Jurnal Ekonomi dan Bisnis Indonesia
Vol. 16, No. 3, 2001, 235 - 245

MODELING DEMAND FOR INDONESIAN COOKING OILS

Catur Sugiyanto
Universitas Gadjah Mada

ABSTRAK

*Penentuan apakah fungsi permintaan ditulis sebagai kuantitas fungsi dari harga (*an ordinary demand*) atau harga fungsi dari kuantitas, terbalik* (inverse demand), *ditentukan oleh kenyataan empiris struktur pasar. Dalam artikel ini permintaan minyak goreng di Indonesia dituliskan secara terbalik. Permintaan minyak goreng diestimasi dalam suatu bundle minyak goreng yang terjadi atas minyak kelapa sawit, minyak kelapa, dan minyak goreng lainnya. Dari berbagai uji diagnostik ternyata fungsi permintaan minyak yang berupa persamaan tunggal lebih baik dibandingkan fungsi permintaan simultan dalam bentuk kebalikan dari* Almost Ideal Demand System *(*Inverse AIDS*). Dalam menganalisis dampak kebijakan terhadap kesejahteraan pelaku ekonomi, untuk kasus minyak goreng, sebaiknya dipergunakan kebalikan fungsi permintaan (*inverse demand function*).*

Key words: *Inverse Demand, AIDS, Cooking oils*

INTRODUCTION

Estimating demand and supply of commodity are key to analyzing welfare of the respective market participants. The consumers and producers surplus, which are usually used as a welfare measurement, are calculated from these demand and supply estimates. Therefore, correct formulation of the demand and supply function become crucial to the analysis.

Cooking oil is one of essential commodities in Indonesia[1]. On the average, 80 percent of cooking oil consumed in Indonesia is from palm while the rest is from coconut and other oils. Moreover, in the last five years the value of palm oil exports accounted for 22 percent of total exports of agricultural products. Indonesia has been the world's second largest producer of palm oil over the last 10 years, contributing 29.5 percent of the world palm oil production. The increasing share of palm oil in world vegetable oil consumption identifies the potential market for Indonesian palm oil.

Many studies have estimated the demand for Indonesian cooking oil, for example Suryana (1986) and Larson (1990 and 1996). Suryana examined the impact of devaluation on the competitiveness of export crude palm oil, while Larson examined the impact of export tax on crude palm oil sector. However, they modeled demand for cooking oil within an ordinary demand, namely quantity of cooking oil consumed is dependent upon the prices. The use of the ordinary demand may not correctly describe the market of palm and coconut oils. Crude palm oil is perishable, what available in the domestic market today will be processed. For the last seven years more than 75 percent of the domestic use of the crude palm oil was to produce cooking oil. The amount of palm cooking oil was predetermined in advance of current prices. Therefore, prices appear to be endogenous in the demand relationship and it may be necessary to use an inverse demand equation.

[1] The other goods are rice, salted fish, granulated sugar, salt, laundry soap, kerosene, textile, and batik.

This paper examines the inverse demand for cooking oils. We estimate the demand for cooking oils within a bundle of cooking oils which contain of palm oil, coconut oil, and other oils. By assuming that consumers preference is separable, we can focus the analysis on a group of cooking oils. Therefore, an inverse almost ideal demand system (inverse AIDS) can fit the above preference. In addition, a single equation models are used as a benchmark model. We found that the estimate inverse demand within a single equation has the desirable properties while the inverse AIDS fails. The ordinary demand, both within the AIDS and single equation also were estimated but the results were not satisfactory.

The paper is organized as follows. The next section outlines the theory used to derived the inverse AIDS, followed by the model to be estimated. Data, the method of analysis, and the results are in section 4. Section 5 concludes.

THEORETICAL BACKGROUND

The consumers' demand function can be derived by assuming utility maximizing or expenditure minimizing consumers. The choice between expressing the demand function as a price dependent equation (*inverse demand*) or quantity dependent equation (*ordinary demand*) is influenced by the biological production process of the commodity (Eales and Unnevehr, 1994), the structure of the market, the perishability of the product (Eales et. al. 1997, Reickertsen 1998), and other things, for example the domination of export that leaves the domestic consumption as a residual to the exports.

For the case of palm oil, the quantity of cooking oil produced is predetermined by how much crude oil is available in the domestic market. Similarly, the amount of coconut oil produced is depend upon the copra available in the domestic market. This amount is simply the production minus the export. On average from 1970 to 1997, 52 percent of the crude palm oil produced was exported. Indonesia is a small component of the world vegetable oils markets. Demand for the Indonesian crude palm and coconut oils in the world markets are infinitely elastic. The world prices of crude palm and coconut oils determine how much these products will be shipped to the world market.

