INTERNATIONAL DEMAND FOR PALM OIL ESTIMATED WITHIN A FATS AND OILS DEMAND SYSTEM

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Abstrak

Sistim permintaan untuk minyak nabati dan hewani bagi tiga pasar internasional utama dan dua negara produsen diduga dengan model *Almost Ideal Demand System* (AIDS). Pembahasan dititikberatkan pada hasil pendugaan untuk sistem permintaan minyak nabati dan hewani bagi MEE karena kawasan ini merupakan pasar ekspor yang paling penting bagi minyak sawit Indonesia. Hasil analisis menunjukkan bahwa kecuali di Amerika Serikat, permintaan untuk minyak sawit di pasar internasional adalah inelastis. Telaahan ini juga menunjukkan hubungan antara minyak-minyak nabati dan hewani tidak saja bersifat substitusi tetapi antara beberapa minyak tersebut terjadi juga hubungan yang komplementer. Negara-negara yang termasuk ke dalam analisis ini adalah MEE, Amerika Serikat, Jepang, Malaysia, dan Indonesia. Sebelas macam minyak nabati dan hewani yang termasuk ke dalam analisis ini adalah *lard, edible tallow*, minyak-minyak sawit, kelapa, kedelai, biji kapas, biji rape, biji bunga matahari, zaitun, jagung, dan ikan.

Abstract

Demand systems for fats and oils of three major international markets and two producing countries are estimated using the Almost Ideal Demand System (AIDS). Discussion is focused on the results of the EEC demand system because this region is the most important market for Indonesian palm oil. Results of the analysis indicate that except for the United States, demand elasticities for palm oil in international markets are inelastic; and the relationships among fats and oils are not only as substitutes, but for certain oils there are also as complements. Countries included in this analysis are the EEC, the United States, Japan, Malaysia, and Indonesia. Eleven fats and oils are analyzed, namely lard, edible tallow, palm, coconut, soybean, cottonseed, rapeseed, olive, sunflower seed, corn, and fish oils.

Introduction

Understanding the international demand for palm oil is of our interest since the product is being considered as one of primadonnas expected to give a big role in foreign exchange earnings. For example, by knowing own and cross price demand elasticities for palm oil of exporting countries, one may predict the magnitude of the effects in fats and oils trade on demand for the products. The changes in those trade variables can be caused by planned or unplanned shock such as increase in tariffs, export taxes, or change in preferences.

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Compared to other fat and oil products, estimation of palm oil demand elasticities for international markets of the products has not been extensively studied. One reason is that palm oil is not an important commodity to their economies (the product is produced in other countries, mainly in developing countries). During the 1960-1980 period, palm oil's shares of the total fats and oils expenditures are 3, 8, and 6 percent for the United States, the European Economic Community (EEC), and Japan, respectively.

Tan (1973) estimated the palm oil price elasticities for these developed countries. He used a single equation with the price of palm oil as a dependent variable. Price elasticity is calculated by inverting a price flexibility, which is estimated from the price dependent equation. Using 1959-1969 data, the study suggests that price elasticities for palm oil for the developed countries were very elastic, ranging from -1.7 for France-West Germany, -14.9 for the United Kingdom, -16.7 for Japan, to -31.4 for the United States. These results were higher than one might have anticipated. Another study using the same price dependent equation form and data from the 1955-1964 period estimates the price elasticity for palm oil for developed countries as -3.3 (Bachelet as cited by Labys (1977)). Later, a study by Labys (1977) applying a demand system approach and annual data from the 1955-1972 period estimates price elasticity for palm oil in the EEC markets to be -0.8.

This paper is an attempt to estimate demand for palm oil in three major international markets and two major producing countries, namely the EEC, the United States, Japan, Malaysia, and Indonesia. The estimation uses the Almost Ideal Demand System (AIDS) model applied to a group of fats and oils. Therefore, the results of this analysis give information on demand aspects not only for palm oil but also for other fats and oils included in the demand systems. In this paper, however, only the EEC case will be elaborated in a great details. The reason for picking up the EEC is that the region is the principal importer for Indonesian palm oil. Results of the demand system analyses for the other four regions will only be discussed its main findings and with emphasis on palm oil. A complete results of those findings can be found in Suryana (1986a).

