Tropical Agricultural Research Vol. 25 (4): 376 – 386 (2014)

Tariff Endogeneity: Effects of Export Price of Desiccated Coconuts on Edible Oil Market in Sri Lanka

K.V.N.N. Jayalath* and J. Weerahewa[1]

Postgraduate Institute of Agriculture
University of Peradeniya
Sri Lanka

ABSTRACT. *Fresh coconut is the main raw material for the production of coconut oil and desiccated coconut. A close examination of the import policy of the Sri Lankan government on edible oils indicates that import tariffs on edible oil are lowered when the supply of fresh coconut in the domestic market is limited. It has been claimed that the desiccated coconut producers lobby for lower import tariffs on edible oil so as to raise fresh coconut availability when the demand for desiccated coconut is higher. The objective of the study is to determine whether there is a relationship between import tariff on edible oil and export price of desiccated coconut. A partial equilibrium model was specified for the coconut market, estimated using a seemingly unrelated regression method and simulated for changes in export prices of desiccated coconut. Monthly data for the period 1990-2009 gathered from published sources were used for the analysis. The findings revealed that the import tariffs are endogenously determined and export price of desiccated coconut has a statistically significant negative effect on the tariff level. The cross price demand elasticity of coconut oil with respect to palm oil price is positive and statistically significant indicating a strong link between the two markets.*

Keywords*: Coconut oil, desiccated coconut, endogenous tariff*

INTRODUCTION

Import tariff is the most common instruments used by the governments to protect domestic producers from import competition. The domestic coconut oil industry in Sri Lanka has been protected using import tariffs placed on imported edible oils, *i.e.,* substitutes for coconut oils. It has been argued however that the Sri Lankan government uses import tariffs not only to protect domestic coconut oil producers but also as an instrument to adjust fresh coconut availability in the country. Fresh coconut is the basic raw material for the production of desiccated coconut (DC) and coconut oil manufacturing industries. Utilization of fresh coconut in one of the two industries affects profitability of the other industry as underutilization of the installed capacity of the mills leads to significant financial losses in the respective industry. Around 95 percent of the DC produced in the country is exported and underutilization of DC mills hence is associated with losses in foreign exchange earnings of the country as well.

[1] Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Sri Lanka
* Corresponding author: nilmisusantha@yahoo.com

While coconut oil producers prefer to have higher tariffs on imported edible oil, final consumers of edible oil and desiccated coconut producers prefer to have lower tariffs on the same due to obvious reasons. It has been argued by the industry experts that coconut oil millers and DC millers lobby government officials and the realized import tariffs are due to their relative lobbying power. This phenomenon is not specific to coconut industry in Sri Lanka. Tariff lobbying by interest groups adversely affected by the import competition is a common reaction in many sectors and in many countries. There exists a vast literature addressing policy formation by the governments in the presence of lobbying power of various stakeholders. Pincus (1975) and Brock & Magee (1978) had showed how import competing producers lobby bureaucrats and politicians for policies that limit imports. Hillman (1989) addressed the endogeneity in trade barriers as determined by interactions among various interest groups and the government.

The studies on coconut market in Sri Lanka on this aspect are limited even though the tariff policy on edible oil imports has been largely discussed among stakeholders. Related studies on the Sri Lankan coconut market include Fernando and Peiris (2002) who investigated the implications of import duty reduction for substitute oils on coconut oil industry and Samarajeewa *et al.* (2002) who did an econometric estimation on trade policy liberalization in edible oil market treating tariff rate as an exogenous variable.

The primary objective of the study is to determine whether there is a relationship between import tariff on edible oil and the export price of desiccated coconuts. It examines the changes in the coconut oil market due to changes in the export price of desiccated coconuts.

MODEL AND DATA

The model used for the analysis comprises of two inter-related markets; a closed market and a market for competing product which is tradable in the world market. The former represents the coconut oil market in Sri Lanka in which prices are internally determined. The later represents the DC market in Sri Lanka where the prices are exogenously determined.