One of the key factors in exporting crude palm oil and coconut oil is the foreign exchange rates. Under free trade, the domestic price is equal to the world price, with some margin. However, Indonesians are free to hold foreign currencies. There is no requirement to bring in the foreign currencies revenues from exports, and the foreign currencies rates relative to the rupiah are free to fluctuate. Therefore, there is a potential gain of currency rate change to the exporters. In the empirical analysis, export will be determined first and the domestic allocation of crude palm oil is the residual.

The allocation of the crude palm oil into the domestic processors is determined by the world market and the government regulation. Once the quantity of crude palm oil for export is set, the crude palm oil available in the domestic market is the production minus export. Since more than 80 percent of the crude palm oil in the domestic market is processed into palm cooking oil (about 77 percent for the last 8 years as reported in Table 1) and crude palm oil is non storable, the quantity of palm cooking oil in the domestic market is predetermined.

The market for coconut oil is similar to that of the palm oil. From 1969 to 1997, the average uses of coconuts to produce copra amounted to 63 percent of the total coconut production, while the fresh use was 0.03 percent, and the total of other uses was 36.97 percent. Moreover, for the same period, 75 percent of the copra produced were processed into cooking oil and the rest were exported. Since the quantity of raw materials to produce coconut oil (coconut or copra) is predetermined at the current year the amount of coconut oil in the market is predetermined. The coconut oil price adjusts to clear the market.

Table 1. The Main Types of Crude Palm Oil Use in Indonesia, 1991-1997 (tons)

Types of Use	1991	1992	1993	1994	1995	1996	1997
Cooking Oil	1,302,308	1,498,554	1,508,462	1,788,369	2,014,062	2,249,706	2,850,943
Share %	77.54	77.83	76.31	77.43	77.25	76.71	79.05
Margarine	43,840	56,960	61,520	65,520	79,104	87,014	95,751
Share %	2.61	2.96	3.11	2.84	3.03	2.97	2.65
Soap	178,077	195,440	210,660	240,046	303,640	333,083	365,386
Share %	10.60	10.15	10.66	10.39	11.65	11.36	10.13
Oleo-chemical	155,349	174,531	196,066	215,673	210,290	262,862	294,405
Share %	9.25	9.06	9.92	9.34	8.07	8.96	8.16
Total Domestic use (1)	1,679,574	1,925,485	1,976,708	2,309,608	2,607,096	2,932,665	3,606,485
Total Production (2)	2,657,600	2,970,000	3,421,400	3,860,000	4,200,000	4,746,000	5,992,668
Available to Export	978,026	1,044,515	1,444,692	1,550,392	1,592,904	1,813,335	2,386,183
Percent (1)/(2)	63.20	64.83	57.77	59.83	62.07	61.79	60.18

Source: ICBS 1997
Note: Share % means share to the total domestic use.

In addition, the cooking oil markets are influenced by some long-run processes of palm and coconut production. It takes about 3 years for the new oil palm planted to bear fruits, and 7 years for the coconut. With these long-run processes, the quantities of raw materials to produce cooking oils (crude palm oil and coconut or copra) are predetermined at the current year.

Consider that consumption of cooking oils is separable. Consumers are able to rank different food bundles and this ranking is independent of their consumption in other groups such as housing and clothing. Furthermore, the consumer can also rank his/her preferences for fats and oils which is independent of his/her consumption of other goods. Therefore, we focus on consumers' income which is allocated on the cooking oils. The demand for Indonesian palm oil can be formulated within a group of cooking oils: palm, coconut, and other oils.

The ordinary and inverse demand functions are dual to each other. The use of duality concepts enables us to derive a demand function which is consistent with the maximizing behavior of the consumer[2]. All models are aggregated; they explain the behavior of consumers as a group based on certain assumptions about individual consumers' behavior. In particular, consumers are assumed to face similar commodities and prices, have similar utility functions, and maximize utility (French and Matthews, 1971).

