Institutions and Economies
Vol. 9, No. 4, October 2017, pp. 71-87

Effects of Palm Oil Price on Exchange Rate: A Case Study of Malaysia and Indonesia

Mukhriz Izraf Azman Aziz[a], Shri-Dewi Applanaidu[b]

Abstract: *This paper investigates the impact of palm oil prices on exchange rates in Malaysia and Indonesia using the Dynamic Ordinary Least Squares (DOLS) model. The paper uses real monthly data from 1983:1 to 2015:5 and follows three estimation steps: (i) determination of the integrational properties of the data, (ii) testing for cointegration relationship through bounds testing method, and (iii) estimating the long run impact of real palm oil price, real crude oil price and real interest rate differential on real exchange rate. The finding indicates that real palm oil prices have significant negative effects on real exchange rate. While coefficient estimates differ for Malaysia and Indonesia, however, they tend to be around 0.2. In other words, a 10% increase in the real price of palm oil leads to appreciation of about 2% in the equilibrium exchange rate in Malaysia and Indonesia. The findings confirm that an increase in palm oil price leads to exchange rate appreciation.*

Keywords: palm oil price, exchange rate, Malaysia, Indonesia.

JEL Classification: Q17, Q43

Article Received: 15 February 2017; Article Accepted: 20 May 2017.

1. Introduction

The link between exchange rate and crude oil prices has been a subejct of interest among many scholars . Thus, Golub (1983) and Krugman (1983, a. b) were among the earliest scholars to note the significant role of crude oil prices in explaining exchange rate movements. They argued that an increase in crude oil prices generates a corresponding surplus for oil exporters and deficits for oil importers thereby causing reallocation of wealth, which eventually impacts on exchange rates. This has repercussions for both oil-exporting and importing countries due to appreciation or depreciation in exchange rate in case crude oil prices go up, and *vice-versa* when crude oil prices fall. For oil exporting countries such as Malaysia and

[a] Department of Economics and Agribusiness, School of Economics, Finance and Banking, Universiti Utara Malaysia. *Email: mukhriz@uum.edu.my*
[b] Department of Economics and Agribusiness, School of Economics, Finance and Banking, Universiti Utara Malaysia. *Email: dewi@uum.edu.my*

Indonesia where oil exports contribute significantly to their economies, studies have generally found a negative relationship between crude oil price and exchange rates, i.e. an increase in oil prices leads to an appreciation of the domestic currency (see Zalduendo, 2006; Korhonen & Juurikkala, 2009; Aziz, Dahalan & Hakim, 2013). There are insufficent studies on crude palm oil price's effect on exchange rate. While recent studies by Ashfahany and Priyatna (2015) and Kiatmanaroch and Sriboonchitta (2014) showed that palm oil price significantly affects the Rupiah and Ringgit, the authors did not provide theoretical justification linking these two variables. Moreover, simplicity in the modelling framework of both studies suggests that the results could suffer from omitted variable bias.

This paper therefore aims to investigate the impact of palm oil prices on exchange rate in Malaysia and Indonesia from 1983 to 2015. The paper contributes to the literature in three ways. First, it complements the methodologies employed in Ashfahany and Priyatna (2015) and Kiatmanaroch and Sriboonchitta (2014) on the use of Dynamic Ordinary Least Squares (DOLS) with structural breaks. The estimates produced by DOLS with structural breaks are robust despite the endogeneity issues among its regressors. Second, in addition to palm oil prices, in controlling the omitted variable biasness, two important determinants of exchange rate movements, namely real crude oil price and real interest rate differential, are incoporated into the modelling framework. The inclusion of the real interest rate differential is motivated by uncovered real interest rate parity as exhibited by Meese and Rogoff (1988), while the inclusion of real crude oil price follows the work of Chen and Chen (2007). Third, in describing the theoretical link between real exchange rate and real palm oil price, the paper applies Amano and van Norden (1998) terms of trade model that describes the mechanism through which changes in real palm oil price could affect the real exchange rate.

The paper is further organised as follows. Section 2 discusses, briefly, the importance of the palm oil industry in Malaysia and Indonesia while section 3 presents theoretical justification and methodology of the paper. Section 4 discusses results of the unit root and cointegration tests, while Section 5 examines the long run effect of palm oil price on exchange rate. Section 6 concludes the paper.

2. Brief Review of Palm Oil and Oil and Gas Industries in Malaysia and Indonesia

The four commonly traded edible oils in the agricultural commodity market (namely palm oil, soybean, sunflower and rapeseed), soybean oil and palm oil account for roughly 55 percent of the total world production in 2014. It should again be brought to attention that palm oil currently is the most consumed edible oil in the world, with Malaysia and Indonesia being the top two producers, contributing 85% of the world's export and around 5 percent of Gross Domestic Product (GDP) respectively. It is popular because of the lower cost and high oxidative stability of the refined product when used for frying. Additionally, palm oil is often blended with other fuels to create palm oil biodiesel blends. These applications drive its demand in the market, thus competing with soybean for a share in edible oil and biodiesel markets.

