *first difference*, all the data time series turns to be stationary.

TABLE I  
UNITROOT TEST RESULTS (ADF TEST)

| Variable          | Data Level  |        | First Difference |        |
|-------------------|-------------|--------|------------------|--------|
|                   | t-statistic | Prob   | t-statistic      | Prob   |
| ER <sub>idn</sub> | -1.01328    | 0.7496 | -15.9416***      | 0.0000 |
| ER <sub>mly</sub> | -1.72424    | 0.4182 | -16.3107***      | 0.0000 |
| PCPO              | 2.58483*    | 0.0970 | -12.579***       | 0.0000 |

Note: \*\*\*, \*\*, \*) consecutively significant at 1%, 5%, and 10% probability level

### B. Error Correction Mechanism Analysis: 1984 to 2014

Regression equation between PCPO against Rupiah and Ringgit exchange rate is negative and significant. There is enough evidence that the increase in the world CPO price affects the Rupiah and Ringgit exchange rate appreciation in 1983 to 2014 period. Cointegration equation shows a negative and significant residual value, indicating there is long-term relationship (cointegration) between the world CPO price with the exchange rate. So, the initial regression equation can be said as the regression equation in the long term (cointegrated regression).

The result of the empirical analysis of short-term PCPO relation to the exchange rate is negative but not significant. There is no enough evidence that, in short-term, Indonesia Rupiah and Malaysia Ringgit exchange rate is influenced by the world price of crude palm oil. ECT value is negative and significant indicating that ECM models used in the study period 1983-2014 was valid.

TABLE II  
ECM RESULT 1984 TO 2014

|                    | 1983-2014<br>(n=383)              |                                  |
|--------------------|-----------------------------------|----------------------------------|
|                    | Indonesia<br>(ER <sub>idn</sub> ) | Malaysia<br>(ER <sub>mly</sub> ) |
| Long Run           |                                   |                                  |
| C                  | 31.52231<br>(1.130876)            | 0.003070<br>(0.902585)           |
| PCPO               | -1.124815*<br>(-1.812192)         | -0.000173*<br>(-2.287548)        |
| R-Squared          | 0.008524                          | 0.013514                         |
| F-Statistic        | 3.284039                          | 5.232875                         |
| Cointegration Test |                                   |                                  |
| D(U <sub>i</sub> ) |                                   |                                  |
| U <sub>i-1</sub>   | -0.939492***<br>(-18.36955)       | -0.839804***<br>(-16.55985)      |
| R-Squared          | 0.469685                          | 0.418523                         |
| F-Statistic        | 337.4405                          | 274.2285                         |
| Short Run          |                                   |                                  |
| D(ER)              |                                   |                                  |
| C                  | 0.131795<br>(0.004720)            | 0.000253<br>(0.075486)           |
| D(PCPO)            | -0.884355<br>(-1.617788)          | -8.23E-05<br>(-1.253219)         |
| U <sub>i-1</sub>   | -0.939434***<br>(-18.34891)       | -0.840006***<br>(-16.58361)      |
| R-Squared          | 0.471598                          | 0.421357                         |
| F-Statistic        | 169.5750                          | 138.3543                         |

Note: \*\*\*, \*\*, \*) consecutively significant at 1%, 5% and 10% probability level

Based on the result, we found enough evidence of the increasing in the world CPO price (PCPO) significantly affects the exchange rate appreciation in the long term but not in short term. PCPO value is negative according to Aprina (2011) and Sebastian Edward's research (1987) whom conducted an analysis of the impact of the main export commodity exchange. The negative sign indicates the higher PCPO, the lower the amount Rupiah and Ringgit that used to get one dollar (appreciation)—*ceteris paribus*. In the long term, the increase of 1 point palm oil's price will appreciate the amount of Indonesian Rupiah by 1.124815 points, while it will appreciate by 0.000173 points in Malaysia Ringgit. In the

short term, the increasing in PCPO does not cause a change in the exchange rate of Rupiah and Ringgit

### C. ECM Analysis: 1984 to 1996 and 2000 to 2014

The crisis of 1997-1998 occurred in Southeast Asia countries including Indonesia and Malaysia. The crisis was initially a monetary economic crisis, which then evolved into a political crisis and became multidimensional crisis. In 1998, Rupiah fell from Rp4,650/USD to Rp10,375/USD or depreciated by 123%. While the Ringgit desced from RM 3.7907/USD to RM 4.4093/USD or depreciated by 16,32%. That depreciation is determined by the global crisis factor rather than purely economic factors. In order to make this analysis deeper, we will analyze further by conducting the dividing of periodicity analysis of ECM before and after the crisis in 1998.