Let $\boldsymbol{q}$ denotes an n-coordinate column vector of quantities demanded, $\boldsymbol{p}$ an n-coordinate column vector of their prices, $m = \boldsymbol{p}'\boldsymbol{q}$ the consumer's total expenditure, and $U(\boldsymbol{q})$ the utility function which is assumed to be non-decreasing and quasi concave in $\boldsymbol{q}$. The primal function for consumer utility maximization is the following Lagrangian function:

$$\text{Max}_{q,\lambda}\ L = U(q) - \lambda(\mathbf{p}'\mathbf{q} - m) \qquad (1)$$

The necessary conditions for the optimum are obtained as

$$\partial U(\mathbf{q})/\partial q_i = \lambda p_i \qquad i = 1,2,.......,n, \qquad (2)$$

and

$$\mathbf{p}'\mathbf{q} = m. \qquad (3)$$

[2] The next discussion follows Huang (1983 and 1988)

A solution to these (n + 1) equations (2 and 3) gives the ordinary demand (Marshallian demand):

$$q_i = f_i(\mathbf{p}, m). \quad (4)$$

The inverse demand function can be obtained from the dual relationship of maximizing the consumers' utility. First, substituting the ordinary demand function (4) into the utility function yields an indirect utility function, *V(p)*. Then, minimizing the following Lagrangian function:

$$\text{Min}_{p,\lambda}\ L = V(\mathbf{p}) - \lambda(\mathbf{p'q} - m), \quad (5)$$

is equivalent to maximizing the Lagrangian function in equation (1).

The necessary conditions for the optimum are obtained as

$$\partial V(p)/\partial p_i = \lambda q_i \qquad i = 1,2,\ldots,n, \quad (6)$$

and

$$\mathbf{p'q} = m. \quad (7)$$

A solution to these (n+1) equations (6 and 7) gives the inverse demand function (Hicksian demand):

$$p_i = h_i(\mathbf{q}, m). \quad (8)$$

The Hotelling-Wold identity is the direct procedure to obtain an inverse demand function from a differentiable utility function.

$$\frac{p_1}{m} = \frac{U_i(q)}{\sum_{j=1}^{n} q_j U_j(q)} \qquad i=1,2,\ldots\ldots,n,$$

$$U_i(q) = \frac{\partial U}{\partial q_i} \quad (9)$$

For a specific utility function defined as:

$$U(q) = -\ln a(q) / [\ln b(q) - \ln a(q)], \quad (10)$$

where

$$\ln a(q) = \alpha_0 + \Sigma\, \alpha_j \ln q_j + 0.5\, \Sigma_i \Sigma_j\, \gamma^*_{ij} \ln q_i \ln q_j, \text{ and} \quad (11)$$

$$\ln b(q) = \beta_0\, \Pi_j\, q_j^{-\beta j} + \ln a(q), \quad (11')$$

we can proceed with the above Hotelling-Wold to obtain the inverse demand function. However, for the purpose of this research, we will follow Eales and Unnevehr (1994) in deriving the inverse demand function for the above specific utility function through a distance function.

We define a distance function as the amount by which all quantity consumed must be changed proportionally to attain a particular utility level. Consider a distance function written as,

$$\ln D(u,q) = (1-U) \ln a(q) + U \ln b(q), \quad (12)$$

where *u* is the utility level and *q* is consumption goods.

By using (11) and (11'), we have

$$\ln D(u,q) = \alpha_0 + \Sigma\, \alpha_j \ln q_j + 0.5\, \Sigma_i \Sigma_j\, \gamma^*_{ij} \ln q_i \ln q_j + U\, \beta_0\, \Pi_j\, q_j^{-\beta j}, \quad (13)$$

where α's, β's, γ's are parameters.

Similar to maximizing a utility function subject to a budget constraint to obtain Marshallian demand functions, differentiating the distant function at a certain level of utility with respect to the quantity consumed yields compensated inverse demand functions:

$$\partial \ln D/\partial \ln q_i = w_i = \alpha_i + \Sigma_j\, \gamma_{ij} \ln q_j - \beta_j\, U\, \beta_0 \Pi_j\, q_j^{-\beta j}, \quad (14)$$

where $\gamma_{ij} = 0.5\ (\gamma^*_{ij} + \gamma^*_{ji})$, w_i is expenditure share of good *i*, q_j is consumption of good *j*, and *U* is utility level.

