Palm oil export : is it price led or exchange rate led? evidence from Malaysia

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Palm oil export : is it price led or exchange rate led? evidence from Malaysia

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Abstract:

Economic theory suggests that in a closed economy, the quantity demanded is sensitive to price and in an open economy, it is also sensitive to exchange rate. However, the theory can't clearly tell us which variable is relatively the driver and which variable is the follower in the context of dynamic interdependence of the variables. We need to apply the dynamic time series techniques to obtain the relative lead-lag position between these variables. Malaysia is used as a case study. Findings suggest that in the long run, variables under study are theoretically related as evidenced in their being cointegrated. In addition, based on the generalized variance decompositions technique, the findings tend to suggest that exchange rate is the most exogenous variable followed by palm oil price and export volume. This is an important finding which is intuitive and does contain strong policy implications.

Keywords: Exchange rate, Price, Export, Palm Oil, lead-lag, VECM, VDC, Malaysia

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1. Introduction

Theory says that, when one trades outside the domestic horizon; exchange rate plays an important role. As exchange rate depreciates in home country, theoretically export volume tends to be more than usual because relative price in foreign country is cheaper. When home currency appreciates, relative price of the goods in foreign country becomes more expensive. However, the same case is also applicable when the price of the goods itself decrease, demand for it increase and therefore export. As price of that good increases, then demand for it is reduced and less export will be recorded. Empirical evidences show mixed result. Studies (Erfita, Arfani, & Dewanta, 2016) (Harvey & Oskooee, 2011) (Harvey & Oskooee, 2012) (Ahmed, Ismail, Ahmad, & Aftab, 2015) (Aftab & Oskooee, 2016) (Aftab & Oskooee, 2017) show that exchange rate have long term relationship and influence the export volume of palm oil. While others also prove that price of goods influences export volume (Cornejo & Ahumada, 2015) (Narayan & Narayan, 2004).

These two theories to some extent may be confusing about the relationship they have to the export volume. It is important to address nowadays because the economy had become more open. And that means, a lot of factors can contribute to export volume. As to this study, we would like to investigate within the framework of price-led export and exchange rate-led export on the sector that Malaysia ranks at second place in the world; palm oil. There are many recent studies that investigate Malaysia's bilateral trade balance against exchange rate volatility and income of the other trading partner due to availability of data at favorable frequency that can accommodate time series techniques. While their study focuses more on aggregate industry, our study would focus on palm oil. In addition to that, we will extend their cointegration testing with long run structural modelling and variance decomposition to dictate empirically who is the most exogenous and most endogenous variable.

The structure of this study is as follows: Section 1 provides an introduction as to what issue we intend to address.. Section 2 will discuss theoretical controversy as well as empirical controversy. Section 3 will explain on data, model specification and methodology, and followed by empirical findings in section 4. Section 5 concludes.

2. Background & Literature Review

Price leads export – theoretical

Economic theory connotes that quantity demanded is sensitive to the changes in price. The good is said to be unit elastic when the percentage change in demand corresponds with the same percentage change in price. Inelastic goods has less percentage changes in demand compared to percentage change in price, while perfectly elastic goods has more percentage changes in demand when percentage change in price is little. For palm oil, as one of the world edible oils have line of substitutes namely soybean oil, corn oil, coconut oil, rapeseed oil, sunflower oil, olive oil, and ground peanut oil. The usage is primarily in domestic cooking ingredient and can be used also in cosmetics,

food and beverages, and toiletries. Theoretically, these features justify enough that palm oil is very elastic goods.

There are two possible impacts of substitutes oil can bring to the export volume of palm oil. First is when price of other edible oils change and palm oil price remain constant, let us say become cheaper compared to palm oil; will make the price of palm oil less competitive and unattractive and therefore demand for palm oil weakens. Second is when there is excess export supply of other substitute oils, supply for palm oil remain unchanged, and price of substitute oils are adjusted accordingly; therefore palm oil price is still unattractive. Palm oil exporter however needs not to worry so much because of the magnitude of changes not necessarily that big. Replacing and switching from one edible oil to another edible oil require cost at industrial level, as if they (foreign manufacturer) have made preliminary contract with palm oil exporter at certain quantity and at agreed price. While at household level, level of income can be attributed to the demand for palm oil as other edible oil is more expensive. If they have more income, means they have more purchasing power and able to switch to other than palm oil at anytime as they can absorb extra cost of switching (Schembri, 1989).

