An Analysis of Indonesia's Palm Oil Position in the World Market: A Two-stage Demand Approach

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ABSTRACT

Indonesia and Malaysia are the major producers of palm oil in the world. Together they contribute almost 87% of the world production in 2007, while in the export market, they contribute 91% of the world palm oil export. This article analyses Indonesia's palm oil position in the world market. A two-stage demand equation was constructed. The first equation analysed the world demand without considering the source of the product. Meanwhile, the second equation considered the source of the product using the almost ideal demand system (AIDS) approach. Considering the stationarity of the data, the error correction mechanism (ECM) was employed. The result shows that the increase in the world demand for palm oil is mostly contributed by the increase in world income. In addition, palm oil products from Indonesia and Malaysia are complementary to each other rather than competing. Therefore, both countries should co-operate in order to increase the world demand for palm oil in the future.

INTRODUCTION

Indonesia and Malaysia are the major producers of palm oil in the world. Together they contribute almost 87% of the world production in 2007. Indonesia is the largest producer of palm oil with a production of 18.3 million tonnes, followed by Malaysia with 17.4 million tonnes (US Department of Agriculture, 2009). Meanwhile in the export market, the two countries together contribute 91% of the world palm oil export, with Malaysia leading with 13.7 million tonnes followed by Indonesia with 13.3 million tonnes in 2007 (United Nations, 2009).

Indonesia exports 73% of her total production. This means that export performance plays an important role in determining the profitability of the Indonesian palm oil industry. Therefore, analysing the export market will be crucial in order to determine what policy should be taken by the Indonesian government to increase Indonesia's competitiveness in the world market.

The main objective of this study was to determine the position of Indonesian palm oil in the world market. A two-stage import demand equation was employed following Honma (1993). The first equation was the world import demand for

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palm oil which was calculated without considering the source of goods. In the second import demand equation, total import of palm oil was allocated by competing import suppliers. Considering the stationarity issue, the first equation employed the error correction model (ECM) approach, while the second import demand equation was calculated using an error-corrected linearized almost ideal demand system (AIDS).

The specific objectives of the study were: (1) to estimate the import demand elasticities of palm oil in the world market; and (2) to derive policy implications for marketing Indonesian palm oil in the world market. The results of the study are expected to provide useful information for government officials and industry organizations in dealing with competition from other palm oil producers.

A brief overview of the world palm oil market in the supply and demand side is provided in the next part. Following this, the import demand, AIDS model and data used in the empirical analysis are discussed. This is followed by a discussion on the main results from this study, including estimates and policy implications. Lastly, some concluding remarks are presented.

THE PALM OIL MARKET

Compared with other vegetable oils, the production volume of palm oil is the largest. In 2008, world palm oil production reached 38.9 million tonnes, and since 1998 it has increased by over 100%, thus, surpassing the production of soyabean oil (*Table 1*).

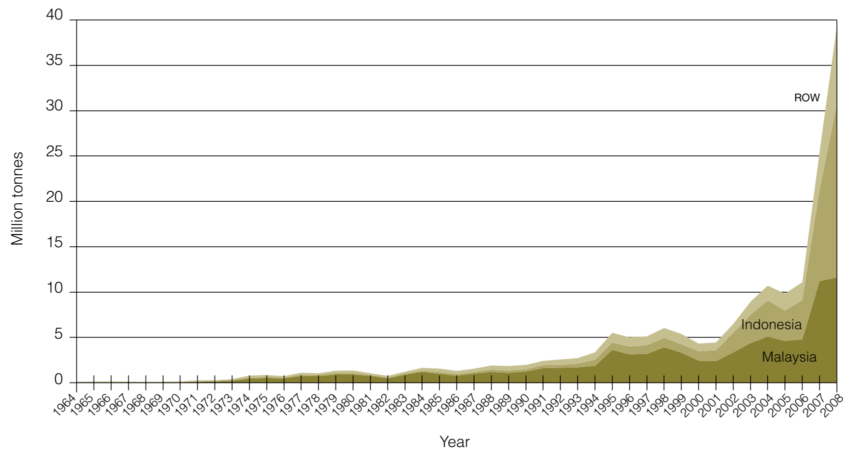
Furthermore, the world palm oil trade in recent years has increased significantly. During the period 1964-2008, the palm oil trade grew by 17.7%, with the highest growth occurring in the period from 2000 until 2008 at 36.9% (*Figure 1*). Comparing Indonesia and Malaysia, the palm oil trade from Indonesia grew by 21.2% on average during the 1964-2008 period, while that from Malaysia grew by 20.3%. Indonesia's palm oil trade had the highest growth during the period from 2000-2008 at an average of 50.5%. For Malaysia, highest growth was during the 1970s at an average of 43.2%. Indonesia's recent palm oil trade growth was caused by the massive expansion of oil palm areas in recent years.