TABLE III  
ECM RESULT 1984 TO 1996 & 2000 TO 2014

| Dependent Exchange Rate (ER) | Indonesia<br>(ER <sub>idn</sub> )     |                                      | Malaysia<br>(ER <sub>mly</sub> )      |                                      |
|------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|
|                              | Before Crisis<br>1983-1996<br>(n=168) | After Crisis<br>2000-2014<br>(n=179) | Before Crisis<br>1983-1996<br>(n=168) | After Crisis<br>2000-2014<br>(n=179) |
| Long Run (ER)                | (1)                                   | (2)                                  | (3)                                   | (4)                                  |
| C                            | 10.007***<br>(2.980866)               | 33.84100<br>(1.292409)               | 0.001082<br>(0.506677)                | -0.001264<br>(-0.4675)               |
| PCPO                         | 0.052968<br>(0.652252)                | -2.1721***<br>(-4.123188)            | -5.18E-05<br>(-1.00220)               | -0.000282***<br>(-5.1913)            |
| R-Squared                    | 0.002556                              | 0.087183                             | 0.006013                              | 0.131493                             |
| F-Statistic                  | 0.425433                              | 17.00068                             | 1.004243                              | 26.94933                             |
| Cointegration Test           |                                       |                                      |                                       |                                      |
| D(U <sub>i</sub> )           |                                       |                                      |                                       |                                      |
| U <sub>i-1</sub>             | -1.0228***<br>(-13.14307)             | -0.9601***<br>(-12.80463)            | -0.631***<br>(-8.93911)               | -0.723***<br>(-9.66048)              |
| R-Squared                    | 0.511495                              | 0.480875                             | 0.326277                              | 0.345232                             |
| F-Statistic                  | 172.7402                              | 163.9586                             | 79.90767                              | 93.32484                             |
| Short Run                    |                                       |                                      |                                       |                                      |
| D(ER)                        |                                       |                                      |                                       |                                      |
| C                            | 0.029825<br>(0.008822)                | -1.547913<br>(-0.058901)             | 0.000433<br>(0.221538)                | 0.000221<br>(0.08533)                |
| D(PCPO)                      | 0.099145<br>(1.468067)                | -1.8401***<br>(-3.785923)            | -4.27E-05<br>(-1.097)                 | -0.000176***<br>(-3.6580)            |
| U <sub>i-1</sub>             | -1.0277***<br>(-13.13077)             | -0.9577***<br>(-12.72761)            | -0.631***<br>(-8.8933)                | -0.7072***<br>(-9.5074)              |
| R-Squared                    | 0.512644                              | 0.493524                             | 0.326662                              | 0.357609                             |
| F-Statistic                  | 86.25492                              | 85.74953                             | 39.78141                              | 48.98817                             |

Note: \*\*\*, \*\*, \*) consecutively significant at 1%, 5% and 10% probability level

The empirical result of the relationship between PCPO and exchange rate in the period before the crisis in 1983 to 1996 is positive for Indonesia and negative for Malaysia, but they are not significant. There is no enough evidence of a relationship between PCPO and exchange rate in that period. While the result of cointegration test shows negative and significant value to both countries. In other words, PCPO regression equation and the exchange rate is a long-term equation. The empirical result of short-term Exchange PCPO relationship is positive Indonesia and negative to Malaysia, but not

significant. Another aspect is: there is not enough evidence of a relationship between PCPO and exchange rate in the short term. ECT is negative and significant value indicates that the ECM model used is valid.

The relationship between PCPO, Indonesia and Malaysia exchange rate is negative and significant even at  $\alpha = 1\%$ . In the period after crisis in 2000 to 2014, we found that there is enough evidence of the increase in world crude palm oil prices appreciates Rupiah and Ringgit during the period. Cointegration test between the two countries showed a negative and significant value, indicating the regression equation between PCPO and exchange rate is long-term regression equation (cointegrated regression).

The empirical results of short-term relationship between PCPO and Exchange rate for both countries showed a negative and significant value. There is enough evidence in short term that PCPO affects Rupiah and Ringgit. Negative and significant value of ECT shows a valid ECM models and also shows the *adjustment speed* (Firmansyah 2014 & Lyla 2013), Exchange rate adjust in change of PCPO with a lag in both countries. Indonesia ECT value is 0.9573, meaning that 0.96% difference in equilibrium long-term and short-term equilibrium between PCPO and Exchange can be corrected in one period. While the Malaysia ECT 0.707177. The difference, 0.71% equilibrium long-term and short-term equilibrium exchange rate PCPO and can be corrected in one period.