As Malaysia is a major exporting country, one must not leisurely claim that the price is the leader in determining palm oil export volume. Even when production and export of Malaysia and Indonesia combined and consequently mirror the monopolistic world producer, still the price of palm oil fluctuates and corresponds to other edible oils' price. In theory, it is a firm that operates under monopolistic market has the power of price determiner. As Malaysia and Indonesia have significant world market power of palm oil production and export, so it is logical to say that both countries have the power to set the world palm oil price. Having said that at whatever price level of palm oil is, say higher than normal market price; demand for export of palm oil remains unchanged and exporter reaps tremendous profit. Palm oil becomes perfectly inelastic since. It is then only a matter of maintaining domestic supply and to ensure domestic price of palm oil is not distorted. However in reality, this is far from happening because world market for edible oil is not monopolistic but yes to palm oil market. Unfortunately substitution hinders Malaysia and Indonesia to be the world palm oil price determiner and therefore miss the chance to earn extra profit (Johnson & Scobie, 1979) (Inder & In, 1997).

Exchange rate leads export - theoretical

Under the theory of purchasing power parity, relative price changes according to exchange rate movements. Several scenarios can be drawn from this theory in relation to palm oil relative price and its export volume. Assuming the domestic price of palm oil is constant but ringgit exchange rate depreciates against dollar; export volume is expected to increase as importing countries have extra purchasing power to buy more palm oil. At the same time, export volume is expected to decrease when ringgit appreciate against dollar, as the relative price increase. On the other hand when we assume exchange rate is constant and that palm oil price increase domestically, the relative price is increasing and by right should have reduced export demand and volume to importing countries. Export will increase when palm oil price at exporting country reduces.

But one must be aware that decision to export and how much the quantum is, and the price level of palm oil changes to the change in exchange rate; are subjective. Subjective here best refers to the behavior of the firm, of which how they adjust export volume and price to achieve profit maximization when exchange rate appreciates or depreciates. Palm oil exporter's reaction may deviate from the theory explained above. Deviations may materialize when the exchange rate changes are perceived to be permanent, causing the exporter to adjust its export price expressed in foreign currency. However if the change is expected to be temporary and will come back in near future to 'equilibrium', palm oil exporter might opt to maintain its export volume and the price level; and therefore absorbs the loss if any from exchange rate translation in profit margin (Schembri, 1989).

One is not wrong to expect that changes in exchange rate leads to none or less impact to export volume. The degree of risk averseness of exporter must also take into consideration as it has power to normalize the theoretical impact from exchange rate movements. As explained earlier, if the changes of exchange rate are perceived to be temporary; palm oil exporter might consider earning less profit if they maintain the export volume and that not always is the case. The exporter will magnify the palm oil export volume to cover the profit margin loss from the exchange rate changes. Normalization can also be explained by the availability of hedging mechanism in the market. Suppose that changes in exchange rate perceived to be permanent, exporter may enter into forward or futures contract to lock the future relative price in foreign currency while maintaining the export volume. Hedging becomes more favorable when exchange rate volatility is high, but the trade-off is exporters need to incur more cost as to pay the premium. It doesn't matter if exporter increases the export volume and pay the premium so long the exchange rate is certain in the future as it means profit margin is secured and profit is within expectation (Ozturk, 2006).

Price leads export – empirical evidence

Reinhart (1995) examines the cointegration of export volume to export price within a sample of twelve countries from 1970 to 1992. The result is mixed. Congo, Morocco, Hong Kong, Sri Lanka, Argentina, Pakistan, Columbia, Costa Rica and Mexico are shwoing cointegration between export volume and price in long term. While Kenya, Indonesia, and Brazil show no cointegration between export volume and price. Empirical investigation on Fiji's export conducted by Narayan & Narayan (2004) assume that Fiji's export demand is the function of trading partner income, export price, and competitor price. By using autoregressive distributed lag, they found that export volume is explained significantly by export price in both long term and short term but has negative relationship. The magnitude in long term is much bigger than of short term indicate that, while reduction in export price will increase export volume assuming other factors constant, the price impact is much greater for long term export.

A study exploring Argentina's commodity export determinants has been conducted by Cornejo & Ahumada (2015)[1]. By using cointegration technique and vector error correction model, they study

[1] Retrieved on December 15, 2017, from https://ideas.repec.org/a/lap/journl/595.html

commodity export to the function of sector production capacity, world price of exports, and real exchange rate. Their finding suggests that export price, for long term, has positive and significant relationship where increase of export price encourage the export volume. Compared to exchange rate influences, export price is a weak exogenous determinant in their export volume function. That's mean the impact of price is less than the impact of exchange rate. Erfita, Arfani, & Dewanta (2016) explore the competetiveness of Indonesia' palm oil export at India from 1990 to 2014. They estimate the function of export volume to the international price, GDP of India, and real exchange rate by using cointegration test and vector error correction model. They found that in long term, price of palm oil is insignificant but negatively significant in short term.