On the demand side, the major palm oil importing countries in 2007 were China, India and the European Union (including the Netherlands), together accounting for about half of the world's total palm oil imports (US Department of Agriculture, 2009). Almost 70% of Indonesia's palm oil exports were sent to Asia, while the remainder went to Europe (21%) and other regions. The main export destinations for Indonesia's palm oil were India (28%), China (12%) and the Netherlands (7%).

TABLE 1. WORLD VEGETABLE OIL PRODUCTION IN 1998 AND 2008 (t)

Vegetable oil	1998		2008	
	Production (t)	Share (%)	Production (t)	Share (%)
Palm oil	18 215 637	21.77	38 936 925	29.46
Soyabean oil	24 184 526	28.91	37 524 824	28.39
Rapeseed oil	11 496 718	13.74	18 171 518	13.75
Sunflower oil	8 868 495	10.60	11 027 327	8.34
Groundnut oil	5 357 069	6.40	5 797 109	4.39
Palm kernel oil	2 313 631	2.77	5 140 477	3.89
Cottonseed oil	3 857 753	4.61	4 988 201	3.77
Coconut oil	3 500 793	4.18	3 752 825	2.84
Olive oil, virgin	2 394 830	2.86	2 886 019	2.18
Maize oil	1 864 259	2.23	2 217 006	1.68
Others	1 603 253	1.92	1 742 461	2.08
Total	83 656 964	100.00	132 184 692	100.00

Source: FAO (2010).



Source: United Nations (2010).

Figure 1. World palm oil trade (1964-2008).

LITERATURE REVIEW

There have been several studies on Indonesia's and Malaysia's palm oil products in the world market, which either compared the two countries or discussed each individual country. Rifin (2010) analysed the market shares of Indonesia's and Malaysia's palm oil products [which consist of crude palm oil (CPO) and refined palm oil] in Asia, Europe and Africa using the constant market share analysis (CMSA). By using the CMSA, the change in market share can be divided into three causes: the size of market effect, the market composition effect and the competitive effect. The results indicate that Indonesia's market share had increased during the period from 1999-2001 to 2005-2007 for the two products and in the three markets except for CPO in Europe. The increase in market share was mainly caused by the competitive effect. On the other hand, Malaysia's market share decreased except for CPO in Europe. The competitive effect was also mainly responsible for the decrease in Malaysia's market share.

For individual countries, Yulismi and Siregar (2007) calculated Indonesia's own price and income elasticities for palm oil in China and India. The authors inferred that in both countries Indonesia's palm oil is price-inelastic and has an income elasticity above one. Shariff *et al*. (2006) calculated the same elasticities for Malaysia's palm oil in five countries: China, Pakistan, India, South Korea and Egypt. Both short-run and long-run elasticities were calculated. The results show that Malaysia's own price elasticities in the short-run are mainly elastic except in China, while in the long-run they are all elastic except in South Korea which is insignificant. For income elasticity, in the short-run income is insignificant, while in the long-run income is significant and elastic in China, Pakistan and India.

Furthermore, Niemi (2004) calculated own price elasticity and income elasticity for various agricultural products including palm oil in the European Union (EU) market. The results indicate that palm oil in the EU market has inelastic price elasticity in both the short-run and the long-run, and an income elasticity of 0.63 in both the short- and long-runs.

Unlike previous studies, this study utilized a different method which can analyse the interaction between Indonesia's and Malaysia's palm oil products. Previous studies only analysed individual countries, and where both countries were analysed, the interaction between the palm oil products from both countries could not be captured.