At the optimum level of consumption (q^*), the distant is $D(U,q^*) = 0$. Thus, if equation (12) is evaluated at q^*, we have

$$U(q) = -\ln a(q) / [\ln b(q) - \ln a(q)]. \quad (15)$$

Substituting (15) into (14) we obtain a system of inverse demand functions that is the Inverse Almost Ideal Demand System, IAIDS (Eales and Unnevehr, 1994). It can be written as:

$$w_i = \alpha_i + \Sigma_j\, \gamma_{ij} \ln q_j + \beta_i \ln Q, \quad (16)$$

where $\ln Q = \alpha_0 + \Sigma\, \alpha_j \ln q_j + 0.5\, \Sigma_i \Sigma_j \gamma_{ij} \ln q_i \ln q_j$. Adding up, homogeneity, and symmetry conditions are: (a) $\Sigma_i\, \alpha_i = 1$, $\Sigma_i\, \gamma_{ij} = 0$, $\Sigma_i\, \beta_i = 0$; (b) $\Sigma_i\, \gamma_{ij} = 0$; and (c) $\gamma_{ij} = \gamma_{ji}$. The compensated flexibility can be calculated as $f_{ij} = -\delta_{ij} + \{\gamma_{ij} + \beta_i (w_j - \beta_j \ln Q)\}/w_i$, for own and cross price flexibility and δ_{ij} is Kronecker delta ($\delta_{ij} = 1$ for i = j, and 0, otherwise). These inverse demand functions allow us to analyze demand for commodities whose quantities are exogenously determined and whose prices adjust to clear the markets.

The linearized IAIDS can be obtained by specifying the *ln Q* as $\ln Q = \Sigma^{n}_{i=1} w_{it} \ln q_{it}$. To avoid the simultaneity problem several procedures can be used, including using lags of the expenditure share to calculate *ln Q* (Eales and Unnevehr, 1993), using a moving average expenditure share (Eales,1996), using an index in logarithmic values analog to Laspeyres (Moschini, 1995), and using an index normalized to one to better approximate the IAIDS parameters (Asche and Wessels, 1997).

How well the linearized IAIDS model approximates the nonlinear IAIDS is an empirical issue. It should be noted that quantities are not as highly correlated as prices that are used in the AIDS model and that assisting in developing a good proxy.

THE DEMAND FOR PALM AND COCONUT COOKING OILS MODELS

The demand focuses on the demand for palm and coconut oils. In any year, the amount of crude palm oil available in the domestic market is the residual after the exports. Indonesia is a small player in the world vegetable oil markets. Demand for the Indonesian crude palm and coconut oils in the world markets are infinitely elastic. The world prices of crude palm and coconut oils determine how much these products will be shipped to the world market. The allocation of the crude palm oil to the domestic processors, *(QDCPO)*, is determined by the world market and the government regulation. The domestic uses for crude palm oil are to produce palm cooking oil *(QPO)*, other products, *(QOCPO)*, and for stocks. This can be represented as:

$$QDCPO = QCPO - QXCPO, \qquad (17)$$

and

$$QDCPO = QPO + QOCPO + Stocks \qquad (18)$$

where *QCPO* is the total crude palm oil production, *QPO* is the total palm cooking oil production, *QXCPO* is the total crude palm oil exported, *QOCPO* is the crude palm oil used to produce other products, and stocks are inventory. The crude oil is also allocated into other products and to stocks which are temporary because of perishability of the crude, and are treated as a residual.

Similarly, coconut production *(QCOCO)* is allocated into copra *(QCOPRA)*, fresh use *(QFC)*, and other types of uses *(QFOTHER)*. On the average, between 1970 to 1997, 63 percent of the coconut produced was dried into copra, 0.03 percent was consumed as fresh coconut, and the rest was directed to other uses.

$$QCOCO = QCOPRA + QFC + QFOTHER \qquad (18)$$

More than 80 percent of this copra was processed into crude coconut oil *(QCOIL)*, while the rest was exported *(QXCOPRA)*.

$$QCOPRA = QCOIL + QXCOPRA. \qquad (18')$$

The disposition of the crude coconut oil *(QCOIL)* was to domestic consumption *(Q^DCOIL)*, to export market *(QXCO)*, and to stocks. On the average, exports of coconut oil during 1970-1997 periods accounted for 15 percent of total coconut oil production.

$$QCOIL = Q^{D}COIL + QXCO + Stock. \qquad (18'')$$

The average import of coconut oil has been very small (2.7 percent of total consumption). In effect, coconut oil production is predetermined by the coconut production.