Crude palm oil (CPO) is considered as one of the most important contributors to Malaysia's economy. It is the fourth largest contributor to gross national income (GNI), accounting for RM52.7 billion or 8% of GNI in 2011 and it is expected to increase to RM178 billion by 2020 (Abdullah, Dahlan & Rahman, 2015). Acccording to the Malaysian Palm Oil Council (MPOC), Malaysia currently accounts for 39% of world palm oil production and 44% of world exports. Taking into account other oils & fats produced in the country, Malaysia accounts for 12% and 27% of the world's total production and exports of oils and fats respectively. The significance of palm oil industry is well noted when it was identified as one of the 12 National Key Economic Areas (NKEA) to drive the nation's economy. The major aim of this sector, according to the NKEA, is to improve upstream productivity as well as increase downstream expansion, while focusing on the sustainable development of the oil palm industry.

Besides palm oil, the oil and gas (O&G) industry plays an important role in the Malaysian economy by contributing one-tenth of the national GDP over the past decade. Malaysia is an important world energy market because of its large oil and natural gas resources. It is the second-largest O&G producer in the Association of Southeast Asian Nations (ASEAN), where the excess of O&G produce are exported to neighbouring countries such as Singapore, South Korea, Thailand and Japan. Petroleum exports in 2014 contributed significantly to the revenue of the Malaysian government. Revenue from the O&G sector accounted for around 30% of the government revenue, averaging around RM66 billion in 2014 (Pemandu, 2014). The revenue is in the form of petroleum income taxes, oil and gas royalties and dividends paid by Petronas[1] and other international players such as Shell and Exxonmobil. This revenue has assisted the government in undertaking development by spending on infrastructure, education and healthcare, thus contributing further to the country's long-term productive capacity.

The Malaysia Palm Oil Board (MPOB) reported that Indonesia overtook Malaysia as the biggest palm oil exporter in 2008 and currently its global market share is over 50%. It is a major contributor to Indonesia's GDP at around 4.5%. Private enterprises produce 48% , small holder farmers 40%, and state owned plantations, 12%. About 70% of oil palm plantation is located in Sumatra, which is the main production hub while other plantations are located in East and West Kalimantan. It is important to note that exports have been growing with an average of over 70% of total production targeting international markets, India and China being the main destinations, followed by the Netherlands and Singapore. In Indonesia, energy is not just an important economic contributor, but also a principal contributor to the country's export earnings, GDP and government revenues. The significant contribution of energy to Indonesia's economy was clear during the oil boom period (from late 1970s to early 1980s). Data shows that for the last decade, the share of energy sector (O&G and mining) to Indonesia's GDP was continuously declining, from about 15 percent in 2000 to about 10 percent currently, due particularly to rapid growth of the manufacturing and services sectors (Jakarta Post, 2010).

3. Theoretical Justification and Methodology

3.1 Theoretical justification

A number of studies have examined the relationship between commodity prices and the real exchange rate (see Amano & van Norden, 1998; Cashin, Céspedes & Sahay, 2004; Chen & Rogoff, 2002; Douglas, Thompson & Downes, 1997; Edwards, 1985a; Edwards, 1985b). Most of these studies showed a significant relationship for both developing and developed countries and more so for the former whose exports tend to be dominated by commodities (Ngandu, 2005). According to Cashin et al. (2004), commodity prices are likely to be the most important source of persistent change in the real exchange rate of commodity-dependent countries, most of which are developing countries. They pointed out that although terms of trade fluctuations are significant in explaning real exchange rates movements, there has been no comprehensive work done to explain how changes in real commodity prices affect the real exchange rate. Therefore, the current paper will assess the potential impacts of real palm oil price on the real exchange rate using the trade model developed by Amano and van Norden (1998).