THE MODEL

Before constructing the import demand equation, a stationarity test, followed by a cointegration test, was conducted because the data came from a time series. Unit root test was conducted in order to check the stationarity of the time series data of all the variables. Unit root test, applying the Augmented Dickey-Fuller (ADF) test, was used to test whether the variables were stationary or not. The test was performed by 'augmenting' the preceding three equations by adding the lagged values of the dependent variable ΔY_t (Gujarati, 2003). The ADF test consists of estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i-1}^{m} \Delta Y_{t-i} + \varepsilon_t$$

where ε_t is a pure white noise error term, and where $\Delta Y_{t-1} = (Y_{t-1}-Y_{t-2})$. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms in order for the error term in the equation to be serially uncorrelated. In ADF, $\delta=0$ is tested, and the ADF test follows the same asymptotic distribution as the DF statistic, so that the same critical values can be used (Gujarati, 2003).

If the variables are considered to be non-stationary variables, the next step is to check whether the variables are cointegrated. When variables are cointegrated, it means that the variables have a long-term relationship between them. One of the methods to test cointegration is by the Johansen method (Enders, 1995). Consider a vector autoregression (VAR) of order *p*:

$$Y_t = A_1 Y_{t-1} + \dots + A_p Y_{t-p} + BX_t + \varepsilon_t$$

where Y_t is a *k* vector of non-stationary I(1) variables, X_t is a *d* vector of deterministic variables, and ε_t is a vector of innovations. The VAR equation above can be written as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i-1}^{p-1} \Gamma_i \Delta Y_{t-i} + BX_t + \varepsilon_t$$

where

$$\Pi = \sum_{i-1}^{p} A_i - I \qquad \Gamma_i = \sum_{j=i+1}^{p} A_j$$

Granger's representation theorem states that if the coefficient matrix Π has reduced rank r < k, then k x r matrices α and β exist, each with rank *r* such that $\Pi = \alpha\beta'$ and $\beta' Y_t$ is I(0). The *r* is the number of cointegrating relations (the *cointegrating rank*), and each column of β is the cointegrating vector. Johansen's method is to estimate the Π matrix from an unrestricted VAR, and to test whether we can reject the restrictions implied by the reduced rank of Π (Eviews 5 Users Guide, 2004).

In calculating the number of cointegrating relations (*r*), it can be computed using the following two test statistics (Enders, 1995):

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln (1-\hat{\lambda}_i)$$

$$\lambda_{max}(r,r+1) = -T \ln (1-\hat{\lambda}_{r+1})$$

where

$\hat{\lambda}_i$ = the estimated values of the characteristics roots obtained from the estimated Π matrix.
T = the number of observations.

The λ_{trace} tests the null hypothesis that the number of distinct cointegration vector is less than or equal to *r* against a general alternative, while λ_{max} tests the null hypothesis that the number of cointegrating vectors is *r* against the alternative of r+1 cointegrating vectors (Enders, 1995).

After checking the stationarity and cointegration of the variables, the import demand equation is constructed. When the data are not stationary in the level form, the difference form is employed. When considering the non-stationarity of the data in the level form, the error correction mechanism is employed to capture the long-run relationship between the variables.

In the first stage, the world import demand is calculated as follows:

$$\Delta M_t = \alpha_0 + \alpha_1 \Delta P_t + \alpha_2 \Delta PS_t + \alpha_3 \Delta GDPPC_t + \alpha_4 EC_{t-1}$$

where
M = world import (t).
P = real world palm oil price (USD/t).
PS = real palm oil substitute price (USD/t).
GDPPC = real world GDP per capita (USD/capita).
EC = error correction term.
Δ indicates the difference form, and all are in the log and real forms.