With the above predetermined quantity variables, the Inverse Almost Ideal Demand System (IAIDS) is used to describe the Indonesian demand for palm cooking oil and coconut oil. This study extends the current application of the IAIDS by Eales and Unnevehr (1994), Eales (1996), and Rickersten, (1998), to include a perennial crop case and refines the previous treatment to the Indonesian demand for cooking oil by Suryana (1986) and Larson (1990). The demand system to be estimated is

$$SHPO = \alpha_1 = \gamma_{po1} LQPOC_t + \gamma_{po2} LQCOC_t + \gamma_{po3} LQOTHER_t + \beta_{po} QTOTAL_t$$

$$SHCO = \alpha_2 = \gamma_{co1} LQPOC_t + \gamma_{co2} LQCOC_t + \gamma_{co3} LQOTHER_t + \beta_{co} QTOTAL_t$$

$$SHOTHER = \alpha_3 = \gamma_{ot1} LQPOC_t + \gamma_{ot2} LQCOC_t + \gamma_{ot3} LQOTHER_t + \beta_{ot} QTOTAL_t \quad (19)$$

where *SHPO*, *SHCO*, and *SHOTHER* are the expenditure shares of palm oil, coconut oil, and other oils, respectively. The right-hand side variables are in logarithmic values: the quantity of palm oil consumed *(QPOC)*, quantity of coconut oil consumed *(QCOC)*, other vegetable oils consumed *(QOTHER)*, and the quantity index *(QTOTAL)*. L denotes logarithmic operator and the consumer price index is the deflator.

$$QTOTAL_t = SHPO1 * LQPOC_t + SHCO1 * LQCOC_t + SHOTHER1 * LQOTHER_t \quad (20)$$

The quantity index used is the Stone's index, which is

where SHPO1 is the lag of the expenditure share of palm cooking oil, SHCO1 is the lag of the expenditure share of coconut oil, SHOTHER1 is the lag of the expenditure share of other oils. In other words, we linearize the IAIDS model (and is usually called LIAIDS).

The single inverse demands for Indonesian cooking oils are written as follows:

The demand for palm oil is

$$LPPO = \beta_0 + \beta_1 LQPOC + \beta_2 LQCOC + \beta_3 LQOTHER + \beta_4 QTOTAL + w_t, \quad (21)$$

and for the demand for coconut oil is

$$LPDCO = \alpha_0 + \alpha_1 LQPOC + \alpha_2 LQCOC + \alpha_3 LQOTHER + \alpha_4 QTOTAL + v_t, \quad (22)$$

The dependent variables are *PPO* (the price of palm cooking oil) and *PDCO* (the price of coconut oil). The independent variables are: *QPOC* (the quantity of palm cooking oil consumed), *QCOC* (the quantity of coconut oil consumed), *QOTHER* (the quantity of other oil consumed), and *QTOTAL* (the quantity index).

DATA, METHOD OF ANALYSIS, AND RESULTS

Data. The data used annual data covering the period 1970 to1997. All data on quantities (production and consumption) are from various issues of the *Oil World* publications and the Directorate General of Plantation Estates of the Government of the Republic of Indonesia. Data on prices are from *Oil World* and *Economic Indicators*. The deflator used is the consumer price index (CPI). All models are in logarithms. The summary of the variables is reported in the Appendix.

Method of Analysis. The analysis is started with an examination on the simple correlation among the variables. The correlations among the variables used are small. This indicates that there is no multicollinearity problem. High correlations are found between the dependent variable and its lag. The small correlation between dependent variable and independent variables also indicates a weak explanatory power of the models. The correlation coefficient matrix is presented in the Appendix.

The demand for cooking oils is written in a system of expenditure share equations: expenditure on palm oil, coconut oil, and other oils. The system is estimated using the iterative Zellner's seemingly unrelated regressions. The expenditure share of the demand for other cooking oils is dropped due to adding up restriction. The other restrictions, namely symmetry and homogeneity are examined. As alternative, the single equation is estimated by using OLS (Ordinary Least Squares) method. All estimations are performed using the Shazam econometric program (White, 1993).

To assess the adequacy of a single equation regression we use joint tests: the joint conditional mean and variance test (Mc Guirk *et.al.*, 1993)[3]. The advantage of these tests over the individual test is that they allow us to implement tests with fewer maintained hypotheses. The joint conditional mean test includes tests of functional form, independence (auto correlation), and parameter stability, by assuming (maintained hypotheses) normality and a constant variance. The joint conditional variance tests simultaneously examines the static and dynamic heteroskedasticity as well as variance stability under the assumption that the model has correct functional form whose parameters are stable, with normal and independent residuals.

A system of equations also has some cross-equation assumptions, i.e., the cross- equation error covariance is homoskedastic, independent, and non-varying over the period of observation. In addition, a system of equations also has joint-mean assumptions: appropriateness of functional form, independence, and stable parameters. Consequently, a system of joint significant tests is needed to address such assumption (Mc Guirk *et.al.*, 1995).