The Model

The AIDS model estimates parameters of demand for a group of commodities in a system of equations. The model is applied to data on a group called fats and oils. By using this group of commodities, this study implies that a weak separability assumption between the fats and oils group and another bundle or bundles of food such as meat, cereals, fruits and vegetables must be held.

Generally, commodities are partitioned into groups such as food, housing, clothing, entertainment, etc., and the separability assumption is applied to this grouping. In this analysis, the assumption is imposed at both levels. So, a consumer can rank different food bundles and the ranking is independent of his consumption in other groups such as housing or clothing. Further, the consumer can also rank his preferences for fats and oils, which is independent of his consumption of other food. Eventhough such a deeper subgrouping is rare, Deaton and Muellbauer (1980b) state that: "There is no reason why each subutility function could not have one or more deeper subgroupings within it, nor should we rule out the possibility that some groups may only contain one good" (see p. 122).

This study also assumes that the budgeting is deeper than two stage budgeting. It means the consumer can allocate total expenditure in three stages. First, the expenditure is allocated to broad groups, including food. Next, food expenditure is allocated to food bundles, of which a group called fats and oils is one. Then, fats and oils expenditure is further allocated to individual fats or oils.

From a theoretical point of view Deaton and Muellbauer (1980a, 1980b) claim that the AIDS model has several advantages over previous demand system alternatives. It preserves the generality of both the Rotterdam and the Translog models, as well as many desirable properties of these models.[1] The AIDS is derived from the expenditure function as:

$$(1)\quad \log C(U,P) = \alpha_0 + \sum_{k=1}^{n} \alpha_k \log P_k + \sum_{k=1}^{n} \sum_{j=1}^{n} \gamma^*_{kj} \log P_j \log P_k$$

$$+ U \beta_0 \prod_{k=1}^{n} P_k^{\beta_k}$$

where P_k's are prices of goods included in the system, U is utility, α, β, and γ^* are parameters.

Using Shephard's lemma, $\{\partial C(u,p)/\partial P_i\} = Q_i$, then one can express shares of expenditure as:

$$w_i = \frac{P_iQ_i}{M} = \frac{P_i}{C} \cdot \frac{\partial C}{\partial P_i} = \frac{\partial \log C}{\partial \log P_i}, \text{ or}$$

[1] The advantages are, in Deaton and Muellbauer's words: Our model, ..., gives an arbitrary first-order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel curves, it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and it can be used to test the restrictions of homogeneity and symmetry through linear restriction of fixed parameters (Deaton and Muellbauer, 1980a, p. 312).

(2) $w_i = \alpha_i + \sum_j \gamma_{ij} \log P_j + \beta_i U_0 \prod_k P_k^{\beta_k}$,

where: $\frac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji}) = \gamma_{ij}$.

An indirect utility function can be obtained by inverting the cost function (1), and C is now expressed as M or total expenditures. Substitute the indirect utility function into (2). The share equation obtained from those steps is:

(3) $w_i = \alpha_i + \sum_j \gamma_{ij} \log P_j + \beta_i \log(\frac{M}{P})$,

where: $\log P = \alpha_0 + \sum_k \alpha_k \log P_k + \frac{1}{2} \sum_k \sum_j \gamma^*_{kj} \log P_k \log P_j$

To make the model consistent with the theory of demand, *i.e.*, expenditure function (1) is homogenous of degree one in prices, and demand function (3) homogenous of degree zero in prices and expenditure; then the restrictions on the parameters in the equations are:

(4) $\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \beta_i = 0$

(5) $\sum_{j=1}^{n} \gamma_{ij} = 0$

(6) $\gamma_{ij} = \gamma_{ji}$

Condition (4) is the adding up restrictions, condition (5) is required for homogeneity of the demand equation, and the symmetry condition is satisfied if (6) holds.