The second import demand is the world import demand classified by source. The AIDS was selected as the specification for the empirical analysis. The AIDS model was introduced by Deaton and Muellbauer (1980) for demand analysis. Several years later, Winters (1984) utilized the approach to analyse the import demand which analyses competition between different importing countries in a specific market/country for a particular product. The AIDS model has been used extensively in applied demand analysis in recent years because of its theoretical consistency and functional flexibility (Chang and Nguyen, 2002). In this article, the model was considered for testing the stationarity of the data, therefore the AIDS model is as follows (Karangiannis *et al.*, 2000; Feleke and Kilmer, 2007):

$$\Delta S_i = \vartheta \Delta S_{it-1} + \beta_i \Delta \ln\left(\frac{m}{p^*}\right) + \sum_{i=1}^{n} \gamma_{ij} \Delta \ln P_j + \lambda_i EC_{it-1} + \varepsilon_t$$

where
S = share of import source in the world market.
P = price of palm oil (USD/t).
M = expenditure.
P* = corrected stone price index.
EC = error correction term.
Δ indicates the difference form.

In the usual linearized AIDS, *P* is the stone index. However, according to Moschini (2000), the stone price index can affect the calculation properties of the AIDS model because it is not invariant to changes in the units of measurement. Moschini (2000) suggested using the corrected stone price index which is the log-linear version of the Laspeyres index. The index is defined as follows:

$$\ln P^* = \sum_{i=1}^{n} S_i \ln \frac{p_{it}}{p_t^0}$$

where the P_t^0 is the price on the base year.

The theoretical restrictions of adding up, homogeneity and symmetry hold if the parameters satisfy the corresponding expressions; these theoretical restrictions are tested using the likelihood ratio test (LR-test):

Adding up: $\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_i = 0$

Homogeneity: $\sum_{i=1}^{n} \gamma_{ij} = 0$

Symmetry: $\gamma_{ij} = \gamma_{ij}$

The uncompensated price elasticities (η_{ij}) and expenditure elasticities (μ_i) are calculated as follows:

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij} - \beta_i S_j}{S_i} \quad \mu_i = 1 + \frac{\beta_i}{S_i}$$

where δ_{ij} is the Kronecker delta.

DATA AND DATA SOURCES

The data used in this study were annual data. For the first stage world import demand, the annual data were from 1964 until 2006. The palm oil import figures were taken from the UN Comtrade database, palm oil price from the International Financial Statistics (IFS) database of the International Monetary Fund (IMF), the palm oil substitute price was obtained by the average weight of three palm oil competing products, namely, soyabean oil, sunflower seed oil and canola oil. Data on the GDP per capita were taken from the World Development Indicator (WDI) database of the World Bank.

For the second stage import demand, the annual data utilized were from 1975 until 2006. Three sources of imports were considered: Indonesia, Malaysia and the rest of the world (ROW). The data were all acquired from the United Nations Commodity Trade Statistics (UN COMTRADE). The unit import values, which were equivalent to average CIF prices, were calculated by dividing the total import value by total import volume for each individual country source. In this study, SITC revision 1 code 4222 was used to obtain the palm oil data.

RESULTS

In order to test the stationarity of the variables, the unit root test was conducted. One of the methods in testing unit root is the ADF test. Two different ADF equations were calculated to test the presence of a unit root, the first equation included the constant variable while the second equation included constant and trend. In addition, Akaike Info criterion (AIC) was utilized to calculate the best lag. The results show that all the variables were stationary at the 1% significance level at the first difference (*Table 2*). This means that it was appropriate to conduct the cointegration test on all variables.

All variables indicated the I(1); thus, the next step was to test cointegration between the four variables utilizing the Johansen cointegration test. The lag chosen for the test was 1 because the data were annual. The Johansen cointegration test employed two tests, the trace test and the max-eigen value test. The results of the Johansen cointegration test are reported in *Table 3*. The results reveal that there was one cointegration between the variables at the 5% significance level which is shown in the probability column that has a number lower than 0.05 on both the trace test and the max eigen-value test. This implies that there was a long-run equilibrium relationship between the four variables.

The next step was to calculate the import demand function after considering the stationarity of the data. In the first stage import demand, the coefficient of error correction indicated a negative and significant sign which showed that the variables were cointegrated in the long-run.

Therefore, the long-run coefficient could be derived. The coefficient also indicated the elasticity because the variables were in the logarithm form. In the short-run, only the price of the substitute was not significant. This shows that the consumers tended to shift to other vegetable oils in the long-run instead of in the short-run when the price of palm oil increased.