The results of the analysis of the ECM after the crisis is very different from the results of the ECM before the crisis. From 1997 to 1999, there was a crisis which disturbed economic and political instability in Southeast Asia—including Indonesia and Malaysia. In around three years, the exchange rate fluctuated sharply, by then it would be wrong to specify that only the exchange rate is determined by the price of palm oil, there are too many factors which cause the exchange rate to fluctuate.

ECM analysis in after crisis period shows the PCPO influence of the Rupiah and Ringgit in the long term is greater than the effect of short-term, an increasing of 1 point in the long-term PCPO appreciates each Rupiah and Ringgit by 2.172211 and 0.000282 points. Next, in the short term, the increase of 1 point PCPO only appreciates Rupiah and Ringgit of 1.840945 and 0.000176 points.

## V. CONCLUSION

CPO is the non-oil primary commodity exports of Indonesia. Together with Malaysia, Indonesia's CPO production reached more than 80% of the world total production. Nowadays, the CPO trade surplus is the main contributor to the foreign exchange. CPO plays an important role in reducing poverty and unemployment. Furthermore, CPO may support sustainable development in the future as it does not destroy the environment (GAPKI 2014).

It's important to mention that the value of CPO exports would affect the rate of Rupiah and Ringgit. The period study in 1983 to 2014 using ECM models showed enough evidence of a long-term relationship between PCPO and domestic

exchange rate. Furthermore, this study analyzes two different periods: before and after the Southeast Asian crisis. It is projected that there is enough evidence of long-term and short-term relationship between PCPO and Rupiah and Ringgit after crisis period but no evidence before crisis period.

From this study we have another evidence that there is relationship between PCPO and exchange rate for Indonesia and Malaysia. These results reinforce the results of previous research on the relationship of the main export commodities in the local currency of a country by Sebastian Edward. Furthermore, due to the limitations, his paper uses *first difference* data as the only one variable. For more comprehensive research in the future, it appears to be better to do the transformation of data in other forms such as the growth or the natural logarithm. Moreover, some relevant variables can be added as long as it represent relation between palm oil prices and the exchange rate as the budget deficit, foreign exchange reserves, or substitution variables such as palm kernel oil prices or soybean oil prices.

The results of this study may become the important intellectual property for both countries, particularly Indonesia as the world's largest palm oil producer. It is possible to determine the reference price of CPO in accordance with the standard normal level and desired to be more beneficial for the economy, in this case is the stability of the Rupiah exchange rate. In addition, the results of this study further demonstrate the existence of palm oil as an important pillar for the economy of Indonesia. It should be repeated once again that this study deepens repertoire of literature and science of palm oil in Indonesia.

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**Afief El Ashfahany** was born in Jakarta January 14<sup>th</sup>, 1994. He finished senior high school from Husnul Khotimah Islamic Boarding School in 2011, and currently is pursuing bachelor degree in Diponegoro University Semarang, majoring Economics and Development Studies. He is expected to be graduated in 2015.

He served as a The President Student Executive Board Economics and Bussines Faculty, Diponegoro University and now became a Vice President of Academic and Community Development Student Board Diponegoro University. He also well known for his academic awards comprises of 1<sup>st</sup> Place, NETS National Paper Competition at Jenderal Soedirman University, Purwakarta Indonesia (2013) with the title "Redenomination, An Indonesian Opportunity for Facing Asean Economic Community 2015" and 2<sup>nd</sup> Place, PIJAK National Paper Competition at Brawijaya University, Malang Indonesia (2013) with the title "Tax Elasticity and Tax Buoyancy : Indonesia's Tax Performance Analysis in 1990-2011".



**M. Fahmi Priyatna** was born in Rokan Hilir May 19<sup>th</sup>, 1993. Currently, he is enrolled as senior student in Economics and Development Studies Departement Diponegoro University Semarang.

Previously in 2014, he served as The President of Economic Finance Study Club (ECOFINSC), which followed by supervising the organization up until now. He is determined in Economic and Development Studies as he have won some awards comprises of: 1<sup>st</sup> Place, National Paper Competition Indonesia Economic Outlook 2013 at University of Indonesia with the title "Industrial Policy and Trade in Indonesia in the Era of Trade Liberalization". Last year, he also presented his paper on Blue Economy in Society of Interdisciplinary Business and Economics Research (SIBR) international conference Hongkong in 2014. Being prominent in study and social services, Fahmi was nominated as 3<sup>rd</sup> Place Most Outstanding Student of Diponegoro University in 2014.

**Mr. Ashfahany and Mr. Priyatna** currently planning to continue their study in economics after graduating from Economics and Development Studies Departement Diponegoro University Semarang. Mr. Ashfahany plans to explore the field of monetary while Mr. Priyatna interested in the field of public economics. They plan to continue the study of economics in one of the best universities in Europe.