Theoretical Model

Demand and supply are specified as functions of own prices and vectors of other exogenous factors as presented in equations (1) and (2) respectively:

$$Q_t^d = f(P_t, PS_t, Z_t^d) \quad (1)$$

$$Q_t^s = f(P_t, Z_t^s) \quad (2)$$

Where;

Q_t^d = quantity demanded at time t

Q_t^s = quantity supplied at time t

P_t = price of the commodity at time t

PS_t = price of substitute products at time t

Z_t^d = other determinants of demand (i.e., income, taste and preference) at time t

Z_t^s = other determinants of supply (i.e., price of inputs, technological change) at time t

Suppose that quantity demanded is equal to quantity supplied at equilibrium. The price P_t will be simultaneously and endogenously determined by the equality of demand (1) and supply (2) functions and (3) below.

$$Q_t^d = Q_t^s \quad (3)$$

The reduced form of the model expresses price of the product as a function of price of the substitute product and the other exogenous factors affecting demand and supply.

$$P_t = f(PS_t, Z_t^s, Z_t^d) \quad (4)$$

Suppose that the substitute product is imported and protected by an import tariff. The linkage between the world market price and the domestic price for the substitute product is given by Equation 5.

$$PS_t = PS_t^w (1+tariff_t) \quad (5)$$

Where;

PS_t^w = world price of imported substitute at time t

$tariff_t$ = ad-volerem tariff at time t

It was hypothesized that tariff level is endogenously determined due to lobbying by the interest groups who respond to world market prices of products in the competing industries as presented in Equation 6.

$$Tariff_t = f\ (PC_t^w) \quad (6)$$

Where;

PC_t^w = world market price of products in the competing industries

The equations (1), (2), (3), (5) and (6) constitute the theoretical model. The endogenous variables of the model are D_t, S_t, P_t, PS_t, and $tariff_t$. The exogenous variables of the model are Z_t^d, Z_t^s, PS_t^w, and PC_t^w.

Empirical Model

The Equations 1 – 4 show the equilibrium in the coconut oil market and the Equations 5 and 6 show how the DC market influences the equilibrium of the former. The structure of the empirical model is presented below.

Consumer demand of coconut oil in the domestic market is determined by the retail price of coconut oil, price of palm oil, per capita income and taste and preference of the consumers. Palm oil is considered as the main substitute for coconut oil in the coconut oil demand equation (1').

$$D^{CO} = f(P^{CC}, P^{PO}, M, T) \quad (1')$$

Where;

D^{co} = per capita demand for coconut oil
P^{cc} = consumer price of coconut oil
P^{po} = price of palm oil at domestic market
M = per capita income
T = time trend

Coconut oil supply is mainly a function of producer price, price of fresh coconuts which is the basic input and technological changes as depicted in equation (2').

$$S^{CO} = f(P^{PC}, P^{fn}, T) \quad (2')$$

Where;

S^{co} = supply of coconut oil

P^{pc} = producer price of coconut oil

P^{fn} = price of fresh coconuts

At equilibrium, quantity of coconut oil demanded is equal to quantity supplied and price of coconut oil is determined by Equation 3'.

$$D^{CO} = S^{CO} \quad (3')$$

In order to protect the domestic coconut oil industry, price of imported palm oil is regulated by imposing import tariff. Hence the price of imported palm oil is higher than the world market price and price of palm oil at domestic market is given in Equation 5'.

$$P^{PO} = P^{wp}(1 + \text{tariff}) \quad (5')$$

Where;

P^{wp} = world price of palm oil
tariff = ad-volerem tariff on palm oil

It is hypothesized that tariff on palm oil is endogenously determined due to lobbying of DC producers who compete with coconut oil producers for same basic raw material, fresh coconuts. DC is an export oriented product and domestic consumption is negligible therefore DC producers face the world price (6').

$$\text{tariff} = f(P^{dc}) \quad (6')$$

Where;

P^{dc} = export price of DC

The producer price in the coconut oil supply function and the consumer price in the coconut oil demand function are linked by the equation (7).

$$P^{PC} = f(P^{CC}) \quad (7)$$

Single equations were first estimated using Ordinary Least Squares and then estimated as a system of equations using Seemingly unrelated regression (SUR) to obtain parameter estimates of the above system of equations. The endogenous and exogenous variables in the model are listed below. The model contains six endogenous variables and six equations. The equations were specified in linear form. Stationarity properties of the data series were tested using Augmented Dickey-Fuller test.

