Peanuts

INDIRECT COSTS OF PEANUT CONTROL PROGRAMS

by

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ABSTRACT

An annual econometric model is used to measure the indirect costs of partial government controls for the domestic peanut industry. Results indicate that the costs of controls to consumers of peanut products totaled $6.98 billion (in 1976 dollars) from 1935 to 1976.

INDIRECT COSTS OF PEANUT CONTROL PROGRAMS

For over forty years the level of domestic peanut production has been partially controlled by the government through acreage allotments and price supports. As a consequence of partial control, technological progress, and capital for land substitution, peanut production per acre has almost tripled since the late 1930's. In recent years, increased production under the peanut loan and price support program has resulted in the accumulation of vast government stocks of peanuts. These peanuts are generally sold by the government at a loss for crushing, for use in the edible peanut market, or for export. Losses accrued are direct costs of control programs and have been enormous for peanuts in recent years, more than the costs of supports for any other commodity on a per unit output basis.

In addition to direct costs, there are two other types of costs imposed by a partial control program. These are indirect costs, which include the additional costs to consumers of higher product prices, and welfare costs, which result as a consequence of alternative price-quantity equilibria. Direct costs are easily measured in terms of program expenditures and returns. Indirect costs are more difficult to measure, requiring a comparison of product price-quantity equilibria with and without the controls program operative. Welfare costs are even more difficult to quantify, requiring a comparison of price-quantity equilibria utilizing an arbitrary index, such as consumer or producer surplus, as a measure of relative costs or benefits.

This paper presents the results of a study designed to measure the indirect costs of partial controls in the domestic peanut industry using an annual econometric model. The methodology utilized is similar to that employed by Heien in a recent study of the U.S. dairy price support program, and is an extension of the approach used by Song, Franzmann, and Mead to analyze the effect of peanut price supports on farm income. The first section of the paper discusses the nature of the peanut controls program and its direct costs. The second section presents the econometric model utilized in the study. The third section gives estimates of the model. The stability and validity of the model are discussed in the fourth section of the paper, and estimates of indirect costs of the peanut control program are given in the fifth section. The substantive conclusions of the study are presented in the final section.

Controls and Direct Costs

The two control variables which have been actively utilized to influence price-quantity time paths in the domestic peanut industry are acreage quotas, g_t $t \in T$, where T is the set of years considered in the study, and the price support level, h_t $t \in T$. In addition, the level of government stocks, r_t $t \in T$, is a pseudo control variable which generally has no target value. During periods when controls are operative (set S), the market price of peanuts, p_t $t \in T$, is related to the price support level such that $p_t \geq h_t$ $t \in S$ and the land allocated for peanut production, a_t $t \in T$, is related to the acreage quota such that $a_t \leq g_t$ $t \in S$. In addition, when controls are operative, generally $r_t \geq o$ $t \in S$.

Direct control costs consist of two components: net losses on resale operations by the Commodity Credit Corporation (CCC), the control agency, and administrative costs. While the level of administrative costs are virtually impossible to determine, CCC losses on purchases and sales of peanuts are recorded annually. These losses totaled $1.609 billion in 1976 dollars from 1935 to 1976, according to the Economic Research Service. Until 1962, the level of CCC losses on peanuts was nominal, but increased in the late 1960's and 1970's. Almost one-fifth of total CCC losses occurred in 1975 and 1976, when carry-overs from preceding years were sold.

The Model

Four markets are represented in the model developed for this study. These are the markets for peanuts, peanut oil, peanut meal, and edible peanuts. The objective of model specification is to explain the price-quantity time paths for each of these markets in what is clearly an interdependent market system. The complete model consists of 10 linear behavioral relations and 5 identities, and is algebraically simultaneous. With respect to estimation, however, the system consists of a 13-equation simultaneous subsystem with the two additional relations being recursive.