The results indicate that the value of income elasticity was 3.34 in the short-run which means that an increase of 1% in the world GDP per capita would increase the demand of palm oil by 3.34%, and that the number increased in the long-run. In the short-run, own price elasticity was inelastic, while in the long-run it was elastic. This shows that the palm oil consumers adjusted their consumption in the long-run. In addition, the effect of the substitution products only occurred in the long-run and not in the short-run because time was needed to switch to palm oil (*Table 4*).

In the second stage import demand, a system demand was estimated with two equations, for Indonesia and for Malaysia (*Table 5*). The hypothesis of imposing homogeneity and symmetry was tested using the likelihood ratio test (LR-test). The χ^2 was 13.97 which was greater than the corresponding critical values, suggesting rejection of imposing homogeneity and symmetry.

The lag share of both equations showed significant results which indicate the existence of a habit of importing of palm oil. In addition, the results indicate that the error correction coefficients for both equations were negative and significant. This shows that a long-run relation between the variables existed, implying that a long-run elasticity can be obtained from these results. The coefficient can be interpreted as the speed of adjustment; a number close to zero indicating slow adjustment while a number close to one shows that the adjustment takes a shorter time for the equilibrium to be restored (Feleke and Kilmer, 2007). The coefficient for both equations was relatively similar, at about 43% which implied that the adjustment was relatively slow.

The coefficient was also utilized in the estimation of long-run elasticities. The long-run estimate equals the negative of the short-run estimate divided by the error correction (EC) parameter (Johnson *et al.*, 1992; Nzuma and Sarker, 2010). The parameters obtained were employed in calculating the elasticities in *Tables 3* and *4*.

TABLE 2. AUGMENTED DICKEY-FULLER (ADF) TEST

Variable	ADF test (constant included)	Lag	ADF test (constant and trend included)	Lag
Level				
Import	0.0399	2	-3.4059*	4
Import price	-0.7290	2	-1.8346	2
Price of substitute	-0.9054	2	-1.6980	2
Income	-0.8845	4	-3.5721**	1
First Difference				
Import	-5.9976***	1	-5.9289***	1
Import price	-7.1285***	1	-7.0466***	1
Price of substitute	-5.9458***	1	-5.9023***	1
Income	-4.6119***	1	-4.7113***	1

Note: ***, **, * = significant at 1%, 5% and 10% probability levels, respectively.

TABLE 3. JOHANSEN COINTEGRATION TEST

Hypothesized number of cointegration	Lag	Trace test		Max Eigen-value test	
		Trace statistic	Probability	Max Eigen statistic	Probability
None	1	49.9667	0.0312	27.8845	0.0458
At most 1	1	22.0822	0.2940	13.1774	0.4361
At most 2	1	8.9048	0.3743	7.6780	0.4124
At most 3	1	1.2269	0.2680	1.2269	0.2680

TABLE 4. SHORT- AND LONG-RUN ESTIMATES OF THE FIRST STAGE WORLD IMPORT DEMAND

Period	Constant	Import price	Price of substitute	Income	Error correction	Result
Short-run	0.0203 (0.5698)	-0.3907 (-2.0665)**	0.2668 (1.2198)	3.3417 (2.0108)**	-0.4635 (-3.6424)***	R^2= 0.3691 DW=2.2140
Long-run	-	-1.3814 (-4.5836)***	1.1423 (4.0672)***	5.0832 (11.3072)***	-	-

Note: Figures in parenthesis are t-values.
***, **, * = significant at 1%, 5% and 10% probability levels, respectively.

TABLE 5. PARAMETER ESTIMATES OF THE SECOND STAGE DEMAND SYSTEM

Parameter	Estimated parameters with respect to		
	Malaysia	Indonesia	ROW
Lag share	-0.2331 (-1.7547)*	-0.2389 (-1.7136)*	
Price Malaysia	0.1627 (1.5027)	0.0200 (0.2248)	-0.1827 (-0.9535)
Price Indonesia	-0.1494 (-1.4991)	0.0896 (1.0793)	0.0597 (0.3373)
Price ROW	0.0751 (0.9432)	-0.1343 (-2.0491)**	0.0592 (0.4201)
Expenditure	-0.0076 (-0.1522)	0.0797 (1.8526)*	-0.0720 (-0.8067)
Error correction	-0.4311 (-2.8065)***	-0.4308 (-3.5297)***	-
R^2	0.3863	0.2569	-
χ^2	35.22	26.91	-

Note: Figures in parenthesis are t-values.
***, **, * = significant at 1%, 5% and 10% probability levels, respectively.
ROW = rest of the world.

