AN ANALYSIS OF THE IMPACT OF ALTERNATIVE PEANUT MARKETING QUOTAS AND SUPPORT PRICES*

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The first significant changes in the peanut program in more than 20 years are contained in the Food and Agricultural Act of 1977. The new program retains the use of acreage allotments, marketing quotas, and support prices but changes the procedure used to establish the size of the allotments and quotas given. The new program provides for two support prices versus one under the old program and no longer relates the support price level to a "parity price" concept.

In anticipation of the changes expected to be forthcoming from the new program during 1978 and future years, an analysis was undertaken to determine the effect of changing peanut marketing quotas and support prices on producer income, peanut consumer surplus, and peanut program costs. The analysis does not focus on changes generated by the new program because specific aspects of the program were not known when the research was conducted. Rather, the effect of a change or combination of changes in marketing quotas and support prices is analyzed in a general manner. Generalizations about the new program can be made on the basis of the analysis.

THE PEANUT MARKET

Previous studies of the peanut market centered on three forms of demand for peanuts: edible demand, crush demand, and export demand [1, 3 - 5, 7 - 9]. These studies document that the demand for peanuts can be separated into two distinct markets, an edible market and a nonedible market consisting of crush and export demand. Empirical results of these studies show that nonedible demand is substantially more price elastic than edible demand for peanuts.[1]

THE PEANUT PROGRAM

The peanut program establishes acreage allotments, marketing quotas, and price supports. Before the 1977 Food and Agriculture Act, peanut prices were supported at a level between 75 and 90 percent of parity. Peanuts not sold for edible use at the established support price level were acquired by the Commodity Credit Corporation (CCC) through a nonrecourse loan program. Thus the support price was maintained for all peanuts marketed. Because the quality of peanuts deteriorates as the length of storage increases, the CCC generally has resold its acquired stocks in the export market or domestic crushing market within the current crop year.

In the past the minimum national acreage allotment for peanuts has been 1.6 million acres. The marketing quotas granted generally have been sufficient to allow all peanuts produced on the allotted acres to be sold. Slightly more than half of all the peanuts produced and sold typically have been purchased by the CCC for resale in the crush or export market (Table 1). The crush price for peanuts has been approximately equal to the estimated variable cost of peanut production. Both the crush market price and the direct (variable) cost of producing peanuts have been about one half to two thirds of the support price for peanuts; hence, the CCC has encountered considerable expense in its support operations.

Under the new peanut program contained in the 1977 Food and Agricultural Act, price supports will be continued and acreage allotments are likely to remain unchanged. However, the new program does not require the support price to fall between 75 and 90 percent of

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[1]The peanut demand studies reviewed and cited here contained estimates of elasticities of demand for edible peanuts ranging from −.07 to −.44. Estimates of elasticities of demand for peanuts to crush ranged from −2.74 to −26.3. Estimates of export elasticities are not numerous but range from −.97 to as high as −32.1.

parity; rather the support price for the period 1978-1981 will remain constant at approximately 21 cents per pound. The 21 cent support price will be maintained only for a portion of expected total production, i.e. 3,360 million pounds in 1978 or about 80 percent of expected potential production from allotted acres. In each successive year after 1978, the quota of peanuts that will be supported at 21 cents per pounds will decline by 5 percent. A second but lower support price, taking into consideration "the demand for peanut oil and peanut meal, expected prices of other vegetable oils and protein meal, and the demand for peanuts in the foreign market" [10, Sec. 108] will be maintained for any peanuts produced in addition to the quota. Such peanuts are referred to in the act as "additional peanuts." The 1978 additional peanut support price is 12.5 cents per pound.

ANALYTICAL FRAMEWORK

An acreage control/price support system, such as the one which forms the basis of the past and forthcoming peanut programs, requires consideration of three controllable factors in policy formulation: (1) the acreage allotment and/or marketing quota level, (2) the support price level, and (3) the cost of the program. The procedure used to analyze the effect of changing any of these three policy variables consisted of combining a nonlinear optimization algorithm[2] with a peanut demand model[3] developed by Fleming and White[3, 4] to form a static optimal control framework. By use of optimal control techniques, values for the controllable policy variables were found which optimized alternative objective functions. The objective functions used were defined so that "targeted conditions" would be achieved

TABLE 1. PEANUT PRODUCTION AND DEMAND DATA, 1970-75[a]