3.2 Model Specification

Meese and Rogoff (1988) examined the link between real exchange rates and real interest rate differentials. The real exchange rate, q_t (in log), can be expressed as:

$$q_t \equiv e_t - p_t + p_t^* \qquad (1)$$

where e_t is logarithm of nominal exchange rate (domestic currency per foreign currency unit) and p_t and p_t^* are the logarithms of domestic and foreign prices. Here, three assumptions are made: first, that when a shock occurs, the real exchange rate returns to its equilibrium value at a constant rate; second, that the long-run real exchange rate, $\hat{q}$, is a non-stationary variable; finally, uncovered real interest rate parity (UIP) is fulfilled:

$$E_t (q_{t+k} - q_t) = R_t - R_t^* \qquad (2)$$

where R_t^* and R_t are respectively the real foreign and domestic interest rates for an asset of maturity k. Combining the three assumptions above, the real exchange rate can be expressed in the following :

$$q_t = -\delta(R_t - R_t^*) + \hat{q}_t \qquad (3)$$

where δ is a positive parameter larger than unity. Equation (3) leaves relatively open the question of which are the determinants of $\hat{q}_t$ that are non-stationary variables. The next section discuses the possible incorporation of real palm oil price on real exchange rate movemnents.

3.2.1 Incorporating palm oil price

Amano and van Norden (1998) explained that the model linking terms of trade and exchange rate movemnents may be utilised to clarify the link between palm oil prices and exchange rates. Consider a small country with two sectors of tradable and non-tradable goods, whereby each sector exploits both a tradable input (palm oil) and a non-tradable input (labour), in addition to constant-returns-to-scale technology, with an assumption that the inputs are mobile between sectors and that none of the sectors make profits. The output price of the tradable sector is fixed internationally; hence, the real exchange rate corresponds with the output price in the non-tradable sector. In this case, a rise in the palm oil price will lead to a decrease in the labour price in order to satisfy the competitiveness requirement of the tradable sector. On the other hand, in case the non-tradable sector uses more tradable input than the tradable one, its output price will rise leading to the real apprciation of the exchange rate. The opposite will occur if the non-tradable sector employs less tradable input than tradable one. This has an implication for a palm oil-exporting country such as Malaysia and Indonesia, where a real palm oil price increase may result in the appreciation of the real exchange rate as prices of non-tradable goods increase relative to tradables and *vice-versa*. Correspondingly, this study describes the real exchange rate (RER) as a function of the real price of oil (ROIL), real palm oil price (RPALM) and real interest rate differential (RDR). That is,

$$RER = F(ROIL, RPALM, RDR) \quad (4)$$

One may argue against expression (4) by asserting that it neglects the fact that some other important variables may be missing. However, it is crucial to note that this study aims at exploring the long-term relationship between the real exchange rate and the relevant explanatory variables, especially real palm oil price and its contribution to fluctuations of the real exchange rate. If the study finds a cointegrating relationship among the variables in the model, this will imply that there is no serious problem in so far as missing important variables are concerned, or omitted variable bias. A similar approach in modelling exchange rate as a function of commodity prices can also be found in the work of Chen and Chen (2007) and Korhonen & Juurikkala (2009).

3.3 Data and the long run econometric estimation

This study makes use of monthly data of oil price, palm oil price, nominal exchange rate and interest rate for Malaysia and Indonesia from January 1983 to May 2015 sourced from the International Financial Statistics (IFS). Real exchange rates (RER) are derived from domestic price level and price level in a foreign country. Real exchange rate is the product of nominal exchange rate and the ratio of foreign to domestic price. Real crude oil price (ROIL) is defined as the price of monthly average crude oil expressed in US dollars, deflated by domestic consumer price index (CPI). Real palm oil price (RPALM) is defined as the price of monthly palm oil expressed in US dollars, deflated by domestic CPI. Real interest rate differentials (RDR) is calculated as $RDR_{it} = r_t - r_t^*$, where r_{it} is the real interest rate of domestic country and r_t^* is the real foreign interest rate. Real interest rate is derived using the Fisher equation. The real interest rate solved from the Fisher equation is (1 + Interest) / (1+Inflation) -1. The Hodrick Prescott filter is applied to RDR monthly series to smooth out noisy fluctuations in the series. The United States (US) is chosen as the numeraire country. Logarithmic transformations of RER, ROIL and RPALM are taken before the analysis. The RDR is not in log form as the series contain negative integers.

The long run model to be estimated is given as:

$$\ln(RER)_t = \alpha_1 + \beta_1 \ln(ROIL)_t + \beta_2 \ln(RPALM)_t + \beta_3 (RDR)_t + \mu_t \qquad (5)$$

In this situation, all explanatory variables are expected to have negative coefficient signs. Specifically, an increase in the real interest rate differential (RDR) will lead to the appreciation of the currency. Hence, for oil exporting countries like Malaysia and Indonesia, an increase in the real price of crude oil (ROIL) is expected to lead to an appreciation of the real exchange rate. Likewise, an increase in palm oil price would lead to exchange rate appreciation.

4. Unit Root Test and Cointegration

Before one estimates the long run impact of palm oil on exchange rate, it is important to identify the properties of the data as well as the existence of long run relationships between the variables. This section discusses the results of the unit root and cointegration tests.