Endogenous Variables: D^{co}, S^{co}, P^{cc}, P^{pc}, P^{po}, *tariff*

Exogenous Variables: M, P^{fn}, P^{wpo}, P^{bd}, T

Validation of the Model

Validation of the model is needed to check the closeness of the predictions of the model to actual values within the sample period. It is conducted to primarily determine whether the simulation model accurately represent the system under study (Kleijnen, 1995). Correlation coefficient, biasness and root mean square error (RMSE) are the commonly available measures for the validation of simulation model. The RMSE measure is a measure of the deviation of the simulated value from its actual time path (Pindyck and Rubinfeld, 1991). The bias is an indication of systemic error. It measures the extent to which the average values of the simulated and actual series deviate from each other (Pindyck and Rubinfeld, 1991). If the validations statistics are within an acceptable range, the model will be qualified for the purpose of simulation of various policies. If not, re-estimations of the equations will be required until the validation statistics are satisfactory.

Simulation of the Model

Simulation is simply a mathematical solution of a simultaneous set of different equations and demand supply models have extensively used in policy analysis (Arzac and Wilkinson, 1979; Bhati, 1987; Brandt *et al*, 1992). The above market models were simulated by assigning alternative values for the exogenous variable to obtain corresponding values for the endogenous variables in the system.

DC millers prefer to have lower tariffs on palm oil, especially when the world market price for DC is higher, as it reduces the demand for fresh coconut by the coconut oil millers and more fresh coconut become available in the market for DC production. Equation (6') captures the extent to which the world market price of DC influences the import tariffs on palm oil. Lower tariffs lower the price of palm oil in the domestic market as depicted in equation (5'). The effects on lower price of palm oil on quantities of demand for and supply of coconut oil and retail and producer prices of coconut oil are captured by equations (1'), (2'), (3') and (7) simultaneously.

Data and Data Sources

Monthly data for the period of 1990 to 2009 were used for the analysis. Monthly Bulletin and Annual Reports published by Central Bank of Sri Lanka, Statistical Abstract published by the Department of Census and Statistics, Sri Lanka and Coco Market Focus published by Coconut Development Authority of Sri Lanka were the sources of data. Prices and income were converted into real values using appropriate indices. Data on policy changes, tariff on edible oil imports were collected from Department Ordinance of Sri Lanka Customs. The domestic price of palm oil is taken as the price of substitute since it contributes for 70% of the edible oils imported to the country and hence expected to have significant effect on coconut oil market.

RESULTS AND DISCUSSION

Results of the Stationarity Test

Since time series data were used in the analysis and literature has suggested the possibility of having co-integrating relationship in the coconut oil demand function (Samarajeewa and Gunatilake, 1999), stationary properties of the data and necessary conditions for the cointegration analysis were explored first. Demand for coconut oil, retail price of coconut oil and retail price of palm oil are stationary in order zero while per capita income and world price of palm oil are stationary at first difference (Table 1). In order to be cointegrated, two conditions should be satisfied; a) order of integration of the dependent variable should not be higher than the order of integration of the any of the explanatory variables and b) there must be none or at least two explanatory variables integrated to an identical order higher than the order of integration of the dependent variable. In this case, the first requirement is met since demand for coconut oil is integrated in order zero while other explanatory variables namely retail price of coconut oil and per capita income are integrated in order zero and order one respectively. However, the second requirement is not met. Therefore cointegration analysis could not be applied to estimate demand for coconut oil.

