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Political Economy of the United States Sugar Policies

by

Rigoberto A. Lopez

WP-8

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Political Economy of the United States Sugar Policies

The sugar policies of the U.S. government constitute one of the best case studies for analyzing political-economic decision making in agriculture. Since 1789, the U.S. government has involved itself in the sugar industry, setting import and domestic quotas, tariffs, and support prices, singly and in combination. In only 4 of the last 200 years, 1975-76 and 1980-81, did the government not approve a sugar target price, and in these years the abnormally high world sugar prices obviated the need for one. As a result of the U.S. governmental involvement, the price of sugar has been much higher and more stable domestically than in the world market.

In the late 1980s, the U.S. sugar program faces challenges on several fronts. Critics contend that high domestic prices have encouraged the development and adoption of sugar substitutes, such as high-fructose corn syrup; that ever more restrictive import quotas increase foreign policy risk (the quota was reduced by 41% from 1986 to 1987 alone); and that the program is highly inefficient. Clearly, government officials and all those who make policy and participate in domestic and foreign markets must strive to better understand how policies are formed and what factors affect policy choices.

A survey of the literature reveals the lack of an integrated political-economic analysis of sugar policy. Research on sugar policy has focused on evaluating the welfare consequences of given sugar policy scenarios (e.g., Leu et al., Gemmill) but not the other way around—on how policy responds to the welfare of market participants. But in closely related literature on

trade and protectionism, several studies have integrated political factors by endogenizing government behavior into the empirical framework (Sarris and Freebairn; Friedlaender; Rausser and Freebairn; Riethmuller and Roe). Little work has been done on modeling public choice along with commodity market models. The purpose of this article is to develop a framework to analyze the determinants of the level of U.S. sugar policy instruments, sugar import quotas and target prices, based on the economic surpluses of market participants. By doing so, the empirical framework incorporates both the economic and political aspects involved in the U.S. sugar case.

Conceptual Framework

Pressure groups and government agencies interact in U.S. sugar policy-making. The endproduct is a sugar program that consists of policy choices, including price-support levels and import quotas. Lobbyists provide a critical input in policymaking by representing the special interests of pressure groups trying to influence policies in their favor.¹ The political and economic importance of corn sweeteners cannot be underestimated, especially that of high fructose corn syrup, which had captured over 35% of the U.S. caloric sweetener market by 1986. Although the sugar target price is primarily intended for sugar, it is also a price umbrella for corn sweeteners.

As in other public policies, sugar policy involves two strata of decision making: *legislating* and *administering*, or *implementing*, a sugar program. The first part is done by Congress and the second by executive branches. In the case of sugar policy, the role of Congress has been confined to establishing the price support level for domestic sugar producers. Administering

the program to achieve the price support level starts with an interagency review by a Sugar Working Group composed of representatives of the Departments of Agriculture, State, Treasury, and Commerce; the Office of the U.S. Trade Representative; the National Security Agency; and the Council of Economic Advisors (Nuttall). This group develops recommendations on program administration that then go to the Cabinet and are ultimately approved by the President. Basically, Congress sets the price-support levels, and the President, via the Cabinet and the Sugar Working Group, decides on the particular policy instruments to implement the legislation. For example, the Food Security Act of 1985 supported sugar price levels with a loan rate of \$0.18 per pound of sugar, and the President instructed the Secretary of Agriculture to run the sugar program "at no cost" to the U.S. Treasury in compliance with the legislation. This was implemented by restricting imports, although domestic quotas might also have been used to run the program at "no cost."