4.1 Conventional unit root tests

It is essential to analyse the stationary properties of the data before estimating the long run cointegrating regression. To achieve this, the conventional Augmented Dickey-Fuller (ADF), Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and Phillips-Perron (PP) unit root tests are applied to ROIL, RPALM, RER and RDR. Tables 1 and 2 present the results for Malaysia and Indonesia respectively. Of the four variables, RER and ROIL are integrated at order one or $I(1)$ at 1% significance level when using all three tests for both countries. However, the plot of the log of the series suggests that RER and ROIL might be stationary with a structural break or more than one break (Figure 1 and 2). This is not surprising because crude oil prices and exchange rates may have been affected by major events. Failing to account for structural changes may bias the conventional tests for stationarity that lead to the non-rejection of a unit root, as pointed out by Perron (1989).

Table 1: Conventional Unit Root Tests-Malaysia

Variable	Palm Oil Price	Exchange Rate	Crude Oil Price	Interest Rate Differential
Series in level				
ADF[a]	-3.367564**	-1.92904	-2.574080	-3.934835***
KPSS[b]	0.242767	0.344852***	0.485727***	0.528550**
PP[a]	-2.843748*	-2.057042	-2.826546	-4.080003***
Series in first difference				
ADF[a]	-7.746642***	-18.82635***	-9.687518***	-7.292135***
KPSS[b]	0.033991	0.050469	0.055378	0.053299
PP[a]	-13.94678***	-18.84296***	-13.64799***	-17.85031***

Notes: [a] signifies that the null hypothesis is the unit root. [b] Signifies that the null hypothesis of no unit root. * (**) *** denote statistical significance at the 10%, 5% and 1% levels.

Table 2: Conventional Unit Root Tests –Indonesia

Variable	Palm Oil Price	Exchange Rate	Crude Oil Price	Interest Rate Differential
Series in level				
ADF[a]	-2.8543	-2.1961	-2.9807	-5.2203***
KPSS[b]	0.2298***	0.408725***	0.4785***	0.0752
PP[a]	-2.4736	-3.0284	-2.3285	-4.3874***
Series in first difference				
ADF[a]	-7.8550***	-6.2054***	-6.5417***	-7.8178***
KPSS[b]	0.0416	0.0339	0.0405	0.0127
PP[a]	-13.995***	-18.65369***	-13.515***	-10.292***

Notes: [a] Signifies that the null hypothesis is the unit root. [b] Signifies that the null hypothesis of no unit root. *(**) *** denote statistical significance at the 10%, 5% and 1% levels.

On the contrary, RDR is integrated of order zero at 1% level when using ADF and PP tests for both countries. For RDR, the series is stationary at level because of the construction of the variables itself. Real interest rate differential is derived from taking the difference (or the change) between domestic and US real interest rate. Likewise, RPALM is an $I(0)$ variable at 5% significance level under ADF and KPSS tests for Malaysia but it is an $I(1)$ variable for Indonesia when using all unit root tests. It is interesting to note that careful observation from line plots of Figures 1 and 2 reveal similar pattern of real palm oil price movements for Malaysia and Indonesia, regardless of their contrasting results. This can be attributed to palm oil prices, which are historically influenced by frequent uncertain weather variations that negatively affect crop productivity and supply. A case in point is the last three El-Niño seasons, which caused a sharp slowdown in production; the worst being in 1998, with 7 percent reduction annually. However, these frequent large fluctuations in RPALM may not necessarily lead to structural breaks compared with the price trends in RER and ROIL.