Table 1. Characteristics of individual price series

	Character	D_t^{co}	P_t^{cc}	M_t	P_t^{po}	P_t^{wp}	P_t^{bd}	Tariff
	Unit	kg/head	Rs/kg	Rs/capita	Rs/kg	Rs/kg	Rs/kg	Rs/kg
In level	Mean	0.21	2.06	773.00	1.74	36.05	65.88	0.31
	SD	0.12	0.53	98.79	0.46	13.66	25.85	0.20
	t-statistic on constant	16.24	40.79	-2.71	28.76	9.98	2.47	13.27
	Probability	0.0	0.0	0.0	0.0	0.0	0.01	0.00
	t-statistic on trend	0.27[ns]	-3.98	15.94	1.63[ns]	24.57	2.47	-1.55[ns]
	Probability	0.79	0.0	0.0	0.11	0.0	0.0	0.12
ADF in level	With drift*	-9.87	-3.17	0.94[1]	-3.28	-1.85	-1.32	-2.52
	Probability	0.0	0.0	0.35	0.0	0.07	0.19	0.01
	D-W	2.18	2.23	1.96	1.99	1.99	1.88	1.91
	Drift& trend**	NS	-4.26[2]	-1.08[1]	NS	-3.03	-2.81	NS
	Probability	-	0.0	0.28	-	0.0	0.0	-
	D-W statistic	-	2.01	1.96	-	1.97	1.84	-
ADF in first difference	ADF statistics with drift, trend**	-	-	-6.07	-	-12.86	-14.56	-
	Probability	-	-	0.0	-	0.0	0.0	-
	D-W statistic	-	-	2.68	-	1.94	2.01	-

Notes: ns – no significant trend or constant. *Critical values of ADF test statistics for rejection of a unit root at 1%, 5% and 10% probability levels are -3.4593, -2.8738 and -2.5732 respectively. **Critical values of ADF test statistics for rejection of a unit root at 1%, 5% and 10% probability levels are -3.9997, -3.4299 and -3.1382 respectively. These are the Mackinnon critical values provided by E-views output.[1]The critical value at four lags was considered since autocorrelation is observed. However, non-stationary property did not change with inclusion of lags. [2]The critical value at two lags was considered since autocorrelation is observed. However, stationary property did not change with inclusion of lags.

Results of the Econometric Estimation Using Single Equations

The results of the single equations are reported in Table 2. All the variables considered in the estimation except per capita income in coconut oil demand function were significant.

Table 2. Results of the single equation estimation (1990-2009)

Dependent variable	Independent variable	Unit	Mean	Coefficient estimated	Elasticity
Coconut oil supply	7-month lag producer price	Rs/mt	5043	0.27 (2.34)	0.21
	Fresh coconut price	Rs/1 000 nuts	552	-4.87 (-2.86)	-1.16
Coconut oil demand	Retail price	Rs/mt	2754	-0.00002 (2.78)	-0.32
	Per capita income	Rs/month	773	0.000045 (1.52)	0.13
	Palm oil price	Rs/mt	1778	0.000031 (2.63)	0.20
Import tariff on edible oils	FOB (SL) price of DC	Rs/mt	5398	-0.098 (-6.43)	-1.74
Price transmission	Retail price	Rs/mt	2754	1.45 (18.70)	0.78

Results of the Econometric Estimation Using System Equations

The results of the SUR estimation of coconut oil market show that the model explains 60% of the variability of the system. It was found that coconut supply is positively related with its own price lagged for seven months and supply elasticity of coconut oil with respect to its own price is 0.01 (Table 3). As indicated earlier, coconut is the basic raw material for manufacturing of coconut oil and as expected wholesale price of fresh nut is negatively and significantly related with supply of coconut oil. The supply elasticity of coconut oil with respect to fresh coconut price is -0.19 which indicates that for a 10% increase in fresh coconut price reduces coconut oil supply by 1.9%.

Further the estimation of the coconut oil demand equation show that coconut oil demand is negatively and significantly related to retail price of coconut oil. The own price elasticity of coconut oil demand was estimated to be -0.19. Most of the Sri Lankans use coconut oil as the main source of edible oil in food shorting for many centuries and this inelastic price response is as expected. The demand of coconut oil responds positively and significantly to increase in price of palm oil which is the main substitute. The elasticity with respect to price of palm was estimated to be 0.25 which indicates that for 10% increase in price of palm oil increases the demand for coconut oil by 2.5%. The estimated value for the income elasticity of coconut oil demand is not statistically significant (note: Samarajeewa and Gunatilake (1999) found that coconut oil may be an inferior good). A close relationship was observed between producer and retail price of coconut oil. The price transmission elasticity was estimated to be 0.78 for coconut oil market suggesting 78% of the retail price is transmitted to producer price.