Belongia & Batten (1984) in their work, study about the possible determinant on why US agricultural export decline from 1971 to 1984. Using OLS, they estimate the export volume to the function of GNP, price of agricultural export, U.S. consumer price index, and exchange rate. The finding tells that exchange rate has significant negative relationship with export volume. According to their result, 1 percent increase in exchange rate will decline the export volume by 0.71 percent. Study by Choudhry (2005) investigates the influence of exchange rate volatility on the real exports of the United States to Canada and Japan. His study under period is from 1974 to 1998 by using Johansen multivariate cointegration method and the constrained error correction to estimate the function of U.S. export to GDP of respective country, relative price of export at importing countries, and the exchange rate volatility. The finding is negatively significant to the export volume in long term. He further test with differenced one time of error term to see the impact in short term, and still produce negative significant relationship.

Exchange rate leads export – empirical evidence

A work by Vieira & MacDonald (2016) examine the role of real effective exchange rate volatility on export volume, rather than the exchange rate itself. By using panel data technique i.e. system GMM over the period of 2000 to 2011, they find that the exchange rate volatility reduce the export volume. Their finding might suffer from aggregate bias because their countries under study are 106. Further testing had been conducted by removing oil export and found that relationship between export volume and exchange rate volatility become insignificant. Study by Erfita, Arfani, & Dewanta (2016) suggest that exchange rate leads the export volume to Indonesia's export country in long term. The export under their period of study, 1990 to 2014, is elastic to exchange rate. 1 percent Rupiah depreciation increases palm oil export to India more than 1 percent. However their result found insignificant relationship in short term.

Evidence from Malaysia

Above are empirical evidence from developed country i.e. U.S. and from developing countries i.e. Indonesia and Argentina. However we found that empirical evidence that investigate Malaysia's export particularly on palm oil is limited. Most of the studies explore the bilateral trade between Malaysia and her trading partners and its relationship to exchange rate and income of the countries under study, since

the data of import and export are rich and publicly available. Nonetheless, an attempt to discern these studies should be conducted and hopefully could find some evidence pertaining the effect of price to export and the effect of exchange rate to plam oil export.

Below table is the summary of the review, where ER is exchange rate for long term, DER is exchange rate differenced to indicate short term, XP is export price for long term, and DXP is export price differenced to indicate short term. Figures are in t-statistic, except those with star which is the coeficient (star is to indicate its t-statistic is significant at 5% error). Those t-statistic are taken from their estimation using export function. Below studies all of them using cointegration technique, some use autoregressive distributed lag, some use non-linear autoregressive distributed lag, and some extend the cointegration technique with vector error correction model. They estimate the function of net export volume according to respective industry to the exchange rate volatility, and income of the trading partner country. None of them include the price of palm oil in their estimation. As for this study, we just extract their estimation result that concern only on palm oil export.

No.	Author	ER	DER	XP	DXP
1.	(Aftab & Oskooee, Asymmetric effects of exchange rate changes on the Malaysia-EU trade: evidence from industry data, 2016)	.1309	.6108	n.a	n.a
2.	(Harvey, Aftab, & Oskooee, Asymmetry cointegration and the J-curve: New evidence from Malaysia-Singapore commodity trade, 2016)	2.50	0.77	n.a	n.a
3.	(Aftab & Oskooee, Malaysia–Korea Commodity Trade - Are there Asymmetric Responses to Exchange Rate Changes, 2017)	13.4768	n.a	n.a	n.a
4.	(Ahmed, Ismail, Ahmad, & Aftab, Does exchange-rate uncertainty matter in the Malaysia–E.U. bilateral trade - An industry level investigation, 2015)	-0.3069**	n.a	n.a	n.a
5.	(Chua & Soleymani, Effect of exchange rate volatility on industry trade flows between Malaysia and China, 2016)	0.69	n.a	n.a	n.a
6.	(Rehman & Aftab, Exchange rate risk and the bilateral trade between Malaysia and Singapore, 2017)	-6.1076**	n.a	n.a	n.a
7.	(Katper, Syed, & Aftab, Exchange-rate volatility and Malaysian-Thai bilateral industry trade flows, 2017)	2.3256	n.a	n.a	n.a

8.	(Aftab & Oskooee, On the asymmetric effects of exchange rate volatility on trade flows - New evidence from US-Malaysia trade at the industry level, 2017)	-.4096	n.a	n.a	n.a
9.	(Harvey & Oskooee, Exchange-rate volatility and industry trade between the U.S. and Malaysia, 2011)	8.37	n.a	n.a	n.a
10.	(Harvey & Oskooee, US-Malaysia Trade at Commodity Level and the Role of the Real Exchange Rate, 2012)	6.72	1.64	n.a	n.a

Table 1: Summary of empirical evidence

As per tabulated above, exchange rate does not influence palm oil export volume in short term. While for long term, there are mixed result. Seven out of ten show significant result and two out of them has negative relationship. While the remaining three out of ten, are insignificant.