Figure 1: Malaysia

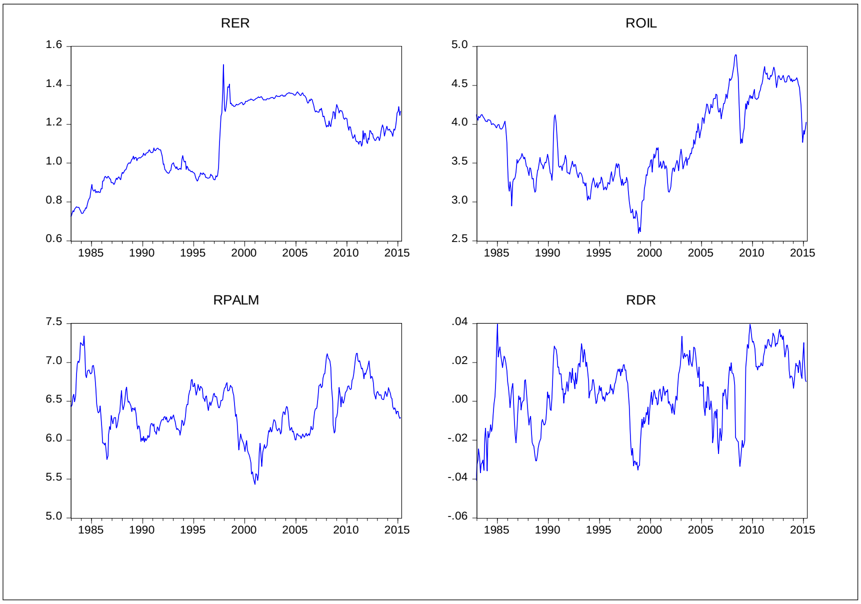
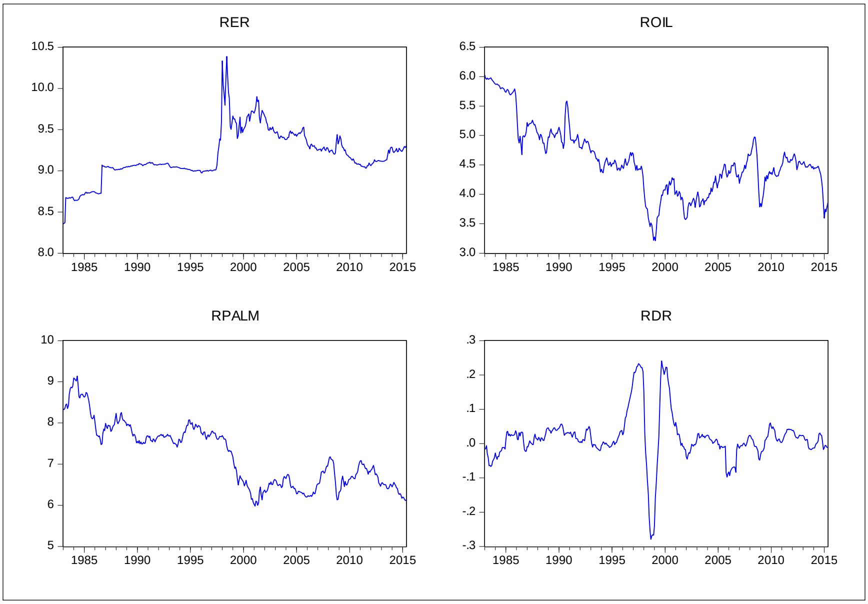


Figure 2: Indonesia



4.2 Unit root tests with structural break

In order to take into account the possible structural break in RER and ROIL series, the study employed the unit root test by Zivot and Andrews (1992) (ZA hereafter) and Perron (1997) (Perron hereafter) that allow for structural breaks. This is because these two tests assume the null hypothesis of unit root against the alternative of a trend stationarity process with a structural break. It is significant to note that, in spite of considering structural breaks, the study cannot reject the null hypothesis of a unit root in the ROIL and RER series for both countries. Both ROIL and RER series are integrated of order one *I*(1) at 5% significance level (see Tables 3 and 4).

Interestingly, the break detected by the tests for real crude oil price in Malaysia roughly corresponds with the timing of the 1999 oil price collapse which resulted from worldwide reduction in consumption due to Asian economic decline and an uncertain warm weather in the US. For real exchange rate, the structural change took place in the mid-1997 for Malaysia and Indonesia, when Asian countries were overwhelmed with the currency crisis. The results from Table 1 to Table 4 show that there is a mixture of *I*(1) and *I*(0) of underlying regressors. It also indicates that RER and ROIL series are integrated of order one regardless of the unit root tests employed. Based on these results, the study proceeds to test whether these variables are cointegrated using Pesaran et al. (2001) bounds cointegration method. This method allows for testing the existence of long run relationships between variables regardless whether they are integrated at order one or zero. Their technique also avoids the problems of uncertainty posed by the lack of power of unit root tests.

Table 3: Unit root with structural break tests-Malaysia

	ZA test	ZA break point	PP test	PP break point
Series in level				
RER	-4.88(0)	1997m07	-4.886(0)	1997m06
ROIL	-4.5970(1)	1999m03	-4.6848(1)	1999m02
Series in difference				
RER	-19.234(0)**	1998m02	-21.291(0)**	1998m01
ROIL	-14.3760(0)**	1999m01	-10.336(3)**	2008m12

Notes: The numbers in parentheses are the lag order. Two asterisks respectively denote rejection of the null hypothesis of the presence of unit root at 5% level.

Table 4: Unit root with structural break tests-Indonesia

	ZA test	ZA break point	PP test	PP break point
Series in level				
RER	-3.805(3)	1997m07	-3.81(3)	1997m06
ROIL	-4.93(1) *	1997m11	-4.96(1)	1997m10
Series in difference				
RER	-8.93(4) **	1998m07	-12.88(4) **	1998m01
ROIL	-14.04(0) **	1999m01	-96.9(3) **	2008m12

Notes: The numbers in parentheses are the lag order. One/two asterisks denote rejection of the null hypothesis of the presence of unit root at 10% and 5% level respectively.