If price index P as defined above is known prior to the model, the AIDS in form (3) is a linear function in parameters α, β, and γ, and estimation can be made equation by equation by using ordinary least square (OLS). If log P is approximated by log fP* (where f is a constant), and P* is estimated using Stone's index, which is $\log P^* = \sum_{k=1}^{n} w_k \log P_k$, then (3) can be expressed as

(7) $w_i = \alpha^*_i + \gamma_{ij} \log P_j + \beta_i \log(M/P^*)$,

where $\alpha^*_i = (\gamma_i - \beta_i \log f)$. The above function is called the linear approximate AIDS. It is easily used and the data needed are easily collected. From (7), one could calculate expenditure, direct, and cross price elasticities as follows, respectively.

$$\epsilon_i = 1 + \beta_i/w_i$$

$$\eta_{ii} = \gamma_{ii}/w_i - 1$$

$$\eta_{ij} = \gamma_{ij}/w_i, \text{ for } i \neq j$$

Blanciforti and Green (1983) estimate a demand system for food in the United States by the linear approximate AIDS (7) and using OLS, and compare these results to the estimates of the AIDS equation (3) and the Linear Expenditure System. They conclude that the AIDS model is a viable system to analyze the demand for food commodities; the approximate AIDS model with homogeneity restrictions performs reasonable well with respect to the estimated magnitudes of elasticities. Capps, Tedford, and Havlicek (1985) used AIDS model to estimate household demand for convenience and nonconvenience foods in the US. As far as Indonesian case as concerned, the AIDS model has been used in studies on demand for food in Indonesia by Johnson *et al.* (1986) using the 1980 SURGASAR (multi-purpose household Survey), Daud (1986) using the 1981 SUSENAS (Socio-Economic National Survey), and Dan (1987) using the 1984 SUSENAS data.

Data

Data used in this study are sets of data at a country level, and obtained from secondary sources mainly from United States Department of Agriculture's publications. Suplementary data for Indonesian vegetable oils data are gathered from Balai Penelitian Perkebunan Medan's publications.

Based on the data availability and domestic use of fats and oils in each region, the commodities included in the demand systems for each region are presented in Table 1.

Table 1. List of fats and oils included in the demand system estimations.

Country/region	Number of commodity	Fats and oils
The United States	7	Palm, coconut, soybean, corn, and cottonseed oils, lard, edible tallow.
The EEC	7	Palm, coconut, soybean, sunflower seed, rapeseed, olive, and fish oils.
Japan	5	Palm, coconut, soybean, rapeseed, and fish oils.
Indonesia	2	Palm, and coconut oils.
Malaysia	2	Palm, and coconut oils.

Annual data used for the US. and the EEC. estimates are from 1964 through 1983, for Japan from 1965 through 1982, and for Indonesia and Malaysia from 1969 through 1983.

Estimation Results

Brief review of fats and oils situation

Before discussing the estimation results, to give a basic feature of the relationship between palm oil and other fats and oils, the following is a brief review of international markets for these commodities.

Fats and oils are glycerides of fatty acids. Technical properties of fats and oils as well as their relative prices, are important in determining the range of end uses for certain fats and oils (see Weiss, 1983).

These technical and economic factors dictate patterns of demand for the commodities and the degree of substitution. Some oils exhibit independent demand patterns, in which case the degree of substitution between them and other oils would be weak. For example, linseed and tung oils are in strong demand from the painting industry because both are drying oils. A wide range of fats and oils can be used in the soap industry, but the demand for lauric oils will always exist as certain quantities of foaming fatty acids are required. Demand for olive oil by the food industry has remained strong despite its high price because of its highly palatable flavor.

Technological progress such as hydrogenation has widened the degree of substitution among oils. The hydrogenation process reduces iodine number and changes the unsaturated fatty acids into saturated fatty acids. Through this process, unsaturated fatty acids such as soybean and cottonseed oils could become adequate substituted for a group of oils with lower iodine numbers (see Allen, 1982). Another processing technique that can widen substitution among fats and oils is the randomization process. Use of the randomization process eliminates one of the major drawbacks of the use of palm oil by the food industry, namely its slow rate of crystallization (Gutcho, 1979; Sonntag, 1982). Thus, this technique, along with its relatively low price, has widened the use of palm oil.