As stated earlier, the primary objective of the study was to determine whether there is a relationship between import tariff on edible oil and export price of desiccated coconuts. The results very clearly show that export price of desiccated coconuts is a determinant of tariff on edible oils. The estimated coefficient is -0.09 (Table 3). It shows inverse relation between Sri Lankan desiccated coconut price and tariff on edible oils.

Table 3. The results of the econometric estimation using system equations (1990-2009)

Dependent variable	Independent variable	Unit	Mean	Coefficient estimates by SUR method	Elasticity
Coconut oil supply	7-month lag producer price	Rs/mt	5043	0.009 (0.21)	0.01
	Fresh coconut price	Rs/1 000 nuts	552	-1.13 (-2.37)	-0.19
Coconut oil demand	Retail price	Rs/mt	2754	-0.00001 (2.21)	-0.19
	Per capita income	Rs/month	773	0.0000023 (0.61)	0.01
	Palm oil price	Rs/mt	1778	0.000033 (7.31)	0.25
Import tariff on edible oils	FOB (SL) price of DC	Rs/mt	5398	-0.092 (-6.28)	-1.63
Price transmission	Retail price	Rs/mt	2754	1.45 (18.85)	0.78

Note: Total number of observations are 240 and values in parenthesis are 't' values. System weighted R^2 is 60%.

Results of the Model Validation

The coconut market model was first simulated to obtain results for all the endogenous variables in the system using values of the exogenous variables in the 1991 to 2009 period. In the system analysis, producer price of coconut oil in the supply equation was not significant and hence the validation statistics of the simulation were not very promising and therefore single equation estimates were used in the simulation. The results of this simulation were considered as the predictions of the baseline. The resulting values of the endogenous variables were compared with the actual values to determine the deviations from the actual values using validation statistics. Table 4 shows the results of validation tests of coconut market model developed.

As shown in Table 4, the coefficients of correlation for the models are closer to 50%, except the models for retail price and producer price in the coconut oil market. RMSE did not give good estimates for most of the models. Lower value of 3.47% was observed only for tariff equation. Bias percentage is very high for coconut oil demand.

Table 4. Validation statistics of the coconut market model

Endogenous variable	Validation statistic		
	Correlation coefficient (%)	RMSE (%)	Bias (%)
Supply of coconut oil	59	20.65	5.69
Demand for coconut oil	53	40.75	28.65
Producer price of coconut oil	47	55.91	0.39
Retail price of coconut oil	27	67.82	0.50
Price of palm oil	62	66.02	0.34
Import tariff on edible oil	99	3.47	2.05

Results of the Policy Simulation

Policy simulation exercise was carried out to evaluate the likely effects due to 10% price increase in the export price of desiccated coconuts on the import tariff, coconut oil and desiccated coconut markets. Table 5 presents the results of the policy experiment, i.e., simulated values of the endogenous variables in relation to the baseline predictions. The results of the policy simulation show that change in export price of desiccated coconuts has considerable implications on edible oil market.

The 10% increase in export price of desiccated coconuts leads to a drop of import tariff on edible oil by 16.27%.When import tariff is decreased domestic price of palm oil is dropped 2.70%. The reduction of price of palm oil which is a substitute of coconut oil cause escalation in retail price of coconut oil by 0.5% and with this price increase, the demand for coconut oil is reduced by 10.62%. The supply of coconut oil is a function of lagged coconut oil price and the simulation results show that price reduction in the current period is by 5.69%.