Due to lack of evidence that price impacts Malaysia's export volume of palm oil and mixed evidence from exchange rate effect, we would like to make a humble attempt to investigate what actually drives Malaysia's export of palm oil to the world. As the title suggests, next section will explain how we manipulate these two factors by using (1) cointegration testing to find long term relationship, (2) long run structural model to find the real magnitude of effect, (3) error correction model to find the most leading factors, and (4) variance decomposition testing to find the relative power of influence between variables under study. We expect that at the end of this study, result will confirm the theory where exchange rate and price have long run relationship with export of palm oil. Exchange rate depreciation and price increase would encourage export.

3. Data, Model Specification and Methodology

While the main variables to be used here would be export volume of Malaysia's palm oil (LEXP, in log form), price per ton of palm oil (LP, in log form), and Malaysia's Ringgit (LFX, in log form); we will add another two variables i.e. Malaysia's production of palm oil in ton (LPROD, in log form) and whole export value of Malaysia's palm oil to the world in Ringgit (LEVAL, in log form) to avoid omitted variable bias. All data are in monthly, starting from July 2005 until June 2017 (144 observations), and is taken from Bloomberg except for export value in Ringgit which was taken from Malaysia's Merchandise External Trade Statistics Database. The rational for taking such period is that, is to reflect the fluctuation of Ringgit in new exchange rate regime i.e. managed floating starting July 2005. Hopefully with consistent exchange rate regime in that particular period will lead into a consistent interpretation by the end of this study.

This paper is our humble attempt to extend several scholars' works. First, we follow the export function suggested by Just & Chambers (1982) where export volume is a function of exchange rate,

market price of commodity, and international market conditions. They further suggest that production of commodity is a function of price, a separate function from export function. There are also previous studies discussed above that interpret international market condition (from Just & Chambers export model mentioned above) as a trading partners' income where GDP is the proxy.

As for the purpose of this study which is to shed some light on what factors affect export of Malaysia's palm oil, we adjust Just & Chambers (1982) export function as per below;

Export volume = F (market price, exchange rate, production of commodity, international market condition)

We intentionally include production of commodity in above equation on the basis of omitted variable bias avoidance. As production is explained by commodity price, it will mathematically, make variable of market price has two betas; which is not wrong later on to expect that price is more sensitive to production and export volume of palm oil. This therefore eliminates perfect collinearity problem. The proxy for international market condition will be the export value of palm oil in Ringgit and not of the GDP of importer countries. As in this study we assume the existance of two countries i.e. Malaysia and the rest of the world, using GDP of trading partners will not be appropriate because most of Malaysia's palm oil export destination are China, India, and Euros. So, using world GDP might turn whatever coefficient this study estimate later, suffer from aggregate bias.

We employ standard time series technique, whereby the first step is to ensure that data are in non-stationary for level log form and stationary in differenced log form. This is to ensure that variables in level log form is justified for long term variables, which the theoretical value is attached. While for differenced log form, stationary condition must be achieved in order to explain the short term relationship. Second, VAR lag order will be determined. Third, Johansen testing for checking cointegration will be applied. This is the most critical part where without cointegration established, the study will be meanigless for long term interpretation. Forth will be long run structural model testing, where the estimation's result will explain the statistical relationship and challenge the theory. Fifth step will be vector error correction model. The testing will assist any stakeholder of interest to see what is the most variables in the export function of palm oil as shock receiver. Sixth, variance decomposition testing will take place; where this testing will be the most interesting part in standard time series technique as it gives stakeholder the relative degree of shock giver and shock receiver. It will conclude with impulse response testing and persistence profile.

4. Finding and Analysis

Stationary Testing

To start with, we shall present below the stationarity testing results as a proof that appropriate testing has been taken. Augmented Dicky-Fuller stationary testing tool is utilized. All variables in level log form

are in non-stationary condition while variables in differenced log form are in stationary condition. Non-stationary condition in level log form is very important to maintain because it contains previous information, meaning that there is theoretical value in there where worth to challenge for the existence long run relationship. While stationary condition in differenced log form must be in stationary because later will be used in OLS for giving its coefficient, it also will be used to see the short run relationship between them. Phillips-Perron testing on unit root test is not going to be adopted because it will raise an issue on heteroscedasticity. It is suitable for volatility study but unfortunately that is not the aim of writing this paper. So, Augmented Dicky-Fuller would suffice in my humble opinion. The results comfort an earlier expectation that variables under study have the power to transmit the shocks and changes in long run; however, is yet to prove whether they are going along or not. Johansen testing of cointegration will be used later once lag order of VAR is determined.