Year	Peanut Production (mil. lbs.) (1)	Edible Demand (mil. lbs.) (2)	Crush (mil. lbs.) (3)	Export (mil. lbs.) (4)	Crushing Price (¢/lb.) (5)	Estimated Direct Cost of Production (¢/lb.) (6)	Support Price (¢/lb.) (7)	Total Farm Revenue (1 x 7) (8)	CCC Losses and Expenses (mil. $) (9)
1977[b]	3,681	1,825	600	900	-- [d]	10.9-11.6	21.5	791.4	-- [h]
1976[b]	3,751	1,800	1,108	783	-- [d]	11.7	20.7	776.5	-- [h]
1975	3,857	1,870	1,447[c]	435	-- [d]	11.2	19.7	738.2	79.0[g]
1974	3,668	1,800	596	740	-- [d]	8.9	18.3	671.2	3.0
1973	3,474	1,840	683	709	12.0	7.7[e]	16.4	569.7	5.0[f]
1972	3,275	1,694	850	521	8.8	6.9[e]	14.3	468.3	58.0
1971	3,005	1,623	814	552	6.5	6.5[e]	13.4	402.7	97.0
1970	2,979	1,580	799	290	6.6	6.3[e]	12.8	381.3	66.3

[a]Sources: U.S. Department of Agriculture: Fats and Oils Statistics. Prices for crushing peanuts are from USDA, ERS unpublished sources. Estimated direct costs of production are from the ERS-USDA report to the Senate Agricultural Committee entitled "Cost of Producing Selecting Crops in the United States—1975, 1976, and Projections for 1977."

[b]1976 values are preliminary. 1977 values are forecasted.

[c]The large increase in peanut crushing in 1975 and 1976 coincides with "toll crushing" activities. Toll crushing is an arrangement allowing crushers to crush government peanuts and return the oil produced to the government but retain the meal produced as payment for their crushing services.

[d]Since the origin of the "toll crush" program in 1974, crushing prices cannot be determined in a comparable manner.

[e]Backward extrapolations of 1974-76 USDA national average variable cost of production estimates were made on the basis of Oklahoma peanut production budget data.

[f]Abnormally strong demand for peanut meal occurred in 1973 because of a shortage of high protein feeds. This demand resulted in low government costs for the peanut program in 1973.

[g]Net after reimbursements of $47 million from P.L. 480, Title II funds and exclusion of loss of $10 million on roasted peanuts and peanut granules purchased.

[h]Not available.

[2]The optimization-control procedure used is referred to as the "complex algorithm" [2]. Computer coding for the algorithm and a description of its use are presented by Kuester and Mize [6]. The algorithm consists of a systematic search procedure capable of finding the control values which maximize an objective function. The search method used in the complex procedure is a specific modification of the procedure generally referred to as the "hill climbing" method. The objective function describing the desired performance must be formed from output variables of the model and may be nonlinear. Nonlinear constraints may be placed on the permissible control values. The model representing the system being controlled may be of any form desired.

[3]Fleming and Whtie's publication and Fleming's thesis should be consulted for a full description of the model. As adopted for use here, it consists of eight equations and identities including demands for edible peanuts, crushing demand, export demand, feed and seed use, government purchases and resales, and carryover stock. Supply is exogenous to the model and is assumed to be determined by policy or in long-run equilibrium consistent with an assumed cost of production.

rather than maximum values. That is, controls were sought such that certain farm income levels, consumer surpluses, etc., would be obtained rather than maximum levels. This type of objective function makes use of "penalty values" and is maximized when all penalties have been reduced to zero. Penalty values generally are calculated as the squared difference between the targeted value and the simulated value resulting from a given set of controls. An example of this type of an objective function is given below. A negative sign is given to the sum of the penalty values so that maximization instead of minimization can be conducted.

$$U = -(NET + BUDGET + CLEAR)$$

U = value to be maximized

NET = a penalty value forcing net farm income to obtain a targeted value; net farm income is calculated as the difference between total revenue (sales times support price) and the direct cost of production (all costs except land charges) as calculated by ERS-USDA [11] and reported in Table 1.

BUDGET = a penalty value forcing government expenditures to be equal to a given budget; government expenditures are calculated as support price minus nonedible peanut price times the quantity of peanuts resold by the government, plus a 2.18 cent a pound handling charge per pound resold.

CLEAR = penalty value forcing the market to clear, i.e. maintain constant carryover stock levels; it is calculated as the squared difference between carryin stocks and estimated carryout stocks.

By alteration of the targeted values desired and the restrictions placed on the permissible control values that can be used to achieve a targeted set of conditions, the solutions obtained for the policy control variables could be used to develop relationships between combinations of policy variables (support prices, marketing quotas, and program budgets) and the resulting target value for either producer income, edible peanut consumer surplus, or nonedible peanut consumer surplus.

ANALYSIS RESULTS

Isobudget lines showing the combinations of marketing quotas and support prices that could have been financed with a given budget are shown in Figure 1. Isonet farm income lines depicting combinations of marketing quotas and support prices that would result in a given farm income from peanut marketing are shown also. The isobudget lines were derived by use of optimal control procedures. The 1975 market conditions were used to initialize all exogenous noncontrollable variables. By targeting the budget at a given level and restricting the permissible control value for support price at varying levels, optimal control procedures could be used to solve for the associated marketing quota which caused the targeted values of the objective function to be obtained. The solution values obtained for the control variables and the associated targeted budgets and permissible support prices were used to define isobudget lines.

