The Elasticity of Foreign Demand for Malaysian Palm Oil

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ABSTRACT

The price elasticity of export demand is expected to receive considerable attention due to the current economic climate of volatile export markets and prices. The export demand elasticity is used to predict the change in demand for an export for a unit change in its price and to model the behaviour of foreign buyers. This project estimated the elasticity of foreign demand for Malaysian palm oil for the major importing countries - China P R, India, Pakistan, Egypt and South Korea. The error correction mechanism (ECM) method was used for the estimation considering its usefulness in quantifying the short-run and long-run effects of explanatory variables on the dependent variables using time-series data. It was found that the price of palm oil plays a very significant role in its export; thus, the price needs to be stable and competitive with those of its substitutes, especially soyabean oil. From panel data research, the effect of a unit change in the soyabean oil price is greater on the exports of crude palm oil than the effect of the same change in the palm oil price. This means that both oils are highly substitutable.

INTRODUCTION

The current economic climate is characterized by volatile export markets and prices. Due to this, the price elasticity of export demand is expected to receive considerable attention. The price elasticity of demand represents the percentage change in the quantity of a good demanded in response to a unit change in its price. Export demand elasticity is used to predict changes in the demand for exports as consequences of changes in their prices. The export elasticity is used to model the behaviour of foreign buyers. Proper estimates of the export demand elasticity for Malaysian palm oil are important because palm oil earns a large share of the total Malaysian exports. Any changes in the price of Malaysian palm oil may have a great effect on its export.

The present situation indicates increasing competition among the edible oils and fats and also improved substitutability between them. A number of factors can influence the export demand elasticity for Malaysian palm oil, the most important being the structure of the international market. If Malaysian palm oil faces little competition from other oils and fats, then palm oil prices may have significant impact on world oils and fats prices. In the event, its export demand elasticity will be relatively small.

On the other hand, if there are a large number of palm oil suppliers and buyers, the

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international market for palm oil will be competitive, and Malaysian producers will have little influence over world prices. In this case, the export demand elasticity would be high. In the case of many suppliers and few international buyers, oil palm price would have little impact on world oils and fats prices. Accordingly, this would indicate a high export demand elasticity. Finally, if there is little competition from other producers and only a few buyers, then prices may be affected by decisions made by both producers and buyers. In this situation, the export demand elasticity would be small.

OBJECTIVE

The objective of this research was to estimate the elasticity of foreign demand for Malaysian palm oil.

METHODOLOGY

The Armington approach has been used to formulate models to estimate elasticity because it is simple to use and has been proven to be a powerful method for modelling US crop exports. The approach has also been used to estimate the impact on trade in oils and fats with the formation of single Europe (Nasir, 1994). The study on elasticity of export demand for US cotton (Duffy *et al*., 1990) adapted the Armington framework to estimate total elasticity of demand.

Other comparable commodity models have been reviewed and applied the error correction method (ECM), which is a very useful econometric tool for quantifying the short-run and long-run effects of explanatory variables, on the dependent variables using time-series data. Apart from the ECM, other tests were tried, including the unit root test and panel data analysis.

Model Specification

The elasticity of foreign demand for Malaysian palm oil in major importing countries was estimated. The selected importing countries were China P R, India, Pakistan, Egypt and South Korea, to which the ECM method was applied.

There are several advantages for using the ECM model. First, it is possible to clearly differentiate the short- and long-run effects since both the first differences and levels of the variables are quantified in the model. Second, the speed of adjustment towards the long-run relationship can be directly estimated.