Technological progress also has preserved complementarity among oils. A certain company such as one that produces margarine or salad oils may use a specific composition of oils as inputs for its products (see Gutcho). Thus, at least in the short run, it is not unusual to find out that complementarity among oils exists.

Substitution among all of fats and oils increase over time. Studies using data from the 1950s and 1960s indicated that lauric oils were independent of other subclasses of fats and oils (Tan, Nyberg, 1970; Labys, 1975). However, more recent studies using North American data from 1959-1967 and 1968-1976 indicate that price interdependencies among fats and oils have become more significant over time in markets with strong interchangeable demand (Griffith and Meilke, 1979). They also inferred that the prices of lauric oils are no longer independent of those of other fats and oils. The same conclusion was reached by another analysis for the EEC case using 1959-1969 and 1971-1985 data (Suryana, 1986b).

In 1982-1983 about 30 percent of the world production of vegetable oils was in the form of soybean oil. However palm oil was the largest oil being exported, which was about 32 percent of the world's export of major vegetable oils. Soybean, sunflower seed, palm, repeseed, and coconut oils constituted 79 percent of world vegetable oil production and 88 percent of world export. Most of oils produced by countries in temperate zones are consumed by themselves, while oils produced in tropical countries are exported. In 1982-1983 the United States produced 5.44 million tons of soybean oil but exported only 0.92 million tons. The Soviet Union was a major of sunflower seed and cottonseed oils, and China was a major producer of cottonseed and rapeseed oils; however, both countries used most of these oils for their own consumption. On the other hand, all major producers of semisolid or solid oils exported a large part of their production.

In 1983-1984, ten countries consumed more than one million tons a year of vegetable and fish oils. The United States was the largest consumer, followed by India, China, the Soviet Union, Brazil, Japan, Indonesia, West Germany, Italy, and the United Kingdom. Major oil disappearances, as an approximation to consumption, in these countries were 26.5 million tons or about 60 percent of the total world consumption.

Composition of fats and oils consumed in each analytical region are not the same. More than 70 percent of fats and oils consumption in the U.S. is from soybean oil, while in the EEC and Japan eventhough soybean oil is the most important one, but its share is not as higher as in the U.S. case. In Malaysia, 87 percent of vegetable oils consumption is in form of palm oil. In Indonesia the role of palm and coconut oils are almost even. Table 2 presents more detailed figure of this matter.

Table 2. Domestic use of major oils and lard in the analytical regions, annual average 1980/1981-1982/1983a.

Fats and oils use	USA	EEC	Japan	Indonesia	Malaysia
	(1,000 metric tons)				
Total use	5,915	6,795	1,752	1,383	536
	(%)				
Palm oil	2.1	9.1	8.5	43.3	86.9
Coconut oil	6.0	7.4	4.7	49.9	9.7
Soybean oil	70.1	21.9	38.1	—	—
Cottonseed oil	4.7	0.5	3.0	—	—
Sunflower seed oil	—	8.6	—	—	—
Rapeseed oil	—	9.8	28.5	—	—
Corn oil	4.7	—	—	—	—
Olive oil	—	11.8	—	—	—
Fish oil	0.3	9.1	6.4	—	—
Lard	7.2	13.4	6.1	—	—
Peanut oil	—	—	—	—	—
Others	8.4	8.4	4.7	6.8	3.4

a Blanks do not necessarily indicate zero. In the United States, consumption of edible tallow in 1982/1983 was 283,000 metric tons.

Source: United States Department of Agriculture, 1980-1985; United States Department of Commerce, 1970-1985; and Oil World, 1984.

The EEC Demand System

Coefficients of the unrestricted EEC demand system for vegetable and fish oils are reported in Table 3.[2] Both the R^2's and F ratios of the sunflower seed oil and rapeseed oil equations are relatively low, and Durbin-Watson (DW) statistic for the olive oil and fish oil equations are relatively high, around 3.0. Ten and five of the 56 coefficients are significant at the 5 and 10 percent levels, respectively.