We compare the above models with the available estimates from the reviewed literatures. We consider the signs and the size of estimates as the key to evaluation. The statistical adequacy of the model is indicated by the p-values of the tests. A low p-value provides evidence against the null hypothesis.

Results. The demand system has three equations: demand for palm oil, coconut oil, and other oils. We estimate the demand for cooking oils in the form of LIAIDS (Linearized Inverse AIDS). At the first stage, we impose the adding up restriction and test the homogeneity and symmetry. The symmetry and homogeneity are rejected. Then, we impose adding up and homogeneity (to accord with the theory) and test for the symmetry. This model rejects the symmetry restriction. Therefore, we impose the adding up, homogeneity, and symmetry conditions. After the reasonable estimates are obtained, we calculate (evaluate) the estimates of the compensated flexibilities at the mean, as reported in table 2.

Table 2. The Estimates of the Compensated Flexibilities: Palm and Coconut Oils

	Quantity of Palm Oil	Quantity of Coconut Oil
Price of Palm Oil	-0.84	0.75
Price of Coconut Oil	0.3	-1.23

The estimate of the own-price flexibilities for the palm oil is - 0.84 and for the coconut oil is -1.23. These estimates correspond to the inverse estimates elasticities of palm oil and coconut oil reported by Larson (1990) and Suryana (1986) which are: -1.6 and -1.1, respectively. The cross flexibilities from this LIAIDS have incorrect signs. Palm and coconut cooking oils are substitutes, so the cross-flexibilities should have a negative sign[4].

3 This is not the F-test to examine the joint significance of explanatory variables.

4 We estimated several alternative specifications of the demand for cooking oils, including habit formation, a time trend, and mid-sample dummy; prices as dependent variables with seemingly unrelated regression (SUR), and AIDS which expenditures share as dependent variables. However, these models do not pass the diagnostic tests for the system of equations. They are not reported to save the space.

We experience difficulties to obtain reasonable estimates of the demand for Indonesian cooking oils. This difficulties was also found in Suryana (1986) and Larson (1990). Suryana found that the estimated demands were not statistically significant, even at 10 percent level. Serial correlation of the error terms was thought to be the source of the problem. He re-estimated the model using the NLIN procedure in, but still the cross price elasticities are incorrect.

Larson used a two-step procedure to determine total demand for vegetable oils. First, he estimated the total demand for vegetable oil as a function of income, a cooking oil price index, and rice price. Then, the expenditure share for each vegetable oil (coconut and palm oil) was estimated as a function of the ratio of coconut oil and palm oil prices, total of vegetable oil consumed serving as a scale factor. The symmetry and homogeneity restrictions were imposed. All prices were deflated by the index of vegetable oil price. The total consumption of each vegetable oil was the multiplication of the total vegetable oil consumed, the expenditure share of each oil consumed, and the total population.

The results were mixed. The total expenditure on cooking oils per capita had an incorrect sign on its coefficient associated with the price of cooking oil's index. Coefficients of the expenditure share equations had correct signs but the t-statistics on the expenditure share on palm oil were small. Signs of the rest of the coefficients were correct and had acceptable statistics (in total, 10 out of 26 parameters were not significant). The estimates elasticities of the demand for vegetable oils from these studies are reported in the following table 3.

Table 3. Several Estimates of Elasticities of the Indonesian Demand for Cooking Oils

Expenditure Share, Linearized AIDS		Palm Oil Price	Coconut Oil Price
Suryana, 1970-1984	Palm Oil	-.6	-.68
	Coconut Oil	-.05	-.9
Larson, 1970-1988	Palm Oil	-.66	1.6
	Coconut Oil	1.6	-.66

The signs of the estimated own-price are negative and cross price elasticities are positive as were expected, except for the cross price elasticities in Suryana. This might be due to the serial correlation problem or misspecification since he could have included consumption of other oils in his model. The magnitude of the own price elasticities is similar for the demand for palm oil.