Unit Root Test

The unit root test was applied to all variables in the model before estimating the ECM. It can be determined by using the Augmented Dickey-Fuller (ADF) and Phillip-Peron (PP) tests. At the formal level, stationarity is established the time series contains a unit root. The advantage of the unit root test is that it can identify a better model and avoid spuriousness. The ADF test makes three assumptions:

$$\Delta Y_t = \delta Y_{t-1} + \theta i \sum_{i=1}^{m} \Delta Y_{t-i} + \mu_t \qquad (1)$$

$$\Delta Y_t = \alpha + \delta Y_{t-i} + \theta i \sum_{i=1}^{m} \Delta Y_{t-i} + \mu_t \qquad (2)$$

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \theta i \sum_{i=1}^{m} \Delta Y_{t-i} + \mu_t \qquad (3)$$

where Y_t represents a time-series variable. The ΔY_t is written as $(Y_t - Y_{t-1})$, while δ is $(\rho - 1)$, t the period of study, or observation, and μ_t the error term known as *white noise*. The optimum lag in each equation for the unit root test can then be determined based on the Akaike Information Criterion (AIC). The criterion states that the minimum AIC value determines the optimum lag for the equation. The AIC measurement is shown below:

$$AIC(N) = T \ln\left[\frac{RSS}{T}\right] + 2N \qquad (4)$$

where T is the sample size, *RSS* the residual sum of squares and N the parameter used in the model equation. The model equation is regressed using multivariate lag with the final model selected based on the optimum lag – as shown by the minimum *AIC* value.

Long-Run Elasticity Model

Estimating the long-run relationship is likely to pose some problems because the variables used in the analysis typically exhibit multicollinearity and are non-stationary. The problem is often dealt with by taking the first differences of all the variables before any estimation is done (Gujarati, 2003). Nonetheless, taking the first differences is a major drawback because the low frequency (long-run) variation of the data is removed, so that only the short-run effects are explained by the stationary variables. The ECM model used in this paper is the standard empirical model:

$$\ln(EXP^i_t) = \theta + \delta_1 \ln(PO_t) + \delta_2 \ln(SBO_t) + \delta_3 \ln(YC^i_t) + \delta_4 \ln COM^i_t + \delta_5 (ER^{msia}_t / ER^i_t) + \delta_6 \ln(CPI^i_t) + \mu_{it} \qquad (6)$$

where:

EXP^i_t = export demand for Malaysian palm oil in country *i* at time *t*.
PO_t = price of palm oil in time *t*.
SBO_t = price of SBO in time *t*.
YC^i_t = per capita income of country *i* in time *t*.
COM^i_t = per capita consumption (kg) of oils and fats by country *i* in time *t*.
ER^{msia}_t = exchange rate (RM:USD) in time *t*.
ER^i_t = exchange rate of (importing) country *i* to USD in time *t*.

CPI_t = consumer price index (inflation rate) of country *i* in time *t*.
ln = log of the variability of elasticity.
i = selected palm oil importing country.
t = annual time from 1980 to 2003.
θ = intercept.
δ = coefficient of independent variables/elasticity values.

For elasticity explanation:
δ_1 = direct own-price elasticity in the long-run.
δ_2 = substitution price elasticity in the long-run.
δ_3 = per capita income elasticity in the long-run.
δ_4 = elasticity of per capita consumption of oils and fats in the long-run.
δ_5 = ratio exchange rate elasticity in the long-run.
δ_6 = inflation rate elasticity in the long-run.

Based on Equation 6, all the coefficients of the independent variables can be explained in terms of elasticity. The coefficient for palm oil price (δ_1) explained the price elasticity of export demand for palm oil. Its sign should be negative, based on the theory of demand - when the price of palm oil increases, the export demand for Malaysian palm oil will decline. Conversely, if the price of palm oil falls, there will be a positive effect on the expected export demand for Malaysian palm oil. However, if the coefficient >1, we can say that the price of palm oil is an important factor in determining its export demand. Conversely, if the coefficient for δ_1 is <1, the price of palm oil will only have a small impact on its export demand by the country concerned.

To estimate the price elasticity of product substitution, soyabean oil (SBO) was chosen as the substitute as it is the major competing oil to Malaysian palm oil. The coefficient for the SBO price (δ_2) explained the substitution effect for export demand for palm oil. The sign for this coefficient should be positive, based on the theory of demand. This coefficient indicates that, when the price of SBO increases, the export demand for the Malaysian palm oil will also increase, because more consumers will be driven to use more palm oil. However, if the price of SBO falls, the export demand for Malaysian palm oil will decline.