The palm oil equation has fair statistical indicators. The F ratio, R^2, and DW statistics are 9.29, 0.87, and 2.45, respectively. Only two out of eight coefficients of the equations have the 5 percent significant levels. Neither the coefficient for palm oil price nor the one for expenditure is significant.

[2] Since the empirical period encompasses two different exchange rate systems, a dummy year for exchange rate (years after 1971 equal one, zero otherwise) is introduced into the system. The results show that coefficients of the dummy variable in the equations are not significant at the 10 percent level. Therefore, this variable is dropped from the analysis.

Table 3. Parameter estimates and statistic of the unrestricted EEC demand system for vegetable and fish oils based on AIDS model.

Variable and statistic	Expenditure share equation of						
	Palm oil	Coconut oil	Soybean oil	Sunflower seed oil	Repeseed oil	Olive oil	Fish oil
Intercept	0.156	1.607***	-1.087***	-0.165	-0.034	0.024	0.499***
Dependent variable:							
Price of							
Palm oil	0.042	0.106*	-0.046	-0.015	-0.047	-0.057	0.017
Coconut oil	-0.022**	0.045*	-0.007	0.008	-0.011	-0.003	-0.009
Soybean oil	-0.003	-0.178*	0.151	0.093	0.013	-0.127	0.051
Sunflower seed oil	-0.021	-0.010	-0.038	-0.031	-0.005	0.047	-0.004
Rapeseed oil	0.053	0.073	0.011	-0.075	0.072	-0.078	0.054
Olive oil	-0.044***	-0.044**	-0.032	-0.029*	-0.048***	0.247***	-0.050***
Fish oil	-0.001	0.009	0.018	-0.048*	-0.034	0.032	0.023
Expenditure of oils	-0.033	-0.180***	0.117**	0.059**	-0.066***	-0.037	-0.023
Statistic:							
F ratio	9.19	19.32	10.78	2.72	3.88	8.06	11.65
R^2	0.87	0.93	0.87	0.66	0.74	0.85	0.89
DW statistic	2.45	1.96	2.42	2.17	2.30	3.00	2.92
Homogeneity testing							
$\sum_j \alpha_{ij}$	0.004	0.001	0.057***	-0.036**	0.061***	0.061	0.027**
Standard error	(0.008)	(0.018)	(0.017)	(0.022)	(0.013)	(0.043)	(0.009)

*, **, *** represent the 10, 5, and 1 percent significance levels, respectively.

Homogeneity testing indicates that four out of seven equations in the unrestricted EEC demand system reject the homogeneity property at the 5 percent significance level. The four equations are those for soybean oil, sunflower seed oil, rapeseed oil, and fish oil.

Table 4 presents price and expenditure elasticities for the unrestricted EEC demand system. Except for rapeseed oil, the direct price elasticities have negative signs and are inelastic. Expenditure elasticity for coconut oil is negative, whereas those for the six other oils, as expected, are positive. Twenty nine out of 42, or about two-thirds of the cross price elasticities indicate complementarity relationships among the group of oils.

The direct price elasticity for palm oil is -0.54 and its expenditure elasticity is 0.96. Five cross price elasticities indicate complementarity with palm oil. The five oils are coconut, soybean, sunflower seed, olive, and fish oils.

Two equations rejecting the homogeneity restriction at the 1 percent level show large changes in values of their parameters when the homogeneity restriction

Table 4. Price and expenditure elasticities of the unrestricted EEC demand system for vegetable and fish oils based on AIDS model.

Oils	Elasticity with respect to							Elasticity wrt. expenditure of oils
	Palm oil	Coconut oil	Soybean oil	Sunflower seed oil	Rapeseed oil	Olive oil	Fish oil	
Palm oil	-0.53	-0.25	-0.03	-0.23	0.59	-0.49	-0.01	0.96
Coconut oil	1.04	-0.56	-1.74	-0.98	0.71	-0.43	0.09	-0.76
Soybean oil	-0.26	-0.04	-0.14	-0.21	0.06	-0.18	0.10	1.67
Sunflower seed oil	-0.22	0.12	1.34	-0.55	-1.09	-0.42	-0.69	1.86
Rapeseed oil	-0.81	-0.19	0.23	-0.09	0.23	-0.81	-0.59	2.14
Olive oil	-0.13	-0.01	-0.29	0.11	-0.18	-0.44	0.77	0.92
Fish oil	0.25	-0.14	0.74	-0.05	-0.79	-0.73	-0.67	0.67

is imposed. (The estimation is not shown here). As a result, changes in the magnitudes of corresponding elasticities are also large. Results of the reestimation indicate that the two oils, soybean and repeseed, have positive direct price elasticities. The other five equations show small changes in their coefficients.