The market for peanuts is described by three relations in the model. These are:

(1) $q_t = s_{t-1} - s_t + z_t - x_t$ $\quad t\varepsilon T$

(2) $s_t = \alpha_o + \alpha_1 p_t + \alpha_2 s_{t-1} + \alpha_3 r_t + \varepsilon_t$ $\quad t\varepsilon T$

(3) $p_t = \beta_o + \beta_1 h_t + \beta_2 p_{t-1} + \beta_3 q_t + \sum_{i=1}^{2} \beta_{3+i} p_{it} + \nu_t$ $\quad t\varepsilon T$

where relation (1) is a dynamic market equilibrium identity for peanuts, requiring domestic disappearance of peanuts (q_t) to equal the sum of the change in peanut stocks ($s_{t-1} - s_t$) and the production of peanuts, (z_t) less net exports and other uses of peanuts (x_t). Relation (2) is a supply of storage function which states that the quantity of peanuts in storage at the end of t depends on the price of peanuts, lagged stock levels, and the magnitude of government stocks of peanuts at the end of t. Relation (3) is a reduced form price equation for peanuts which includes the price support level, lagged peanut prices, the domestic disappearance of peanuts, the price of peanut oil (p_{1t}), and the price of peanut meal (p_{2t}) as determinants of peanut price. The α_i, β_i $\forall i$ are fixed structural parameters, and ε_t, ν_t are stochastic disturbances with zero means.

The market for peanut oil is characterized by the relations

(4) $z_{1t} = \gamma_o + \gamma_1 c_t + \zeta_t$ $\quad t\varepsilon T$

(5) $p_{1t} = \delta_o + \delta_1 q_{1t} + \delta_2 m_t + \delta_3 p_{1,\, t-1} + \sum_{i=1}^{3} \delta_{3+i} v_{it} + \psi_t$ $\quad t\varepsilon T$

(6) $q_{1t} = z_{1t} - x_{1t}$ $\quad t\varepsilon T$

where relation (4) is a production function relating the production of peanut oil (z_{1t}) to the quantity of peanuts crushed (c_t). Relation (5) is a derived demand function describing the price of peanut oil as a function of the domestic disappearance of peanut oil (q_{1t}), income (m_t), lagged peanut oil price, the price of soybean oil (v_{1t}), the price of cottonseed oil (v_{2t}), and the price of shortening (v_{3t}). Relation (6) is a market equilibrium identity defining domestic disappearance of peanut oil (q_{1t}) as equivalent to peanut oil production, less net exports and other uses of peanut oil (x_{1t}). The $\gamma_i, \delta_i \; \forall i$ are fixed structural parameters and ζ_t, ψ_t are stochastic disturbances with zero means.

Three relations similar to those used to describe the peanut oil market are used to describe the peanut meal market. These are:

(7) $z_{2t} = \pi_o + \pi_1 c_t + \chi_t$ $\quad t \varepsilon T$

(8) $p_{2t} = \ell_o + \ell_1 q_{2t} + \ell_2 m_t + \sum_{i=1}^{2} \ell_{i+2} v_{i+3} + \kappa_t$ $\quad t \varepsilon T$

(9) $q_{2t} = z_{2t} - x_{2t}$ $\quad t \varepsilon T$

where relation (7) is a production function relating output of peanut meal (z_{2t}) to the quantity of peanuts crushed. Relation (8) is a reduced form derived demand function expressing the price of peanut meal as dependent on domestic disappearance of peanut meal (q_{2t}), income, the price of cottonseed meal (v_{4t}), and the price of soybean meal (v_{5t}). Relation (9) is a market equilibrium identity defining domestic disappearance of peanut meal as equivalent to peanut meal production, less net exports and other uses of peanut meal (x_{2t}). The $\pi_i, \ell_i \; \forall i$ are fixed structural parameters and χ_t, κ_t are stochastic disturbances with zero means.

The market for edible peanuts is represented by two relations:

(10) $q_{3t} = \phi_o + \phi_1 v_{6t} + \phi_2 m_t + \phi_3 q_{3,t-1} + \theta_t$ $\quad t \varepsilon T$

(11) $p_{3t} = \sigma_o + \sigma_1 q_{3t} + \sigma_2 p_t + \xi_t$ $\quad t \varepsilon T$

where relation (10) is a dynamic demand function for edible peanuts expressing domestic disappearance of edible peanuts (q_{3t}) as a function of the difference between the price of shelled peanuts and the price of almonds (v_{6t}), income, and lagged domestic disappearance of edible peanuts. Relation (11) is a simple static supply function with price written on the left-hand side. The $\phi_i, \sigma_i \forall i$ are fixed structural parameters and θ_t, ξ_t are stochastic disturbances with zero means. The variable v_{6t} has endogeneous definition

$$(12) \quad v_{6t} = p_{3t} - v_{7t} \qquad t\epsilon T$$

where p_{3t} is the price of shelled peanuts and v_{7t} is the price of almonds.