The coefficient for per capita income (δ_3) explains the nature of income elasticity to the export demand for Malaysian palm oil. This variable is generated from the GDP and population of the country. The per capita income for a country is obtained by dividing its GDP by its population. The sign for the coefficient is positive. If it is >1, it would indicate that the per capita income is one of the important factors in determining the export demand for Malaysian palm oil by the country. If δ_3 <1, then per capita income will only have a small impact on the export demand for Malaysian palm oil by the country.

The coefficient for the per kg consumption of oils and fats (δ_4) explains the consumption elasticity for the export demand of Malaysian palm oil. The sign should be positive. If the value >1, then δ_4 is an important factor determining the export demand for Malaysian palm oil by the country. Conversely, if the value is <1, δ_4 has only a small impact on the export demand.

The exchange rate between RM and the currency of country *i* is used to investigate the effect of the relative currency value on the export demand for Malaysian palm oil. This is one of the important independent variables in the model, and can be interesting to investigate because its sign can be positive or negative. If the value of RM is high vis-à-vis the country's currency, the sign is negative, and *vice versa*. This is based on the theory of demand.

The variable CPI (δ_6) is the consumer price index of the country. It explains the impact of inflation rate in the country on its demand for Malaysian palm oil. The sign for its coefficient should be positive. This is because, if the consumer price index in the country is high, its prices of goods would be higher than those in the exporting country. Hence, its volume of imports will increase when its inflation rate increases.

Short-Run Elasticity Model

The next step in the estimation is to formulate a dynamic model involving the first differences of the explanatory variables plus the lagged variable from the first stage estimation. Specifically, the following regression was used,

$$\ln(EXP_t - EXP_{t-1}) = \theta + \phi_1 \ln(PO_t - PO_{t-1}) + \phi_2 \ln(SBO_t - SBO_{t-1}) + \phi_3 \ln(YC^i_t - YC^i_{t-1}) + \phi_4 \ln(COM_t - COM_{t-1}) + \phi_5 \ln[(ER^{msia}_t / ER^i_t) - (ER^{msia}_t / ER^i_t)_{t-1}] + \phi_6 \ln(CPI^i_t - CPI^i_{t-1}) + \Omega\mu_{it-1} + \varepsilon_t \quad (7)$$

where, $\Omega\mu_{it-1}$ is obtained from:

$$\mu_{it} = \ln(EXP^i_t) - \theta - \delta_1 \ln(PO_t) - \delta_2 \ln(SBO_t) - \delta_3 \ln(YC^i_t) - \delta_4 \ln(COM_t - COM_{t-1}) \delta_5 \ln(ER^{msia}_t / ER^i_t) - \delta_6 \ln(CPI^i_t) \quad (8)$$

For elasticity explanation:
ϕ_1 = direct own-price elasticity in the short-run.
ϕ_2 = substitution price elasticity in the short-run.
ϕ_3 = per capita income elasticity in the short-run.
ϕ_4 = per kg consumption of oils and fats elasticity in the short-run.

ϕ_5 = ratio exchange rate elasticity in the short-run.

ϕ_6 = inflation rate elasticity in the short-run.

All the coefficients for the independent variables now represent short-run elasticity information. The coefficient for Ω, the error-correction term, specifies the speed with which the system tends to the long-run equilibrium. Specifically, the mean lag of the adjustment process is –1/ Ω, so that the larger the value of Ω in absolute terms, the faster is the rate of adjustment to the long-run equilibrium.