Demand System for Fats and Oils in the Other Four Countries

Selective results of the demand systems for fats and oils for the United States, Japan, Malaysia, and Indonesia are discussed below. Fats and oils included in the U.S. demand system are palm oil, coconut oil, soybean oil, cottonseed oil, lard, and edible tallow. All equations in the U.S. demand system have sufficient F ratios to be significantly different from zero at the 1 percent level. The R^2's are greater than 0.80. However, two equations, those for soybean oil and lard, have low D W statistic. Eighteen out of 56 coefficients are significantly different from zero at the 10 percent level. Fourteen of them are significant at the 5 percent level. For the palm oil equation, the model gives fair statistical indicators. The R^2 is 0.81, the DW statistic is 2.23, and the F ratio is 6.05. Only three out of eight coefficients are significantly different from zero at the 5 percent level. The coefficient of palm oil price, that is, the base number used to calculate the direct price elasticity for palm oil, is not significant, even at the 10 percent level.

The homogeneity property of the unresticted model of the U.S. demand system for fats and oils is tested, and the results indicate that all seven equations in the system do not reject this property. The results indicate that except for edible tallow, direct price elasticities of the fats and oils have negative signs, as expected. The elasticities for palm oil and lard are more elastic (-1.46 and -1.17), whereas corn oil has a very inelastic demand (-0.09). Thirty out of 42 cross price elasticities have negative signs, an indication of the existence of a complementarity relationship among fats and oils. Most of the cross elasticities are less than 1.0. Two out of seven expenditure elasticities have negative signs, those of cottonseed oil and lard. The other five have elasticities with a positive sign, namely 4.22, 0.30, 1.61, 0.85, and 1.66 for palm oil, coconut oil, soybean oil, and edible tallow.

Two equations in the Japan demand system, those for soybean oil and fish oil, have low F ratios (less than 5.0) and R^2's (less than 0.70). The other three, namely palm oil, coconut oil, and rapeseed oil have good statistical properties. Twelve out of 30 coefficients in the system are significantly different from zero at the 5 percent level. The palm oil equation has good statistical indicators. F ratio, R^2, and DW statistic are 15.05, 0.89, and 1.91, respectively. However, the coefficient of palm oil price is not significantly different from zero. Homogeneity testing indicates that coconut oil and rapeseed oil equations reject the property at the 1 and 10 percent significance.

All five direct price elasticities for oils have negative signs, and all five expenditure elasticities with respect to oils expenditure are positive. The signs of 15 out of 20 cross price elasticities are negative, indicating the existence of complementary relationships among oils.

The price elasticities are -0.89, -0.29, -0.55, 0.02 and -0.47 for palm, coconut, soybean, rapeseed, and fish oils, respectively. The direct price elasticities for those oils are 1.81, 0.20, 0.81, 1.52, and 0.90, respectively.

Only two oils are consumed in large amount in Indonesia and Malaysia, namely palm oil and coconut oil. These two oils are included in the model.

Two factors must be considered in relation to the consumption of vegetable oils in Indonesia during the 1969-1983 period. First, because of stagnation in coconut oil production since 1979, palm oil consumption has jumped sharply since then. Second, palm oil consumption was at very low levels or almost negligible in 1976. Two dummy variables, DYEAR1 and DYEAR2, are created to examine their effect on the demand system. DYEAR1 has value 1 for 1979-1983 and 0 otherwise. DYEAR2 has value 1 for 1976 and 0 otherwise. Estimation results indicate that only the coefficient for DYEAR1 is significantly different from zero at the 5 percent level. Therefore, only DYEAR1 is included in the further analysis. Statistical properties of the demand system estimations are fair. The values of the F ratio, R^2, and DW statistic for the coconut and palm oils equations are 8.50, 0.77, and 1.04, respectively. None of the estimated coefficients are significantly different from zero, even at the 10 percent level.