The conceptual framework in this article follows from the premise that the government authorities form preferences over the welfare of domestic producers and consumers, the Treasury's position (which can be viewed as an income claim to others), and foreign interests. According to Nuttall, administrative decisions in the sugar program involve four policy areas: domestic farm programs, domestic budgets, foreign policy ramifications, and implications of trade policy. The theoretical model used in this article is an extension of the one presented by Riethmuller and Roe, in which the government chooses levels of policy instruments so as to maximize an objective function, where producer surplus, consumer surplus, and the net revenue position of the Treasury resulting from a given policy are the inde-

pendent arguments.² A government utility function for sugar policymaking is designated as

$$U = U(PS, CS, FS, BS), \quad (1)$$

where PS is producers' surplus; CS is consumers' surplus; FS is foreign countries' surplus; and BS is federal budget surplus. Assume the government utility function is separable, additive, and concave in the arguments. Given K policy instruments available to policymakers, they choose the levels of these instruments (G_k) in order to optimize (1). It is further assumed that the government preferences in sugar policies are separable from other concerns. The first-order condition for utility maximization is given by

$$\frac{\partial U}{\partial G_k} = \frac{\partial U}{\partial PS} \frac{\partial PS}{\partial G_k} + \frac{\partial U}{\partial CS} \frac{\partial CS}{\partial G_k} + \frac{\partial U}{\partial FS} \frac{\partial FS}{\partial G_k} + \frac{\partial U}{\partial BS} \frac{\partial BS}{\partial G_k} = 0. \quad (2)$$

The first term describes the effect of producers' welfare; the second, the effect of consumers' welfare; the third, the effect of the welfare of foreign countries; and the fourth, the federal budget balance. To illustrate the effect on domestic consumers and producers, assume that the federal budget balance and the welfare of foreign countries are constant. Then, equation (2) implies that

$$\frac{-\partial U / \partial CS}{\partial U / \partial PS} \Big|_{BS, FS = \text{const}} = \frac{\partial PS / \partial G_k}{\partial CS / \partial G_k}. \quad (3)$$

In other words, the government will set a policy instrument level where the marginal rate of substitution between the producers' and the consumers' interests is equal to the market welfare trade-off between consumers' and producers' interests. If utility of the politicians is assumed to depend solely

on political support, then equation (3) asserts that they set policy instrument levels that balance marginal political gains and losses from diverse groups with conflicting interests, as in Becker's results.

As with other government policies, U.S. sugar policies follow market conditions but lag behind them. That is, policy instrument levels are set before they become effective and are thus based on lagged information. As such, sugar policies are based on lagged values of the welfare of market participants and federal budget balance. Policy decisions, G_k^* , resulting from the policymaking process can be represented by³

$$G_{kt}^* = G_k(PS_{t-\tau k}, CS_{t-\tau k}, FS_{t-\tau k}, BS_{t-\tau k}), \quad (4)$$

where τk is the institutional lag associated with policy instrument k . It follows from the implicit function theorem that the government's choice variables can be stated as a function of variables exogenous to its choice, as in Riethmuller and Roe, and in Godek.⁴ The virtue of the approach taken in this paper is that insights are obtained on key factors that motivate policy and on policy response to changes in the welfare of market participants.

Empirical Framework

The empirical procedures involve the estimation of market parameters, the computation of welfare measures based on these parameters, and the estimation of policy instrument parameters based on these welfare measures.

A Domestic Sugar Market Model

A U.S. sugar market model can be specified econometrically as consisting of sectors: domestic cane and beet suppliers, and domestic consumers.

The goal here is to provide an econometric framework to estimate economic surpluses of market participants. The behavioral equations for the domestic sugar supply are specified as follows:

$$P_t^* = \max \{ \bar{P}_t, P_t^{reh} \}, \quad (5)$$

$$\ln A_t^c = \alpha_0 + \alpha_1 \ln P_t^* + \sum_{i=2}^{nc} \alpha_i Z_{it}^c + U_{ct}, \quad (6)$$

$$\ln A_t^b = \beta_0 + \beta_1 \ln P_t^* + \sum_{j=2}^{nb} \beta_j Z_{it}^b + U_{bt}, \quad (7)$$

$$Q_t^s = A_t^c Y_t^c + A_t^b Y_t^b \quad (8)$$

where \ln is the natural logarithm operator; P_t^* is the expected sugar price received by domestic producers; \bar{P}_t is the government-instituted target price; P_t^{reh} is the expected market-clearing price; $A_t^{c,b}$ is acres planted with cane (c) or beet (b); Q_t^s is the current domestic sugar supply; Z_{it}^h is a vector of exogenous variables ($h = c$ or b); U_{ht} denotes random disturbances; $Y_t^{c,b}$ is the sugar yield per acre of cane or beet; and α and β are parameters to be estimated.⁵