4.3 Bounds cointegration test

The Pesaran et al. (2001) autoregressive distributed lag (ARDL) cointegration test determines two sets of critical values for a given significance level. The first critical values are calculated on the assumption that all variables included in the ARDL model are *I*(1) series, while the second one is calculated on the assumption that the variables are *I*(0) series. Under the null hypothesis of no cointegration, the joint *F*-statistic is rejected when the test statistic exceeds the upper critical bounds value, while H_o is accepted if the *F*-statistic is lower than the lower bounds value. If the *F*-test lies between the bounds, the cointegration test is inconclusive. In the presence of cointegration (i.e. H_o is rejected), the study proceeds with estimation of the long-run model of equation (5).

Table 5: *F*-statistic of Cointegration Relationship-Malaysia

Test statistic	**Value**	**Significance level**	**Bound Critical values* (restricted intercept and trend)**	
			I(0)	*I(1)*
F-statistic	5.294			
		1%	5.17	6.36
		5%	4.01	**5.07****
		10%	3.47	4.45

Note: Two asterisks denote rejection of the null hypothesis of the presence of no cointegration 5% level.

Table 6: *F*-statistic of Cointegration Relationship-Indonesia

Test statistic	**Value**	**Significance level**	**Bound Critical values* (restricted intercept and trend)**	
			I(0)	*I(1)*
F-statistic	15.066			
		1%	5.17	**6.36*****
		5%	4.01	5.07
		10%	3.47	4.45

Note: Three asterisks denote rejection of the null hypothesis of the presence of no cointegration at 1% level.

The bounds testing for Malaysia and Indonesia are estimated together with structural break dummies of crude oil price and exchange rate variables. Results of the calculated *F*-statistics for the cointegration tests are displayed in Tables 5 and 6. For Malaysia, the calculated *F*-statistic (*F*-statistic = 5.294) is higher than the upper bound critical value at 5 per cent level of significance (5.07). For Indonesia, the F-statistic is equal to 15.066 and is statistically significant at 1 per cent. The results imply that the null hypothesis of no cointegration cannot be accepted and that there exist cointegration relationships between the exchange rates of Malaysia and Indonesia and their determinants respectively.

5. Findings – Long Run Impact

This study found that if a cointegration relationship existed, equation (5) is estimated using the DOLS as advocated by Saikkonen (1991) and Stock and Watson (1993). The DOLS involves regressing one of the *I*(1) variables on other *I*(1) variables, the *I*(0) variables, and lags and leads of the first difference of the *I* (1) variables (Narayan and Narayan, 2004). The estimates produced by DOLS are robust despite the endogeneity issues among its regressors. It should be noted that when the unit root test with structural break is performed, RER and ROIL are still *I*(1) variables, indicating the presence of structural breaks have no significant impacts on the series. Therefore, the study continues with estimating the long-run elasticities of the impact of real oil price, real palm oil and real interest rate differential on real exchange rate without structural break dummies. For checking robustness, the study will estimate the long run regression with structural break dummies. The two dummy variables enter as deterministic terms to capture the structural breaks in the RER and ROIL series as detected in the ZA and the Perron tests.

Tables 7 and 8 show results of the long run model estimated through the DOLS. Amazingly, the two models in either case without or with dummy variables provide similar results for Malaysia and Indonesia, thus confirming the robustness of the long run model. ROIL and RPALM parameters are statistically significant and have the expected negative signs. Notably, between the two export commodities, palm oil price (RPALM) was found to have a greater impact on exchange rate than crude oil price in Malaysia. It is noted that estimations without deterministic regressors, other things being equal, a 10 percent increase in palm oil price (RPALM) appreciates the Ringgit by 2 percent. On the contrary, estimates without deterministic regressors, with a 10 percent increase in crude oil price (ROIL) showed an appreciation of the Ringgit by 0.74 percent only. However, in the case of Indonesia, the impact of palm oil price on exchange rate is noticed to be marginally greater than crude oil price when estimated with deterministic regressors. It is found that a 10 percent increase in palm oil price and crude oil price individually appreciates the Rupiah by 2.9 percent and 2.2 percent respectively. Finally, the RDR variable is negatively significant for Malaysia in both models but it is only statistically significant for Indonesia when estimated without deterministic regressors.