To complete the specification of the simultaneous portion of the model and to provide the crucial link between the market for peanuts and peanut products requires the addition of the identity

$$(13) \quad q_t = c_t + q_{3t} \qquad t\epsilon T$$

This identity requires the domestic disappearance of peanuts to equal the quantity of peanuts crushed and used for edible purposes. Relations (1) through (13) compose a simultaneous linear system with endogeneous variables: p_t, s_t, q_t, c_t, q_{1t}, q_{2t}, q_{3t}, p_{1t}, p_{2t}, p_{3t}, z_{1t}, z_{2t}, and v_{6t}.

The model is completed with the addition of a production function for peanuts, and an acreage response function. These are specified as

$$(14) \quad z_t = \rho_o + \rho_1 a_t + \rho_2 t + \rho_3 z_{t-1} + \eta_t \qquad t\epsilon T$$

$$(15) \quad a_t = \iota_o + \iota_1 a_{t-1} + \iota_2 g_t + \iota_3 f_t + \iota_4 E_{t-1}(p_t) + \mu_t \qquad t\epsilon T$$

Relation (14) represents peanut production as a function of land input, technology (proxied by t), and other inputs (proxied by z_{t-1}). Relation (15) states that the input of land for peanut production is dependent on lagged peanut acreage, the government acreage quota, a binary variable (f_t) with unit value if acreage controls are operative (zero otherwise), and the expected price of peanuts in t conditional on information available in t-1. Price expectations $E_{t-1}(p_t)$ are exogeneous with definition

$$(16) \quad E_{t-1}(p_t) = \partial_o + \sum_{i=1}^{3} \partial_i p_{t-i} + \partial_4 d_t + \partial_5 h_t \qquad t\epsilon T$$

where d_t is a binary variable with unit value if price supports are operative. The $\rho_i, \iota_i, \partial_i \forall i$ are fixed structural parameters and η_t, μ_t are stochastic disturbances with zero means.

Estimates of the Model

Table 1 presents the results of estimating the expectations function and the behavioral relations of the model. The expectations function is estimated using ordinary least squares (OLS) with the resulting predicted values of $E_{t-1}(p_t)$ being utilized as exogenous arguments in relation (15). The behavioral relations of the system are also estimated using OLS. Estimates of the model using system methods were virtually identical to OLS estimates, so there is no significant introduction of simultaneous equation bias from using OLS estimators.

As indicated in the table, most of the estimated parameters are highly significant statistically and of the expected sign. Variables which are not highly significant, such as q_{2t} in the demand function for peanut meal, and $E_{t-1}(p_t)$ in the acreage response function, are retained on the basis of theoretical propriety.[1] Regarding structural elasticities, the own price elasticities of demand for peanut oil peanut meal, and edible peanuts are -.021, -.002, and -.033, respectively. Reduced form income elasticities for these products are .018, .096, and .127, respectively. Elasticities are reported at mean sample levels and all estimates are based on data for set T, containing the period 1929 through 1976.

Stability and Validity of the Model

The complete system can be described compactly in the reduced form

(17) $y_t = d_o + D_1 y_{t-1} + D_2 x_t + D_3 w_t + e_t$

where y_t is a vector of endogeneous variables in the system, x_t is a vector of exogenous variables in the system not subject to control, w_t is a vector of exogenous variables (g_t, h_t, r_t) subject to control, d_o is a vector of intercepts, the $D_i \forall i$ are coefficient matrices of reduced form structural parameters, and e_t is a vector of stochastic disturbances such that $E(e_{jt}) = o$ for the j subvectors of e_t.