Panel Data Analysis

The use of panel data is the alternative medium for analysing the elasticity of foreign demand for the Malaysian palm oil. The panel data model with fixed effect analysis is used to study the significant factors that influence the export demand for Malaysian palm oil function. A fixed effect with constant change and unchanged slope for the export demand for Malaysian palm oil function is:

$$\ln EXP_t = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \alpha_5 D_5 + \beta_1 \ln PO_t + \beta_2 \ln SBO_t + \beta_3 \ln YC_t + \beta_4 \ln COM_t + \beta_5 \ln RC_t + \beta_6 \ln CPI_t + \varepsilon_{i\,t} \quad (9)$$

where;

EXP_t = export demand for Malaysian palm oil by the country in time *t*.

PO_t = price of palm oil in time *t*.

SBO_t = price of SBO in time *t*.

YC^i_t = per capita income in selected countries in time *t*.

COM^i_t = per kg consumption of oil and fats in selected countries in time *t*.

RC^i_t = exchange rate between the currencies of Malaysia and the importing country in time *t*.

CPI_t = consumer price index (inflation rate) in selected countries in time *t*.

D_i = dummies for selected countries, they are:
D1 for China;
D2 for India;
D3 for Pakistan;
D4 for Egypt and
D5 for South Korea.

Based on the panel data model as shown above, all the time-series variables are transformed to logarithm to observe the elasticity of each coefficient. The dummies are used in the model to show the differences of the intercept values of each model from each country. The findings from the panel data are compared to the OLS regression estimates in terms of elasticity.

ESTIMATION RESULTS OF ERROR CORRECTION MODEL

The export demand model for Malaysian palm oil in selected importing countries contains several independent variables – the price of palm oil, price of SBO, per capita income of the importing country, per kg consumption of oils and fats in the importing country, exchange rate between the currencies of Malaysia and the importing country and consumer price index in the importing country. The results from the model for the short- and long-runs are given in *Tables 1* and *2*, respectively.

TABLE 1. ESTIMATED EXPORT DEMAND FOR MALAYSIAN PALM OIL IN SELECTED COUNTRIES FOR THE SHORT-RUN

	Independent variable						
Importing country	Price of PO	Price of SBO	YC	COM	ER	CPI	ECT
China	Not significant	Significant (elastic)	Not significant	Not significant	Not significant	Not significant	Significant (elastic)
Pakistan	significant (elastic)	Significant (elastic)	Not significant	significant (elastic)	Not significant	Not significant	Significant (elastic)
India	significant (elastic)	Significant (elastic)	significant (elastic)	Not significant	Not significant	Not significant	Significant (elastic)
South Korea	significant (elastic)	Significant (elastic)	Not significant	Not significant	Not significant	Not significant	Significant (elastic)
Egypt	significant (elastic)	Significant (elastic)	Not significant	Not significant	Not significant	significant (elastic)	Significant (elastic)

Notes: PO = price of palm oil, SBO = price of soyabean oil, YC = per capita income, COM = consumption of oils and fats, ER = ratio of exchange rate, CPI = consumer price index, ECT = error correction term.

Table 1 shows the estimated export demand for Malaysian palm oil in selected countries in the short-run. The price of SBO is an important factor influencing the demand for Malaysian palm oil by China, Pakistan, India, South Korea and Egypt. This is because the coefficients are significant for their models and the elasticity for the price of SBO is greater than one (elastic). This means that if the price of soyabean increases by 1%, the demand for Malaysian palm oil by the country will increase by more than 1%.

The price of palm oil is important in influencing the demand for Malaysian palm oil by Pakistan, India, South Korea and Egypt in the short-term. The other independent variables are not significant. Lastly, the ECT for all the models show that in the long-run, the dependent and independent variables are interrelated.

Table 2 shows the estimates of the demand for Malaysian palm oil by selected countries in the long run. The price of palm oil is an important factor for China, Pakistan, India and Egypt, as depicted by the significant coefficients in their models with values greater than one (elastic). The price of SBO is important for export demand by India, South Korea and Egypt, and per capita income for China, Pakistan and India. The consumption of oils and fats is important for Pakistan and India, and the exchange rate for China and South Korea. Lastly, the consumer price index is important only for Egypt.