Table 7: Dynamic OLS –Malaysia

Regressors	*without deterministic regressors*		*with deterministic regressors*	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics
$\beta_1$ln(ROIL)	-0.074***	-4.947	-0.025	-1.698*
$\beta_2$ln(RPALM)	-0.200***	-13.884	-0.240	-19.202**
β_3(RDR)	-2.491***	-9.112	-2.151	-7.567***
Dummy RER	NA	NA	0.182	4.484***
Dummy ROIL	NA	NA	0.048	3.122***

Notes: The DOLS was estimated by including up to two lags and leads. The results presented here do not include lags and leads. * (**) *** denote statistical significance at the 10%, 5% and 1% level

Table 8: Dynamic OLS –Indonesia

Regressors	*without deterministic regressors*		*with deterministic regressors*	
	Coefficient	*t*-statistics	Coefficient	*t*-statistics
$\beta_1$ln(ROIL)	-0.388***	-14.899	-0.223	-13.132***
$\beta_2$ln(RPALM)	-0.176***	-7.021	-0.285	-15.460***
β_3(RDR)	-0.258**	-2.153	-0.060	-0.494
Dummy RER	NA	NA	0.166	2.406**
Dummy ROIL	NA	NA	0.272	5.393***

Notes: The DOLS was estimated by including up to two lags and leads. The results presented here do not include lags and leads. * (**) *** denote statistical significance at the 10%, 5% and 1% level.

Generally, findings from these estimates suggest that real crude oil price and real palm oil price have negative effects on real exchange rate, whereby higher prices result in real exchange rate appreciation. Interestingly, previous literature established the fact that that real commodity prices influence real exchange rates in commodity-exporting countries. Those studies coincide with these findings for Malaysia and Indonesia. Between RPALM and ROIL, the influence of palm oil price on exchange rate is consistently higher than crude oil price in Malaysia. This is somewhat perplexing given the relatively bigger contribution of the O&G industry to the Malaysian economy compared with the palm oil industry. One plausible explanation is that Malaysia is advantaged in the palm oil industry as ‘price maker’ but is a ‘price taker’ in the O&G sector. Consequently, the ability to influence the market price for palm oil exports is reflected on the higher coefficient values of RPALM for Malaysia. The same situation is also true for Indonesia. In spite of the fact that the contribution of O&G industry to Indonesia's GDP is twice than that of palm oil industry, the impact of palm oil price on the Rupiah outweighs the impact of crude oil price. This is true when the long run model is measured with the deterministic regressors.

6. Conclusion

The impacts of crude oil price, crude palm oil price and real interest rate differential on Malaysian Ringgit and Indonesian Rupiah are examined using monthly time series data from 1983:1 to 2015:5. This study uses the Pesaran, Shin and Smith (2001) bounds testing method in determining whether exchange rates are cointegrated with crude oil price, crude palm oil price and real interest rate differential. In order to find out the existence of a long-run relationship, the study utilises the DOLS method to determine the long-run estimates. The empirical results substantiate that real palm oil price and real crude oil price have statistically significant negative effects on Malaysian and Indonesian exchange rates, whereby higher prices will lead to an appreciation in real exchange rate. Given the dearth of studies devoted to the analysis of the nexus between agricultural commodity prices (palm oil price in particular) and exchange rate among commodity exporting countries, findings from this study provide additional evidence linking these two variables, and perhaps justifying the predictive ability of palm oil price in explaining exchange rate movements of the Ringgit and Rupiah.

Notes

1. Petronas (or Petroliam Nasional Berhad) is Malaysia's nationally owned petroleum company.

References

Abdullah, I., Dahlan, A., & Rahman, A. (2015). The transformation of an agriculture to an industrial-based economy through crowd sourcing in Malaysia. *International Journal of Computer Science and Information Technology Research*, *3*(1), 34-41. Retrieved from http://irep.iium.edu.my/40894/

Amano R.A., & Van Norden S. (1998). Oil prices and the rise and fall of the US real exchange rate. *Journal of International Money and Finance, 17*:299-316. https://doi.org/10.1016/S0261-5606(98)00004-7

Ashfahany, Afief El., & M. Fahmi Priyatna. (2015). Analysis of world crude palm oil prices on the real exchange rate: a case study of Indonesia and Malaysia. *International Conference on Trends in Business and Economics* (ICTBE'15); May 29-30, 2015 London (UK). Retrieved from http://icehm.org/upload/7522ED0515510.pdf

Aziz, M. I. A., Dahalan, J., & Hakim, L. (2013). Oil price and exchange rate relationship for ASEAN-5 countries: A panel study approach. *World Applied Sciences Journal 28 (Economic, Finance and Management Outlooks):* 27-31, 2013. https://doi.org/10.5829/idosi.wasj.2013.28.efmo.27006

Cashin, P., Céspedes, L. F., & Sahay, R. (2004). Commodity currencies and the real exchange rate. *Journal of Development Economics, 75*(1), 239-268. https://doi.org/10.1016/j.jdeveco.2003.08.005