With the above problems, we proceed with a single inverse demand model where prices serve as dependent variables. The estimate of the inverse demand for palm oils is as follows (figures in parentheses are t-statistics).

$$\underset{(3.84)}{\text{LPPO} = 5.01} - \underset{(-1.92)}{0.13\ \text{LQPOC}} - \underset{(-3.23)}{0.38\ \text{LQCOC}} -$$

$$\underset{(-0.91)}{0.01\ \text{LQOTHER}} - \underset{(-0.54)}{0.1\ \text{LQTOTAL}} + \underset{(1.58)}{0.03\ \text{YEAR}} \quad ......(23)$$

Originally, we estimate without the time trend (YEAR), but the result was not satisfactory. The time trend (YEAR) helps to obtain correct signs. The adjusted R-square is 0.47 and the t-statistics are in the parentheses. The Jarque-Bera normality test is 2.1 (p-value = 0.23), confirming normality. The Joint conditional mean tests indicate no evidence of structural break (p-value = 0.22), no evidence of incorrect functional form (p-value = 0.21), and no autocorrelation (p-value = 0.20). The joint conditional variance tests confirm no chance in variances between the first and the second half of the sample (p-value = 0.80), no evidence of heteroskedasticity, both static and dynamic with p-value = 0.90 and 0.43, respectively.

The estimate of coconut oil is

LPDCO = 6.24 - 0.01 LQPOC - 0.50 LQCOC
(4.8) (-0.35) (-3.5)

+ 0.02 LQOTHER - 0.15 LQTOTAL
(1-7) (- 1. 1)

….(24)

The adjusted R-square is 0.26 and the t-statistics are in the parentheses. The Jarque-Bera normality test is 2.1 (p-value = 0.34), confirming, normality. The Joint conditional mean tests indicate no evidence of structural break (p-value = 0.97), no evidence of incorrect functional form (p-value 0.52), and no autocorrelation (p-value = 0.20). The joint conditional variance tests confirm no change in variances between the first and the second half of the sample (p-value = 0.05), no evidence of heteroskedasticity, both static and dynamic with p-values = 0. 10 and 0.94, respectively.

The inverse demand estimated using a single equation is more appealing. The signs of both own-flexibilities and cross flexibilities (gross-substitutes) are correct except for the demand for coconut oil with respect to other oils. The estimated own-quantity flexibility of palm oil and coconut oil are -0.13 and -0.5, respectively. These estimates of own-quantity flexibilities are smaller than those reported in Larson (1990) and Suryana (1986), which are -1.6 and -1.1 for palm and coconut oils, respectively. They are also smaller than the (incorrect) estimate based on the LIAIDS, which are -0.84 for palm and -1.23 for coconut oil. The prices of palm oil and coconut oil have become less sensitive to changes in quantity[5]. The reason for this change might be the fact that after the government reduced its participation in the cooking oil markets in 1991, there is no more constraint to the market that makes the market moves more freely. Exports and imports are freed and therefore allow more substitutes. In this study we include other oils in the demand function. The number of observations is larger that capture some changes in the market.

CONCLUSION

This paper examines the Indonesian demand for cooking oils. The model used is the inverse demand, where prices are dependent variables while the quantities are independent variables. Such strategy is inline with the high proportion of export to total production, free of holding foreign exchange, and the fluctuation of Indonesian exchange rates. Producers allocate their crude palm oil to exports first, and then the rest is allocated into the domestic market. Therefore, quantity of oil in the domestic market is predetermined and price adjusts to clear the market.

The inverse demand model is capable of describing the Indonesian demand for cooking oils. The signs of the estimated coefficients are as expected and the model passes various diagnostic tests. The estimated own-quantity flexibility of palm oil and coconut oil are -0.13 and -0.5, respectively. These estimates are smaller than those of previous studies. The reason for this change might be the fact that the government reduced its participation in the cooking oil markets. There is no more constraint to the market that makes the market moves more freely. Exports and imports are freed and therefore allow more Substitutes.

Based on the above results we suggest that one should consider using an inverse demand

5 Inflexibility implies that a 1% increase in the quantity of cooking oils consumed leads to a price decrease by less than 1%. An inflexible inverse demand corresponds to an elastic ordinary demand.

in estimating impact of policy analysis in the cooking oil markets. In general, information about the structure of the market, how the market work, how the commodity flows assist in formulating the model.

Appendix 1. The Summary Statistic of Variables Used in the Study

	N	MEAN	STD. DEV	VARIANCE	MIN	MAX	UNIT	
PDCO	28	681.87	537.59	289001.50	78.99	1937.40	Rupiah/Bottle	Domestic Price Coconut Oil
QFC	28	598.85	110.07	12115.59	469.94	781.77	Ton	Volume Fresh Coconut Consumed
QPOC	28	820.09	831.15	690817.38	22.00	2760.50	000 ton	Volume Palm Cooking Oil Consumed
QCOC	28	515.53	119.38	14250.66	274.40	757.00	000 ton	Volume Coconut Cooking Oil Consumed
QOTHER	28	91.19	74.97	5620.23	0.01	218.00	000 ton	Volume Other Cooking Oil Consumed
PPO	28	444.31	378.12	142972.58	65.54	1424.2	Rupiah/Kg	Price Palm Cooking Oil in Jakarta
PDCPO	28	478.84	452.00	204307.94	73.54	2345.57	Rupiah/Kg	Price Crude Palm Oil - fob Belawan, Sumatera Island
SHPO	28	0.27	0.23	0.05	0.02	0.77	Percent	Share of Palm Cooking Oil in Total Oil Consumption
SHCO	28	0.68	0.25	0.06	0.19	0.98	Percent	Share of Coconut Cooking Oil in Total Oil Consumption
SHOTHER	28	0.05	0.04	0.00	0.00	0.13	Percent	Share of Other Cooking Oil in Total Oil Consumption