Level log form				Differenced log form			
Variable	T – value	C. Value	Result	Variable	T – value	C. Value	Result
LP	3.1312	3.4445	Non-stationary	DLP	5.8842	2.8837	Stationary
LFX	1.4283	3.4445	Non-stationary	DLFX	7.7729	2.8837	Stationary
LPROD	2.1752	3.4445	Non-stationary	DLPROD	4.623	2.8837	Stationary
LEXP	1.505	3.4445	Non-stationary	DLEXP	5.7375	2.8837	Stationary
LEVAL	3.1196	3.4445	Non-stationary	DLEVAL	3.016	2.8837	Stationary

Table 2: Result of stationarity testing

Determining VAR lag order

VAR lag order of 2 is selected, determined from p-value of Adjusted LR Test. Too much lag will reduce the degree of freedom as it is deducted from the number of observation, and too less will expose selection bias.

ORDER	AIC	SBC	P-VALUE	CV
2	1118.6	1039.4	[.101]	5%

Table 3: Result of VAR lag order determination

Finding Cointegration

Having I(1) variables at hand and with optimal VAR of 2, Johansen test will be utilized to find whether the variables of interest are moving together in long run or not. Engle-Granger test will not be used because its limitation to produce number of cointegration vector of the variables. With Maximal Eigenvalue and Trace presented below, have had helped to determine the possible number of cointegration they have i.e. cointegration vector. Based on the table below, the null of no cointegration is fail to reject at 3 cointegration vector, thus accepting the alternative of 4 cointegration vector at both 5% and 10% error. This result implies that export volume of palm oil, exchange rate, palm oil price,

palm oil production, and export value have 4 possible relationship directions. Such finding give the idea where Malaysian government's efforts to increase export very much interdependent to the condition of exchange rate, the factors of palm oil production such as weather and technology, and palm oil price; so therefore the value of export is increasing. Effective policy is needed to be able to create a tool to maintain, and not to mention on wise expenditure. Like for example, export tariff might be a barrier for exporter but government needs income as well. So encouraging production might be one of the ways to increase export and therefore increase government income. However, having proven that there are cointegrations still not suffices for policy maker. Therefore, determining what variable is the most leading and most followers is crucial. This will be uncovered later in vector error correction test and variance decomposition test.

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix				
Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	70.2319	37.07	34.16
r<= 1	r = 2	55.9596	31	28.32
r<= 2	r = 3	42.7537	24.35	22.26
r<= 3	r = 4	8.5517	18.33	16.28
Cointegration LR Test Based on Trace of the Stochastic Matrix				
Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	179.6475	82.23	77.55
r<= 1	r>= 2	109.4157	58.93	55.01
r<= 2	r>= 3	53.4561	39.33	36.28
r<= 3	r>= 4	10.7024	23.83	21.23

Table 4: Result of Johansen testing of cointegration

Long Run Structural Model

Having said that, table below presents the statistical relationship between variables. The test is taken to prove that the variables are explaining the variable that has been normalized. As the variable of interest here, palm oil export volume was imposed exact identifying i.e. normalized, as in model A. Price of palm oil and export value are significant, positively and negatively respectively. The positive relationship of palm oil price with export volume confirm the theory of export supply elasticity where changes in price positively will drive producer to export more, but in this case it is less sensitive because having coefficient less than 1. Unfortunately, it reduces the volume of palm oil export by the almost same magnitude if the value of overall export increases by 1%. Exchange rate and palm oil production in model A are not significant. This is of surprise because the result is contradicted to the theory and previous studies, where exchange rate plays an important role when the horizon of trading expands outside a country. And for production, logically, extra output means available for export given there is demand in foreign market. The insignificant can gives extreme meaning, where whether Malaysia produces palm oil or not, still have no affect on export volume of palm oil from Malaysia. Source from

MIT online info-graphic says, Malaysia also importing palm oil from Indonesia and later on export it back to other foreign market; could possibly explain on the insignificancy.

Over identifying was imposed in model B to exchange rate and palm oil production. Over identifying assumes that those variables are outside the estimation. The result shows palm oil price and export value of palm oil having greater coefficient with the same sign, meaning that posses more power in explaining the export volume of Malaysia's palm oil. While model C, where over identifying was imposed on palm oil production and value, find that exchange rate become significant and palm oil price is insignificant. The model proceed later on is model A because even exchange rate and palm oil production is statistical insignificant, but in theory they are affecting export volume.

Model	A	B	C
LEXP	1 (*NONE*)	1 (*NONE*)	1 (*NONE*)
LP	0.7281 (-0.13831)	0.9357 (-0.13956)	-0.047203 (-0.077229)
LFX	0.005948 (-0.01127)	0 (*NONE*)	0.057392 (-0.01852)
LPROD	-0.20072 (-0.10366)	0 (*NONE*)	0 (*NONE*)
LEVAL	-0.75554 (-0.13995)	-0.97266 (-0.12068)	0 (*NONE*)
LR Test of Restrictions	None	CHSQ(2)= 2.9073 [.234]	CHSQ(2)= 13.6129 [.001]
*Figure in parenthesis is standard error except in LR Test of Restrictions row. Figure in bracket is p-value.			