In conclusion, the study found that the price of palm oil plays a very significant role in the exports of Malaysian palm oil in the short- and long-runs. Thus, the price of palm oil needs to be stable and competitive with those of its substitutes, especially SBO, to ensure the competitiveness of Malaysian palm oil in the world market. The price of SBO is also an important determinant of the success of exports of Malaysian palm oil as it is important in the short- and long-runs in influencing the demand for Malaysia palm oil. As its coefficients are elastic, it is highly substitutable with palm oil.

ESTIMATION RESULTS FOR PANEL DATA ANALYSIS

The results from estimating the export demand for Malaysian palm oil by panel data analysis is shown in the equation below:

$$\begin{aligned}\ln EXP = {} & -7.0303D_1 - 6.8614D_2 \\ & (-1.6397)^* \quad (0.2275) \\ & -5.8743D_3 - 11.1644D_4 - 15.3472D_5 \\ & (1.2777) \quad (-3.1941)^{***} \quad (-1.8819)^* \\ & -1.1692\ln PO + 1.5578\ln SBO + 1.2516\ln YC \\ & (-2.5695)^{**} \quad (2.3985)^{**} \quad (1.8625)^* \\ & + 0.1336\ln COM - 0.7579\ln RC + 1.9451\ln CPI \\ & (0.1751) \quad (-1.1552) \quad (5.4351)^{***}\end{aligned}$$

Notes: ***,** and * indicates significance at 1%, 5% and 10%, respectively. Value of t-statistic in parentheses.

The intercepts of all the five countries are statistically different (D_1 - D_5). The coefficients for price of palm oil, price of SBO, per capita income and consumer price index are statistically significant, thus elastic since they are greater than one. Hence, if these variables increase/decrease by 1%, the export demand for Malaysian palm oil will increase/decrease by >1%.

TABLE 2. ESTIMATED DEMAND FOR MALAYSIAN PALM OIL BY SELECTED COUNTRIES IN THE LONG-RUN

	Independent variable					
Importing country	**Price of PO**	**Price of SBO**	**YC**	**COM**	**ER**	**CPI**
China	Significant (elastic)	Not significant	Significant (elastic)	Not significant	Significant (elastic)	Not significant
Pakistan	Significant (elastic)	No significant	Significant (elastic)	Significant (elastic)	Not significant	Not significant
India	Significant (elastic)	Significant (elastic)	Significant (elastic)	Significant (elastic)	Not significant	Significant (elastic)
South Korea	Not significant	Significant (elastic)	Not significant	Not significant	Significant (elastic)	Not significant
Egypt	Significant (elastic)	Significant (elastic)	Not significant	Not significant	Not significant	Significant (elastic)

Notes: PO = price of palm oil, SBO = price of soyabean oil, YC = per capita income, COM= consumption of oils and fats, ER = exchange rate, CPI = consumer price index, ECT = error correction term.

Therefore, these variables are important factors in influencing the demand for Malaysian palm oil in the importing country. On the other hand, the coefficients for consumption and the exchange rate between the exporting and importing countries are insignificant. Nevertheless, the panel data analysis does not prove that those variables are significant in terms of influencing the export demand for Malaysian palm oil.

CONCLUSION

This study examined the price elasticity of export demand for the Malaysian palm oil. It estimated the elasticity of demand by China P R, India, Pakistan, Egypt and South Korea. The ECM method was used to quantify the short-run and long-run effects of the explanatory variables on the dependent variables using time-series data. All these variables should be constantly monitored since they are important for planning exports to the country concerned. Every importing country of Malaysian palm oil has different export demand elasticity due to the different coefficients for the independent variables in its model.

To ensure that the policy makers make the proper decisions, individual export demand elasticity models for each importing country should be developed. This study found that the price of palm oil plays a very important role in its export; hence the price needs to be stable. From analysing competitive panel data, the effect of a percentage change in the SBO price is greater on the export of palm oil than the effect of the same percentage change in the palm oil price. This means that both oils are highly substitutable. Another finding is that to maximize profit for investors in palm oil, the price of palm oil should be compatible with that of SBO.

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