Since the DW statistic is very low, calculation of the elasticities is based on coefficients estimated by the Autoreg procedure (lag = 1). The results suggest that direct price elasticities for palm oil and coconut oil are about -0.6 and -0.9, respectively; there is a complementarity relationship between palm oil and coconut oil; and the expenditure elasticity for palm oil is more elastic than that for coconut oil.

Unlike the equations of the Indonesian demand system, those for the Malaysian demand system have very large F ratios (162.69) and R^2 (0.98). However, DW statistics of palm oil and coconut oil equations are 1.33. All coefficients in the palm oil equation are significantly different from zero at the 5 percent level. Elasticities are calculated based on coefficients estimated by the Autoreg procedure. Results indicate that the absolute value of the direct price elasticity for palm oil, -0.4, is less than that for coconut oil, -0.7. The results also suggest that a complementarity relationship exists between palm oil and coconut oil, and that the expenditure elasticity for palm oil is more elastic than that of coconut oil. These results are similar to those for Indonesia, although the magnitudes are different.

Demand and expenditure elasticities for palm oil in five countries

Table 5 summarize the demand elasticities for palm oil in five countries estimated by the AIDS model. The results give estimation as follows:

(a) Direct price elasticities for palm oil in the United States is -1.46, while in other regions are inelastic. Direct price elasticities for palm oil in Japan, Indonesia, the EEC, and Malaysia are -0.89, -0.57, -0.53, and -0.38, respectively.

(b) The existence of substitution and complementarity relationships between palm oil and other fats and oils is suggested. There are strong indications that

Table 5. Direct price, cross price, and expenditure elasticities for palm oil in five countries.

Elasticity	USA	EEC	Japan	Malaysia	Indonesia
Direct price:	-1.46	-0.53	-0.89	-0.38	-0.57
Cross price with respect to price of:					
Coconut oil	-0.47	-0.25	-0.13	-0.31	-0.68
Soybean oil	-0.27	-0.03	-0.07	---	---
Cottonseed oil	1.24	---	---	---	---
Sunflower seed oil	---	-0.23	———	---	---
Rapeseed oil	---	0.59	-0.20	---	---
Corn oil	0.60	---	---	---	---
Olive oil	---	-0.49	---	---	---
Fish oil	---	0.01	0.48	---	---
Lard	2.62	---	---	---	---
Edible tallow	-2.63	---	---	---	---
Expenditure with respect to fats and oils:	4.22	0.96	1.81	1.87	2.07

complementarity relationships exist between palm oil and coconut oil and between palm oil and soybean oil. All cross price elasticities between the products in all five countries are negative.

(c) Except for the EEC, expenditure elasticities for palm oil are elastic. In Japan, Malaysia, and Indonesia the elasticities are around 2.0 while in the US is 4.2. These elasticities are usually has an upward bias, since these elasticities are with respect to expenditure of commodities included in a demand system (in this case fats and oils), not with respect to the total expenditure.

Comparison of empirical results

This study is not designed to analyze appropriateness of the estimation method. However, there is a study done by Labys (1977) that, to some extent, can be used to facilitate some comparisons. There are, however, at least two empirical differences between the Labys' work and this study. First, periods of the studies are different; he used annual series data from the 1955-1972 period; this study covers 1964-1983 data. Second, both studies may have different definitions for the same variables included in the estimations. In addition, Labys estimated demand system for major fats and oils for the United States, the EEC, and Japan. Compared to this study, he used different sets of fats and oils in those three demand systems. The comparison suggests that, in general, the R^2 and DW statistical sets of equations in the demand systems of the AIDS model are better than those of the Labys.