Table 5. Results of the policy simulation of 10% increase of export price of desiccated coconut on coconut markets at the mean of the sample (1991-2009)

Variable	Unit	Mean at the base simulation	Predicted value due to 10% increase in export price of desiccated coconut
Supply of coconut oil	MT	3 878	3 657 (-5.69)
Consumer price of coconut oil	Rs/MT	2 783	2 797 (0.50)
Demand for coconut oil	MT	3 750	3 350 (-10.66)
Price of Palm oil	Rs/MT	1 776	1 728 (-2.70)
Tariff	Rs/MT	295	247 (-16.27)

Notes: The prices were deflated using appropriate price indices. Percentage change from the mean base value is given in parenthesis.

CONCLUSIONS

The results of the analysis clearly show that the import tariffs on edible oils are endogenously determined and export price of desiccated coconut has a statistically significant negative effect on the tariff level. The cross price demand elasticity of coconut oil with respect to palm oil price is positive and statistically significant indicating a strong link between the two markets. The tariff changes directly influence on production and consumption of edible oil market. This indirectly influence on fresh coconut market. It was recommended to be cognizant on the above relationships in designing policies to regulate edible oil and related markets.

ACKNOWLEDGEMENT

Special thanks are due for Chairman, Coconut Research Board, Director, Coconut Research Institute for the continuous advice, guidance and financial support for the success of the study. Support of Head and staff of the Agricultural Economics and Agribusiness Management Division at Coconut Research Institute and Postgraduate Institute of Agriculture is appreciated.

REFERENCES

Anderson, K. (1980). The political market for government assistance to Australian manufacturing industries. Economic Record, *56(153),* 132 - 144.

Arzac, E.R. and Wilkinson, M. (1979). A quarterly econometric model United States livestock and feed grain markets and some of its policy implications, American J. Agriculture Economics, *61(2),* 297 - 308.

Bhati, U.N. (Dec., 1987). Supply and demand responses for poultry meat in Australia. Australian J. Agricultural Economics, *31(3)*, 256 - 265.

Brandt, J.A., Kruse, J.R. and Todd, J. (1992). Supply, demand and effects of alternative policies on the U.S. Oats industry. American J. Agricultural Economics, *74(2),* 318 - 328.

Brock, William A. and Magee, S.P. (1978). The economics of special-interest politics: The case of the tariff. American Economic Review, *68*, 246 - 250.

Cadot, O., de Melo, J. and Olarreaga, M. (2004). Lobbying, counter lobbying and the structure of tariff protection in poor and rich countries. World Bank Economic Review *18(3),* 345 - 366.

Central Bank of Sri Lanka (2002).Annual Report of Central Bank of Sri Lanka. Central Bank of Sri Lanka, Colombo.

Davidson, R. and MacKinnon, J.G. (1993). Estimation and Inference in Econometrics. Oxford University Press, Oxford, UK.

Fernando, M.T.N. and Peiris, T.S.G. (2000). Import duty reduction for substitute oils and its implications on coconut oil Industry in Sri Lanka. Paper presented at the International Conference on Plantation Crops (PLACROSYM XIV), on "Global Scenario of Plantation Crops Industry in the New Millennium", 12-15 December 2000, Hyderabad, India.

Hillman, A.L. (1989). Declining Industries and political-support protectionist motives. American Economic Review. *72*, 1180 - 1187.

Kleijnen, J.P.C. (1995). Theory and methodology, Verification and validation of simulation models. European J. Operational Research, *82,* 145 - 162.

Pincus, J.J. (1975). Pressure groups and the pattern of tariffs. J. Political Economy, *83(4)*, 757 - 778.

Pindyck, R.S. and Rubinfeld, D.L. (1991).Econometric Models and Economic Forecasts.3rd Ed. McGraw Hill Inc.

Samarajeewa, S.R. and Gunatilake, H.M. (1999). Estimation of demand function for coconut oil: A cointegrating analysis. Tropical Agricultural Research, *11*, 325 - 334.

Samarajeewa, S.R., Weerahewa, J. and Gunatilake, H.M. (2002).Tariff policy liberalization in edible oil market and its implications on the coconut producers in Sri Lanka. Tropical Agricultural Research.*14*, 317 - 326.