Table 1. Estimates of the Model

Variable	Estimate	R^2	d
$E_{t-1}(p_t)$	$\underset{(.31)}{2.28} + \underset{(.14)}{.41}\, p_{t-1} + \underset{(.16)}{.06}\, p_{t-2} - \underset{(.09)}{.22}\, p_{t-3} - \underset{(.38)}{1.84}\, d_t$		
	$+ \underset{(.08)}{.69}\, h_t$	.99	1.42
s_t	$\underset{(26)}{-28} + \underset{(4.7)}{15.7}\, p_t + \underset{(.10)}{.54}\, s_{t-1} + \underset{(.13)}{.81}\, r_t$	.89	1.49
p_t	$\underset{(.30)}{.54} + \underset{(.06)}{.30}\, h_t + \underset{(.08)}{.49}\, p_{t-1} + \underset{(.00016)}{.00037}\, q_t + \underset{(.016)}{.033}\, p_{1t}$		
	$+ \underset{(.0045)}{.0084}\, p_{2t}$	.99	1.96
z_{1t}	$\underset{(1.8)}{-12.6} + \underset{(.00)}{.33}\, c_t$	.99	1.12
p_{1t}	$\underset{(.61)}{-.27} - \underset{(.004)}{.011}\, q_{1t} + \underset{(.11)}{.34}\, v_{1t} - \underset{(.025)}{.061}\, v_{2t} + \underset{(.12)}{.60}\, v_{3t}$		
	$+ \underset{(.0003)}{.0010}\, m_t + \underset{(.05)}{.31}\, p_{1,t-1}$	.98	1.60
z_{2t}	$\underset{(1.57)}{2.79} + \underset{(.00)}{.21}\, c_t$	.99	.57
p_{2t}	$\underset{(2.63)}{1.57} - \underset{(.034)}{.029}\, q_{2t} + \underset{(.13)}{1.28}\, v_{4t} - \underset{(.09)}{.32}\, v_{5t} + \underset{(.0023)}{.0049}\, m_t$	.95	2.33
q_{3t}	$\underset{(74)}{166} - \underset{(.05)}{2.42}\, v_{6t} + \underset{(.025)}{.054}\, m_t + \underset{(.10)}{.77}\, q_{3,t-1}$	.93	2.01
p_{3t}	$\underset{(.80)}{-.42} + \underset{(.0010)}{.0021}\, q_{3t} + \underset{(.08)}{1.50}\, p_t$	.97	1.72
a_t	$\underset{(173)}{144} + \underset{(.07)}{.96}\, a_{t-1} + \underset{(446)}{1183}\, f_t - \underset{(.25)}{.71}\, g_t - \underset{(11.6)}{8.14}\, E_{t-1}(p_t)$	.83	2.41
z_t	$\underset{(144)}{-142} + \underset{(.07)}{.13}\, a_t + \underset{(5.30)}{14.05}\, t + \underset{(.09)}{.77}\, z_{t-1}$	.91	2.31

Stability conditions require that D_1 possess characteristic roots $|\lambda_j|<1 \forall j$. If this condition is not satisfied the system model is unstable, misspecification is implied, assumptions of estimation are violated, total multipliers fail to exist, and the values of y_t explode as $t \to \infty$. In addition to stability, it is necessary that the model be a valid representation of the system it is designed to emulate. To evaluate the validity of the model a "prospective" simulation is performed following a procedure suggested by Naylor. The system is re-estimated for $t \varepsilon T_1$, where T_1 is the subsample covering the period 1929 through 1972 ($T_1 \varepsilon T$). Simulated time paths are then generated for $t \varepsilon T_2$ where T_2 is the sample period 1972 to 1976 ($T_1 U T_2 = T$). Mean absolute errors (m_j) and Theil inequality coefficients (u_j) are used as indicators of model validity. These are presented in table 2, along with $|\lambda_j|$ for the D_1 matrix. As is clearly apparent, the model is stable. The m_j and u_j $\forall j$ must be interpretted subjectively, but seem appropriate given the relative obscurity of data describing the markets being modeled.