Table 5: Result from long run structural model

Vector Error Correction Model

In this test, vector error correction model is able to label which of the variables under study is the most endogenous; meaning that, variable that most receive the impact when others variable changes. In this case, as appended in below table, production of palm oil is the most endogenous. Below result suggests that production of palm oil is affected by export demand, whereby less demand of palm oil will result in less production and supply of palm oil. Production also affected by exchange rate and price; maybe the relative price of palm oil, say increasing as Ringgit appreciate, negates foreign buyer or consumer from buying it. And the trend variable that represents the long run quantum of adjustment of whole equation to equilibrium is very small, or slow i.e. 0.00048. It indicates 0.00048% of disequilibrium is corrected within 1 month.

Regressor	Coefficient	Standard Error	T-Ratio[Prob]	Result
TREND	-.4783E-4	.9094E-4	-.52597 [.600]	Significant
dLEXP1	-.27540	.12033	-2.2887 [.024]	Exogenous
dLP1	-.027417	.17536	-.15635 [.876]	Exogenous
dLFX1	.026563	.045271	.58675 [.558]	Exogenous
dLPROD1	.49021	.089608	5.4706 [.000]	Endogenous
dLEVAL1	-.071037	.096052	-.73957 [.461]	Exogenous
R^2	.28649			

Table 6: Result from vector error correction model

Variance Decompositions

While vector error correction model provides the absolute causality between variables, variance decompositions will provide the relative causality of the variables which the latter benefit so much to the policy maker. This model will give the degree of exogeneity and endogeneity by looking at the shocks of that particular variable has on its own. Below table are taking from generalized variance decompositions. We assume that generalized is superior than orthogonalized because of in reality, when one variable is shocked, usually one or two other factors than their own emerge as a cause to some extent. That is why assumption under orthogonalized where other variables in the system are switched off when the affected one is shocked; found unreasonable and unacceptable.

Horizon 1					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	85%	3%	1%	19%	39%
LP	1%	93%	1%	4%	2%
LFX	0%	1%	99%	0%	1%
LPROD	1%	3%	0%	98%	2%
LEVAL	42%	4%	1%	8%	93%
Exo.	85%	93%	99%	98%	93%
Ranking	4	3	1	2	3

Horizon 3					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	78%	7%	1%	24%	36%
LP	3%	89%	2%	4%	4%
LFX	0%	1%	95%	1%	0%
LPROD	14%	3%	0%	78%	5%
LEVAL	29%	10%	1%	6%	81%
Exo.	78%	89%	95%	78%	81%
Ranking	4	2	1	4	3

Horizon 6					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	76%	7%	3%	24%	35%
LP	5%	87%	2%	3%	6%

Horizon 12					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	69%	8%	9%	22%	32%
LP	6%	86%	2%	3%	7%

LFX	0%	2%	92%	2%	0%
LPROD	32%	2%	1%	55%	11%
LEVAL	17%	23%	3%	5%	57%
Exo.	76%	87%	92%	55%	57%
Ranking	3	2	1	5	4

LFX	0%	3%	90%	3%	0%
LPROD	41%	2%	2%	42%	13%
LEVAL	9%	32%	5%	5%	44%
Exo.	69%	86%	90%	42%	44%
Ranking	3	2	1	5	4

Horizon 24					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	59%	9%	17%	19%	28%
LP	6%	86%	2%	3%	7%
LFX	0%	3%	90%	3%	0%
LPROD	46%	2%	2%	34%	14%
LEVAL	4%	36%	6%	4%	37%
Exo.	59%	86%	90%	34%	37%
Ranking	3	2	1	5	4

Horizon 36					
	LEXP	LP	LFX	LPROD	LEVAL
LEXP	52%	11%	24%	18%	24%
LP	7%	85%	2%	3%	7%
LFX	0%	3%	89%	3%	0%
LPROD	48%	2%	2%	31%	15%
LEVAL	3%	38%	6%	4%	35%
Exo.	52%	85%	89%	31%	35%
Ranking	3	2	1	5	4

Table 7: Result from variance decomposition testing

Based on result presented above, horizon 6, 12, 24, and 36 show the same exogenous ranking where exchange rate affects palm oil price, palm oil price affects export volume, export volume affects export value, and export value affects production. While horizon 1 and 3 are different, still exchange rate leads in affecting other variables. Overall, the ranking is consistent with the result in vector error correction model where palm oil production is the most affected variable. This finding gives the most valuable piece of information for policy maker to craft and implement suitable, effective, and wisest policy in adjusting the factors along the causation chain. The result suggests that factors in the causation chain must be supportive and motivating the production of Malaysia's palm oil.