Isonet farm income lines were obtained directly (without using optimal control procedures) by multiplying the marketing quota by the profit margin associated with a given point. Profit margin is defined as the difference between the support price and the direct cost of production. The points of tangency between the isobudget lines and isonet income lines indicate the quota and support price combinations that maximize net farm income from peanut sales under alternative budget levels and 1975 market conditions.

Farm Income/Budget Cost Tradeoffs

Figure 1 can be used to answer several policy tradeoff questions. A vertical line drawn through any support price will indicate the net income and program costs associated with alternative quota sizes and a given support price. Likewise, a horizontal line drawn through any quota level will indicate the net

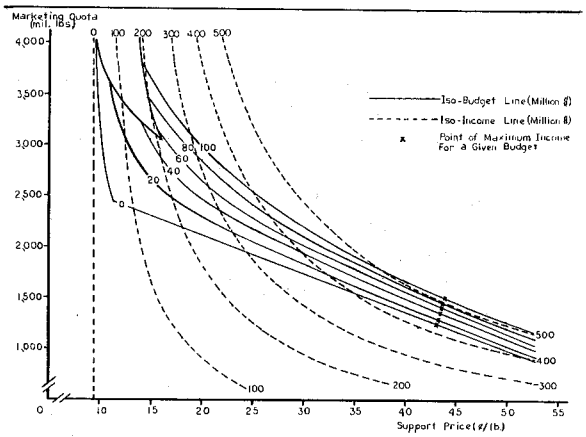

FIGURE 1. TRADEOFFS AMONG POLICY CONTROLLED VARIABLES WITH A PEANUT SUPPORT PRICE ACREAGE CONTROL PROGRAM

income and program cost associated with alternative support prices and a given marketing quota. The intersection of any set of horizontal and vertical lines will define the estimated government cost and resulting net farm income for the represented price support and quota level.

Figure 1 shows that the support prices and marketing quotas set under the past and forthcoming peanut program achieved their associated farm income levels at a much larger budgetary cost than is estimated to be necessary. For example, in 1975 the minimum acreage allotment of 1.6 million acres resulted in the production of 3,747 million pounds of peanuts. The support price was set at 19.7 cents or 75 percent of parity. This level produced a net farm income of $393.5 million. By moving downward to the right on an imaginary isonet income line just below the $400 million isonet income line, one sees that the same income can be provided with a much smaller budget if support prices are raised and marketing quotas reduced.

Peanut program costs to the government under the past peanut program consist of bearing the losses and expenses of purchasing the quantity of peanuts required to maintain the support price and then reselling these peanuts in the nonedible peanut market at a lower price. Total program costs under this system and other systems which conduct market discrimination activities are likely to be less than total increases in farm income generated by the program. This relationship between program costs and farm income increases exists because part of the increase in farm income generated by such a program is obtained through the market by increasing prices in the inelastic edible peanut market. Estimates obtained with the peanut model indicate that between 1970 and 1975, on the average, 41 percent of the increase in farm income (in relation to an open market with the same level of production) was generated through market discrimination. The remaining 59 percent was generated by government purchases of peanuts at the established support price. The magnitude of income increases achieved from the market depends on the elasticity of edible peanut demand and the amount of market discrimination conducted.[4] Under a target price program, market price discrimination is not possible and all farm income increases must come directly from program expenditures.

Consumer Surplus Tradeoffs

Changing the support price or marketing quota will alter consumer surpluses in the edible and/or nonedible markets for peanuts. Figure 2 depicts and quantifies the magnitudes

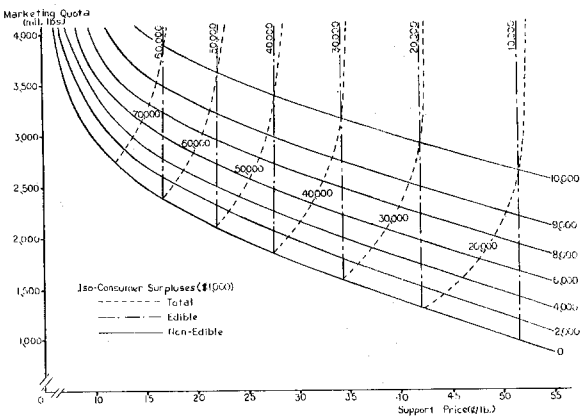

FIGURE 2. CONSUMER SURPLUS TRADEOFFS WITH A PEANUT PRICE ACREAGE CONTROL PROGRAM

and directions of change for edible consumer surplus, nonedible consumer surplus,[5] and total peanut consumer surplus in relation to support price and quota levels. Though the direction of change of consumer surpluses in each market resulting from changing the quota or support price can be deduced from market discrimination theory, the relative magnitude of change and direction of change for total consumer surplus can be determined only by application of an empirical model of the peanut market. Figure 2 was developed by obtaining optimal control solutions to the peanut model. The procedure used to obtain these solutions was similar to that used in developing Figure 1, i.e., by constraining consumer surpluses to a given value and repeatedly solving the model at various support prices, an "isoconsumer surplus line" is mapped. (Figure 2 can be superimposed on Figure 1 if desired.)