REFERENCES

Asche, Frank and Cathy R. Wessells (1997),” On Price Indices in the Almost Ideal Demand System,” *The American Journal of Agricultural Economics*, Vol. 79, No. 4, pp. 1182-1185

Central Bureau of Statistic (CBS) *The Statistical Pocketbook of Indonesia*, The Government of Republic of Indonesia; various issues

Directorate Generale of Plantation Estates 1997 (a): *Statistical Estate Crops of Indonesia: Palm Oil, 1996-1998*, Jakarta, Indonesia

Directorate Generale of Plantation Estates 1997 (b): *Statistical Estate Crops of Indonesia: Coconut, 1996-1998*, Jakarta, Indonesia

Eales, James, Catherine Durham, and Cathy R. Wessells (1997),” Generalized Models of Japanese Demand for Fish, *The American Journal of Agricultural Economics*, Vol. 79, pp.1153-1163

Eales, James (1996), “A Symmetric Approach to Canadian Meat Demand Estimation,” *Journal of Agricultural and Resource Economics*, Vol. 21, No. 2, pp. 368-380

Eales, James and Laurian Unnevehr (1993), Simultaneity and Structural Change in

U.S. Meat Demand, *The American Journal of Agricultural Economics*, Vol. 75, No. 1, pp.259-268

Eales, James and Laurian Unnevehr (1994), "The Inverse Almost Ideal Demand System, *European Economic Review*, 38, pp. 101-115

Economic Indicators Monthly Statistical Bulletin, Central Bureau of Statistic (CBS), The Government of Republic of Indonesia; various issues

Huang, Kuo S. (1983)," The Family of Inverse Demand Systems," *European Economic Review* 23, pp. 329-337

----------------- (1988)," An Inverse Demand System for U.S. Composite Foods, *The American Journal of Agricultural Economics*, Vol. 72, No.1, pp. 902-909

ICBS (1997): Trade Prospect: Palm Oil, *International Contact Business System*, Jakarta, Indonesia

Larson, Donald F. (1990), "The Indonesian Vegetable Oils Sector: Modeling the Impact of Policy Changes," *World Bank Working Paper Series*, No. 382, Washington, DC. World Bank

Larson, Donald F. (1996), "Indonesia's Palm Oil Sub- Sector," *Policy Research Working Paper* No. 1654, The World Bank

McGuirk, Anya M. Paul Driscoll, and Jeffrey Alwang (1993):" Misspecification Testing: A Comprehensive Approach," *The American Journal of Agricultural Economics*, Vol. 75, No.4, pp. 1044-1055

McGuirk, Anya M., Paul Driscoll, Jeffrey Alwang, and Huilin Huang (1995):" System Misspecification Testing and Structural Change in the Demand for Meats," *Journal of Agricultural and Resource Economics*, Vol. 20, No.1, pp. 1-21

Oil World 1958-2007, ISTA Meilke GmBH, 1988, Hamburg,Germany

Oil World Annual, ISTA Meilke GmBH, 1988, Hamburg,Germany; various issues

Rickertsen, Kyrre (1998), "The Effects of Advertising in an Inverse Demand System: Norwegian Vegetables Revisited, *European Review of Agricultural Economics*, Vol. 25, pp. 129-140

Suryana, Ahmad, "Trade Prospects of Indonesian Palm Oil in The International Markets for Fats and Oils," *Unpublished Doctoral Thesis*, Department of Economics and Business, North Caroline State University, Raleigh 1986

SUSENAS, *The National Survey on Social and Economic*, The Indonesian Central Bureau of Statistics, Several issues (a four-year period survey on social and economic development implemented by the Central Bureau of Statistics)

White, Kenneth J. (1993), *Shazam The Econometric Computer Program*, User's Reference Manual version 7.0, McGraw Hill-Book Company.