TABLE 6. SHORT-RUN PRICE AND EXPENDITURE ELASTICITIES

	Price elasticities			Expenditure elasticities
	Indonesia	Malaysia	ROW	
Indonesia	-0.5774 (-1.2532)	-0.1624 (-0.3181)	-0.8446 (-2.2667)***	1.4463 (6.0036)***
Malaysia	-0.2405 (-1.4819)	-0.7280 (-4.0799)***	0.1246 (0.9503)	0.9876 (12.1207)***
ROW	-0.3519	-0.6712	-0.6408	0.6507 (1.5031)

Note: Figures in parenthesis are t-values.
***, **, * = significant at 1%, 5% and 10% probability levels, respectively.
ROW = rest of the world.

TABLE 7. LONG-RUN PRICE AND EXPENDITURE ELASTICITIES

	Price elasticities			Expenditure elasticities
	Indonesia	Malaysia	ROW	
Indonesia	-0.0191	-0.3770	-1.9603	2.0359
Malaysia	-0.5579	-0.3690	0.2890	0.9712

Note: ROW = rest of the world.

Malaysia's own price elasticity was more elastic than Indonesia's which showed that Malaysia's palm oil was more sensitive to price changes. In the cross price elasticity, it was inferred that Indonesia's and Malaysia's palm oil products were complementary rather than competing. This was shown by the negative sign of cross price elasticities for both countries. Meanwhile in the expenditure elasticity, Indonesia had a higher value which indicated that an increase in world import expenditure would be more beneficial to Indonesia rather than to Malaysia.

From the two-stage import demand equation, it can be inferred that the increase in the world demand was mostly caused by the increase in world income. In the first stage of world import demand, the income variable had the highest coefficient compared to the other variables. In addition, the second stage import demand showed that Indonesia had higher expenditure elasticity which was proven by Indonesia's higher increase in the world trade volume of palm oil compared to Malaysia. Therefore, the increase in world income had benefited Indonesia more than Malaysia.

The complementary characteristic of Indonesia's and Malaysia's palm oil indicated that products from both countries were not uniquely identified by the consumers. Therefore, in the future, both countries must work together to promote the use of palm oil to the consumer because any increase in world demand will benefit both countries. India, as the biggest consumer of palm oil, is predicted to increase her vegetable oil demand by around 25% in 2010 compared to consumption in 2006 (Mehta, 2007). In addition, Indonesia and Malaysia can cooperate in market expansion in the form of new markets or new uses of palm oil such as for biodiesel. In recent years, countries like China and India have developed their own biodiesel programs (Koizumi and Ohga, 2007). These two countries are the top importing countries of palm oil products; therefore, by promoting the use of palm oil as biodiesel, it is hoped that the demand for palm oil will increase more in the future.

In the long-term, Indonesia should differentiate her palm oil products from Malaysia's in order to gain more market share. By differentiating her products, she will obtain more consumer loyalty which will lead to less sensitivity to price changes.

CONCLUSION

The increase in the world demand for palm oil in recent years is mostly attributed to the increase in the world income. Indonesia benefited more from the increase in the world income compared to Malaysia as reflected by a higher income elasticity value.

Palm oil products from Indonesia and Malaysia are complementary rather than competing. Therefore co-operation between the two countries is needed in order to increase the world demand for palm oil as this will benefit both countries. In the future, Indonesia should differentiate her palm oil products from Malaysia's in order to increase her competitiveness.

For further research, completing the analysis from the supply side will give a more complete picture of the palm oil market conditions. In addition, using a shorter time period, utilizing monthly data, will give an idea of the effect of the more recent conditions on the position of Indonesia's palm oil in the world market.

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