[4]The potential magnitude of income increases that can be achieved with a given budget increase are shown and quantified in Figure 1. Starting from a support price of approximately 17 cents per pound and a production level slightly above 2,500 million pounds, an increase of support prices of approximately 6 cents to a level of 24 cents increases net farm income by nearly $150 million at an added budgetary cost of only $40 million; hence, the ratio of increased income to increased budget cost is 3.75 to 1 in this instance. (The "Δ income/Δ budget" ratio decreases as one moves the initial point of comparison to the extreme lower right corner of the figure or extreme upper left corner.) Note that moving directly upward from the initial point specified results in equal increases in budget expenses and income because market discrimination and the market income effect associated with it can be obtained only by raising support prices.

[5]No distinction is made between domestic and foreign purchases of peanuts for nonedible use. Policy alternatives which discriminate against foreign buyers could be studied but are not considered here.

In Figure 2, edible consumer surplus (if the quota is adequate to meet the demand at a given support price) is affected only by the support price and has an inverse relation to support price. Nonedible consumer surplus is related positively to both the support price and the marketing quota. The total consumer surplus tradeoff pattern is dominated by the edible consumer surplus relationships, i.e., total consumer surplus is related inversely to support price and has only a slight positive relation to the quota level.

Edible and nonedible consumer isosurplus curves are distinctly different because of the different elasticities of demand for each market and because of the presence of market discrimination. As an illustration, consider the following case. At a production level of 3,441 million pounds and a support price of 14 cents, edible consumption is 2,096 million pounds, nonedible consumption is 1,065 million pounds, and miscellaneous consumption amounts to 280 million pounds. If the same marketing quota is maintained and support price is raised to 15 cents, edible consumption will fall by 33 million pounds and nonedible consumption will increase by 33 million pounds. This change causes a decline in nonedible peanut prices of approximately one tenth of a cent. The decline is small because of the elastic nature of nonedible peanut demand. The associated consumer surplus changes are: a decline of edible consumer surplus of $2,808 thousand, i.e., approximately one times 2,096; an increase of nonedible surplus of $108 thousand, i.e., approximately .1 times 1,065; and a decline in total consumer surplus of $1,988 thousand, i.e., 2,096 minus 108. Hence, edible consumer surplus and total consumer surplus are more sensitive to support price than nonedible consumer surplus. A similar line of reasoning could be developed to show that nonedible consumer surplus is more sensitive to marketing quotas than edible consumer surplus.

IMPLICATIONS

Figures 1 and 2 indicate conflicts among peanut producers, edible peanut consumers, nonedible peanut consumers, and taxpayers. If all groups are considered, any change from an existing support price and/or marketing quota will result in at least one group being harmed. Many changes from past support price, marketing quota, and program budget levels can be analyzed from Figures 1 and 2 and/or the optimal control framework used to derive them. One set of changes worthy of being considered are those which will be brought about by the new peanut program.

The new peanut program specifies that the support price will be maintained at approximately 21 cents per pound while marketing quotas are reduced over a three-year period starting with the 1978 crop year from 3,360 million pounds to 2,880 million pounds. Assuming no "additional peanuts" (peanuts in excess of the marketing quota which can be sold at a lower support price) are produced and barring significant changes in market conditions, this support price and marketing quota schedule specified in the new program would reduce gross revenue from peanut sales by 1981 to $604.8 million or $133.4 million below the 1975 gross revenue level. Budget costs would be reduced from the estimated 1975 level of $122.5 million to approximately $90 million. Edible peanut consumer surplus would be reduced slightly and nonedible peanut consumer surplus would fall by nearly 40 percent. The preceding figures fall short of being forecasts because changing market conditions and the possibility of "additional peanuts" being produced are not considered.

The impact of "additional peanuts" production could be analyzed specifically if the magnitude of additional peanut production under the new program could be predicted. The 1978 support price for additional peanuts of 12.5 cents per pound is barely adequate to cover the direct cost of peanut production in most locations [10]; hence, the production of additional peanuts may be limited. To the extent that additional peanuts are produced, they would increase nonedible consumer surplus and gross farm revenue from peanut sales. Also, to the extent that government support prices for additional peanuts are above the market price for peanuts, expenses would be incurred by the government on additional peanuts purchased.

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