Exchange rate → Palm oil price → Export volume → Export value of palm oil → Palm oil production

Impulse Response Function and Persistence Profile

Impulse response function is the extension of variance decomposition, only turned the numbers into graph. The first five graph are explaining the shock of own variable to itself and other variables (impulse response). It seems like overall variables after receiving shock stabilizes within ten months. The most variable that receive shock from their self is production of palm oil. In other graphs of impulse response also obviously show the same i.e. production of palm oil received the shock when other variable shocked. While persistence profile (the sixth graph) shows the impact of system-wide shock in the long run rather than single, individual variable shock. This function can tells the policy maker on how long it will take to stabilize the variables if the external shock comes in. Based from the graph below, the whole

variables jointly will require only almost six months to come back to normalcy and thus the equilibrium restored.

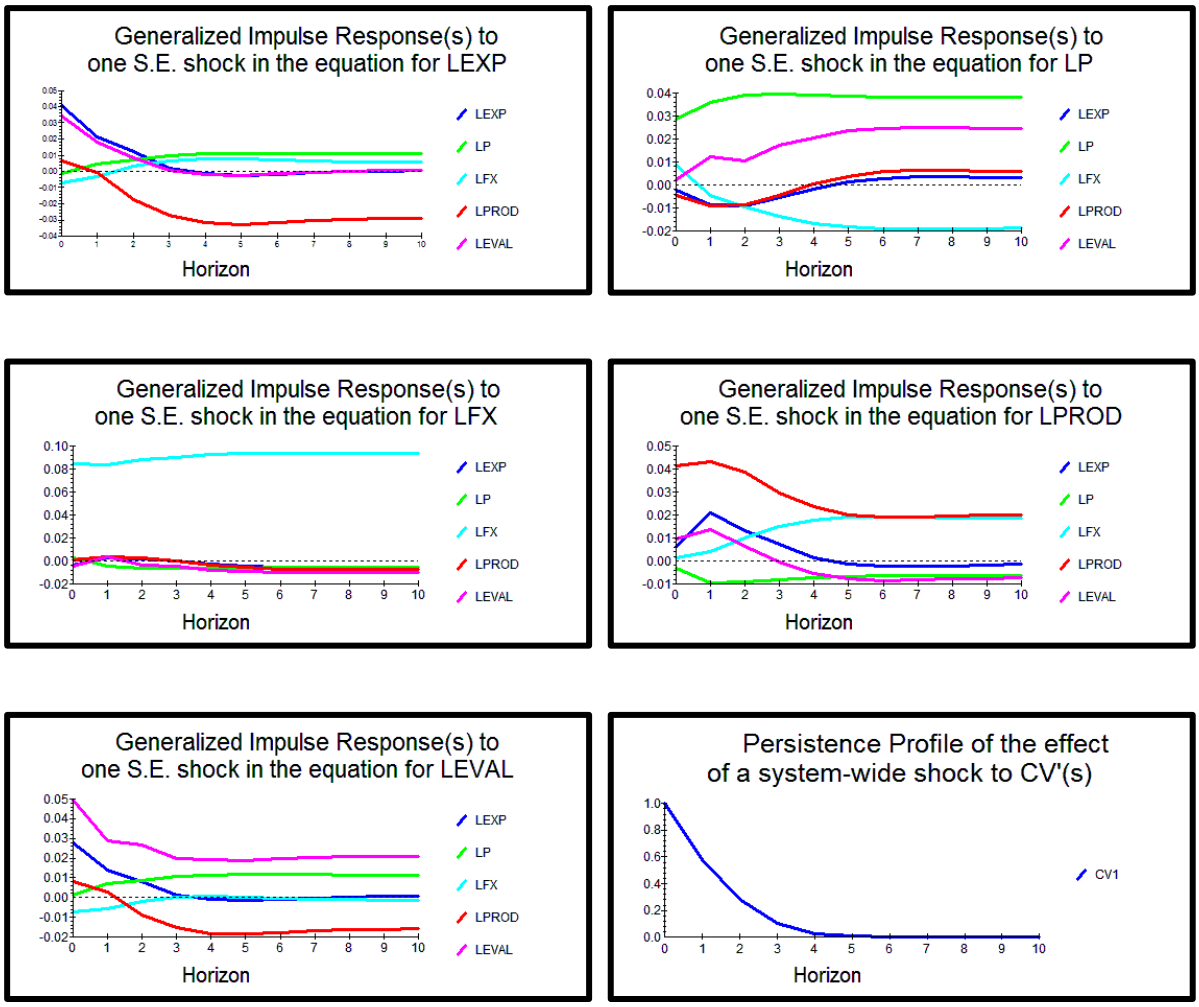

Figure 1: Result from impulse response and persistence profile

5. Conclusion

Our study here is to examine the cointegration and causality between export volume, palm oil price, and exchange rate in the long term. Finding suggests that exchange rate is the leader of shock given i.e. the most exogenous variable in the export function; followed by palm oil price, and volume of palm oil export. It seems like the finding in this paper not only contradicts the previous studies on Malaysia's palm oil export in the long run relationship but also found insignificant contributor to palm oil export volume, as illustrated in long run structural model coefficient and vector error decomposition coefficient.