Chen, S.-S. & Chen, H.-C. (2007). Oil prices and real exchange rates. *Energy Economics, 29***,** 390-404. https://doi.org/10.1016/j.eneco.2006.08.003

Chen, Y., & K. Rogoff, (2002). Commodity Currencies and Empirical Exchange Rate Puzzles. IMF Working Paper WP/02/27 Washington: International Monetary Fund. Retrieved from https://www.dnb.nl/binaries/sr076_tcm46-146853.pdf

Douglas, J., Thompson, H., & Downes, P. (1997, September). Modelling the exchange rate and commodity prices in the Treasury Macroeconomic (TRYM) model. In 26th Annual Conference of Economists, Economic Society of Australia, Hobart (Vol. 29). Retrieved from https://archive.treasury.gov.au/documents/239/PDF/p18.pdf

Edwards, S. (1985a). Commodity export prices and the real exchange rate in developing countries: Coffee in Colombia. In Economic Adjustment and Exchange Rates in Developing Countries (pp. 233-266). University of Chicago Press. Retrieved from http://www.nber.org/chapters/c7675.pdf

Edwards, S, (1985b). Commodity export boom and the real exchange rate: The Money Inflation Link. NBER Working Paper Series WP1741. Retrieved from http://core.ac.uk/download/pdf/6784550.pdf

Golub, S. S. (1983). Oil prices and exchange rates. *The Economic Journal.* 93**:**576-593. https://doi.org/10.2307/2232396

Jakarta Post (2010). Our economic growth can be sustained only if energy to fuel the growth is secured. Retrieved from https://www.pressreader.com/indonesia/the-jakarta-post/20100715/281526517329258

Kiatmanaroch, T. & Sriboonchitta, S. (2014). Relationship between Exchange Rates, Palm Oil Prices, and Crude Oil Prices: A Vine Copula Based GARCH Approach. *Modelling Dependence in*

Econometrics, 399-413. https://doi.org/10.1007/978-3-319-03395-2_25

Korhonen, I & Juurikkala, T. (2009). Equilibrium exchange rates in oil-exporting countries. *Journal of Economics & Finance* 33**:** 71-79. https://doi.org/10.1007/s12197-008-9067-x

Krugman, P. (1983a). Oil and the dollar. In Bahandari, J. S. & Putnam, B. H. (eds.) *Economic Interdependence and Flexible Exchange Rates*. Cambridge, MA, MIT Press.

Krugman, P. (1983b). Oil shocks and exchange rate dynamics. In Frenkel, J. A. (eds.) *Exchange Rates and International Macroeconomics*. Chicago, University of Chicago Press.

Meese, R. & Rogoff, K. (1988). Was it real? The exchange rate-interest differential relation over the modern floating-rate period. *The Journal of Finance* 43**:**933-948. https://doi.org/10.1111/j.1540-6261.1988.tb02613.x

Narayan, S., & Narayan, P. K. (2004). Determinants of demand for Fiji's exports: an empirical investigation. *The Developing Economies*, *42*(1), 95-112. https://doi.org/10.1111/j.1746-1049.2004.tb01017.x

Ngandu, S. (2005). Mineral prices and the exchange rate: What does the literature say. HSRC: Mimeo. Retrieved from http://www.hsrc.ac.za /en/research-data/ktree-doc/1228

Pemandu. ETP Annual Report. (2014). Retrieved from: https://www.pemandu.gov.my/assets/publications/annual-reports/ETP_2014_EN.pdf

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*: *Journal of the Econometric Society*, *57*(6), 1361-1401. Retrieved from http://www.jstor.org/stable /1913712

Perron, P. (1997). Further evidence on breaking trend functions in macroeconomic variables. *Journal of Econometrics*, *80*(2), 355-385. https://doi.org/10.1016/S0304-4076(97)00049-3

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326. https://doi.org/10.1002/jae.616

Saikkonen, P. (1991). Asymptotically efficient estimation of cointegration regressions. *Econometric Theory*, *7*(01), 1-21. https://doi.org/10.10 17/S0266466600004217

Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica: Journal of the Econometric Society*, 783-820. https://doi.org/10.2307/2951763

Zalduendo, J. (2006) Determinants of Venezuela's Equilibrium Real Exchange Rate. *IMF Working Papers*, 6074, 1-17. Retrieved from http://www.imf.org/external/pubs/cat/longres.aspx?sk=19034

Zivot, E., Andrews, D.W.K. (1992). Further evidence on the great crash, the oil price shock, and the unit root hypothesis. *Journal of Business and Economic Statistics, 10,* 251–270. https//doi.org/10.1198/073500102753410372