Indirect Costs

Indirect costs of the peanut support program include those costs imposed on consumers of peanut products which would not be imposed if no program was operative. In this respect, the cost of peanut support programs to consumers is the difference between the cost of peanut products with and without controls. The actual cost of peanut products to consumers is

(18) $C = \sum_{i=1}^{3} C_i = \{\sum_{i=1}^{3} \sum_t p_{it} q_{it} \mid w_t \quad t \varepsilon T\}$

where p_{it}, q_{it} $\forall i,t$ are the price-quantity time paths of peanut products with controls operative. The cost of peanut products to consumers with no controls operative is

(19) $\hat{C} = \sum_{i=1}^{3} \hat{C}_i = \{\sum_{i=1}^{3} \sum_t \hat{p}_{it} \hat{q}_{it} \mid w_t = 0 \quad t \varepsilon T\}$

where $\hat{q}_{it}, \hat{p}_{it}$ are generated as elements of y_t using

(20) $\hat{y}_t = \hat{d}_o + D_1 \hat{y}_{t-1} + D_2 x_t + e_t \qquad t \varepsilon T$

Table 2. Eigenvalues, Mean Absolute Errors, and Inequality Coefficients

j	$\lvert\lambda_j\rvert$	y_{jt}	m_j	u_j
1	.00	s_t	.02	1.59
2	.00	p_t	.15	.71
3	.00	q_t	.14	.49
4	.00	c_t	.23	1.89
5	.00	q_{1t}	.16	.35
6	.00	q_{2t}	.04	.48
7	.00	q_{3t}	.03	1.03
8	.91	p_{1t}	.04	.15
9	.00	p_{2t}	.12	.73
10	.78	p_{3t}	.24	1.92
11	.77	z_{1t}	.22	1.90
12	.51	z_{2t}	.06	.90
13	.31	v_{6t}	.35	18.22
14	.41	z_t	.23	1.86
15	.00	a_t	.14	.14

such that $\hat{y}_1 = d_o + D_1 y_o + D_2 x_1 + \dot{e}_1$. That is, y_o serves as a seed for generating simulated time paths with the levels of all control variables set equal to zero.

Table 3 presents actual and deflated values for $C, C_1, C_2, C_3, \hat{C}, \hat{C}_1, \hat{C}_2$, and $\hat{C}_3$. Indirect control costs are equal to the difference $\sum_{i=1}^{3}(C_i - \hat{C}_i)$. As is apparent from the table, indirect costs of controls to consumers over the study period have been enormous. Actual costs of peanut products to consumers totaled \$23.82 billion in 1976 dollars, while costs of peanut products with no controls operative would have totaled only \$16.840 billion in 1976 dollars. This gives indirect control costs equal to \$6.980 billion dollars which is in addition to the \$1.609 billion of direct costs due to CCC losses on sales.

Conclusion

The results of this study indicate that the indirect costs of controls in the domestic peanut industry have been large. Most of the total indirect costs of controls are attributable to the effect of controls on the market for edible peanuts. In many years the government policy on CCC sales of peanuts resulted in the diversion of edible peanuts to crushing markets, forcing prices up significantly in edible peanut markets since there are few substitutes for edible peanuts. The addition of surplus peanuts to crushing markets failed to dampen peanut oil and meal prices, however, because of their near perfect substitutability with soybean oil and meal. These findings are consistent with Trapp's contention that government activity in peanut markets can be viewed as one of discriminating between the market for edible peanuts and the market for crushed peanuts--consumers incur greater costs in the former market, and lower costs in the latter.

Table 3. Indirect costs of controls

Cost Type	Actual	Deflated
	\$ Billion	\$ Billion (1976)
C_1	1.17	2.18
C_2	.73	1.33
C_3	9.99	20.30
$\sum_i C_i$	11.88	23.82
$\hat{C}_1$	1.52	2.81
$\hat{C}_2$	.97	1.77
$\hat{C}_3$	5.69	12.26
$\sum_i \hat{C}_i$	8.19	16.84

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Footnotes

[1] The failure of the model to isolate statistically significant expectations effects in acreage response is a weakness of the study. This is a consequence of the absence of competition on the supply side over most of the sample period. Nevertheless, as much information as possible has been exploited econometrically, and estimates of the remaining functions of the model seem reasonable.