As the topic of this paper suggests and as empirical findings discussed, where exchange rate leads palm oil price and palm oil price leads export volume of palm oil; not much policy maker can do. As for instance, Malaysia Palm Oil Board and Malaysian Palm Oil Council as related authority in Malaysia's palm oil industry; have no power to influence the exchange rate since exchange rate regime is floated in the market and under the central bank oversight. Even there was a shock in exchange rate starting from the end of 2014 to date; Malaysia's central bank did not peg the currency like before. Instead, they reduced the excessive speculation of Ringgit by prohibiting offshore non-deliverable forward and imposed some kind of capital control at the end of 2016 and early 2017 respectively. No direct changes had been made to curb Ringgit from falling. Figure below depicts the reality, where exchange rate deviates further from export volume and the depreciation could not motivate palm oil producer to export more.

However as the finding suggests that price is giving direct impact to export volume, policy maker may start an aggressive promotion program to the world especially Europe countries. They are very particular to deforestation in palm oil plantation. What policy maker can do is explain to them that our palm oil production is produced in sustainable manner, conscious and aware of health issue highlighted, and employed advance R&D and technology; so that they will confidence and add up value to our palm oil. Consequently, price increases and therefore export volume.

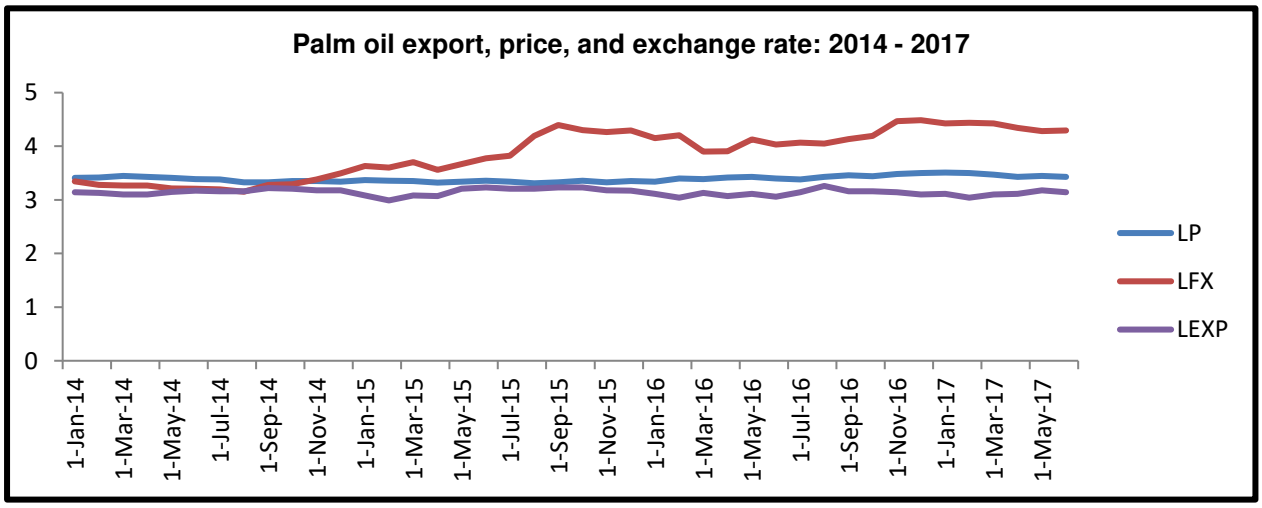

Figure 2: Palm oil export, price, and exchange rate 2014 – 2017

Finally, it is best not to leave these findings unchallenged. There are several reasons that future research might consider to improvise. First, our export function model did not include the purchasing power of trading partner country. It can be proxied later by GDP per capita. An increase in income means increase in purchasing power. By having more purchasing power, one can buy more palm oil or might pay the cost of switching palm oil to other edible oils. Second , one might consider to test with substitute edible oil; whether decrease in, say, soybean oil price dilute the demand for palm oil. Third, export tariff also plays important role because tax is an income to the government. Having more tax means having more income but government must maintain the balance so as not to jeopardize the

export by demotivating the exporter. Last but not the least, it is worth making a future attempt to see the cointegration with the competing country i.e. Indonesia, on its price and exchange rate and their export volume.

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