To narrow the discussion, the US demand system is chosen as a case. Labys included five fats and oils in the US demand system: soybean oil, cottonseed oil, lard, lauric oils,[3)] and edible tallow. To be more comparable, a US demand system for the five oils as used by Labys is estimated using the AIDS model. Table 6 reports the results.

In general, the R^2 and DW statistic for the AIDS model are better than those obtained by Labys. Most of the elasticities estimates are similar in direction. Both methods result in negative expenditure elasticities for cottonseed oil and lard.

The AIDS reports that all direct price elasticities are negative as one might have anticipated. The Labys found that direct price elasticity for lard was positive. Magnitude of the price elasticities reported by both studies is different. The differences are ranging from 0.02 for coconut oil to 0.49 for soybean oil. On the average, percentage of the differences is 19 percent. According to Labys, seven out of 20 cross price elasticities suggest the existence of complementarity relationships

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3) Labys uses lauric oils, instead of coconut oil. Lauric oils consist of coconut and palm kernel oils, with coconut oil has a dominant share.

among fats and oils; meanwhile, the AIDS model indicates complementarity exists among 11 cross price relationships. Only 11 out of 20 cross price elasticities both studies agree on the sign of those elasticities. Complete results of the two estimations are presented in Suryana (1986a).

Other finding needed to be pointed out is the existence of complementarity relationships among a group of fats and oils. This study and the Labys' work suggest that, in general, substitution relationships as well as complementarity relationships exist among the group of fats and oils, even though the studies are not always in agreement on each particular two-goods relationship. In addition, however, not all the estimated price coefficients of the fats and oils variables (the basis for calculating cross price elasticities) are statistically significant. Technological progress, including processing techniques used by industries using fats and oils as main inputs, is suspected as being the main reason for the existence of both the complementarity and substitution relationships among the group of commodities.

Table 6. Demand system comparison: The case of U.S. demand system for fats and oils.

Fats and oils	R^2		DW statistic		Direct price elasticity		Expenditure elasticity	
	LA/AIDS	WL	LA/AIDS	WL	LA/AIDS	WL	LA/AIDS	WL
Soybean oil	0.94	0.92	1.49	0.03	-0.79	-1.28***	1.04***	2.33***
Cottonseed oil	0.90	0.65	1.54	0.52	-0.96	-0.51	-1.69***	-1.31
Lard	0.79	0.92	1.17	0.66	-1.31	0.09	-0.90***	-1.39**
Lauric oil[a]	0.90	0.72	1.78	0.73	-0.31***	-0.31***	0.23***	0.02
Edible tallow	0.88	0.76	2.24	0.79	-0.16***	-0.11	0.92***	1.88

[a] For the AIDS is coconut oil.

, * represent the 5 and 1 percent significance levels, respectively.

Note: WL represents results of the study done by W. Labys (1977). LA/AIDS represents results of this study using the linear approximate AIDS.

Concluding Remarks

Price and expenditure elasticities for palm oil in three international markets indicate that the EEC market for palm oil is more stable than the other two markets, namely the US and Japan. In term of percentage, these facts imply that changes in quantity demand for palm oil due to changes in price and income are expected to be less in the EEC than in the other two markets. This conclusion is true in partial analysis but not necessarily true in a trade equilibrium study taking account interactions of supply and demand within and among markets. Recent data (1981-1985) on Indonesian palm oil exports indicate that 26 percent of palm oil production was exported, of which more than 80% was shipped to the EEC market. This heavy dependence on a market should be changed, because even though in term of percentage the change maybe a modest one, but in term of absolute value it will be large enough to reduce export earnings from this commodity.

Results of this analysis show the existence of substitution as well as complementarity relationships among fat and oil commodities. This finding is in a little disagreement with one may anticipate. The complementarity relationships among fats and oils are not anticipated to exist. On the other hand, the Labys' work also indicates similar finding. To get more information on this matter, further analysis of this subject is one of important research topics in this area.

The linear approximate AIDS model works satisfactorily in analyzing the demand systems for fats oils. In general, statistical properties of the sets of equations in the demand systems are at acceptable levels. Homogeneity testing gives mixed results. The US demand system does not reject the homogeneity property, but some equations for the EEC and Japan demand systems do reject the property.

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