Equation (5) describes the price-expectation structure and allows for bounded price expectations typical of price-supported commodities (Shonkwiler and Maddala). The support price \bar{P}_t is a lower bound on expected price. However, the market-clearing price P_t^{reh} may exceed the support rate. Thus, $P_t^* = P_t^{reh}$ if $P_t^{reh} > \bar{P}_t$, and $P_t^* = \bar{P}_t$ otherwise. The domestic supply of cane and beet sugar is modeled as a supply response, i.e., it consists of acreage decisions (equations (6) and (7)) and sugar yield per acre ($Y_t^{c,b}$). Yields are exogenous to this model because they are predominantly determined by weather (Jesse and Zepp). Total domestic sugar supply, therefore, is given by $A_t^c Y_t^c + A_t^b Y_t^b$.

Actual producer surplus embodies both *expected* and *unexpected* components. Define actual producer revenues that accrue to cane sugar producers as $R_t = P_t Q_t^c$, where $Q_t^c = A_t^c Y_t^c$ denotes total quantity of cane sugar produced, and let $R_t^* = P_t^* Q_t^{c*}$ denote expected total revenues, where $Q_t^{c*} = A_t^c Y_t^{c*}$ and Y_t^{c*} is expected yield. The expected surplus for cane sugar producers is given by

$$PS_t^{c*} = Y_t^{c*} (\alpha_1 + 1)^{-1} e^{\alpha_0} (P_t^*)^{\alpha_1 + 1} \prod_{i=2}^{nc} (Z_{it}^c)^{\alpha_i}. \quad (9)$$

Actual producer surplus is given by $PS_t^c = R_t - R_t^* + PS_t^{c*} = R_t - (R_t^* - PS_t^{c*})$. The term in parenthesis is equivalent to total variable costs. Producer surplus of beet sugar production can be estimated in a similar manner. Total domestic sugar producer surplus is given by $PS_t = PS_t^c + PS_t^b$. Domestic sugar demand is given by

$$Q_t^d = \gamma_0 + \gamma_1 P_t + \sum_{i=1}^{nd} \gamma_i Z_{it}^d + U_{dt}, \quad (10)$$

where Z_{it}^d is a vector of exogenous variables, γ parameters, and U_{dt} random disturbances. Equation (10) includes demand for both crystalline sugar and sugar in processed food products.

Two difficulties in measuring consumer surplus arise. One is that sugar or any of its close substitutes *alone* may not be regarded as a *necessary* input. That is, food manufacturing output may be possible without any sugar or any one of the other corn sweeteners. As noted by Just et al., the part of the quasirent which can be earned without the use of the input is not reflected in the area under the demand curve and above the price. Thus, consumer surplus, so measured, may result in an underestimate of the true consumer surplus.

The second difficulty pertains to multimarket welfare measurement. Although the sugar target price is a policy instrument primarily intended for the sugar market, it is also a price umbrella for closely-related substitutes because the supply of substitute sweeteners is not perfectly elastic. When the price of sugar is increased, the demand for other sweeteners increases, thus increasing their price, and shifting the demand for sugar outward.

An approach suggested by Just et al. (Chapter 9) for addressing the multimarket welfare concern is to utilize an *equilibrium* demand for sugar which takes into account the feedback from substitutes markets.⁶ Let the relationship between the price of sugar and its substitutes be given by

$$P_{0t} = \pi_o + \pi_1 P_t + \sum_{i=2}^{no} \pi_i Z_{it}^o, \quad (11)$$

where P_{0t} is the price of substitutes, P_t the price of sugar, Z_{it}^o is a vector of other factors which affect substitute prices, and the π s are reduced form parameters in the substitutes market. Substitute (11) into (10) to obtain an equilibrium demand for sugar whose consumer surplus measures the consumer surplus in all associated markets. Letting $Z_{2t}^d = P_{0t}$ in (10) and using (11), the equilibrium demand is given by

$$Q_t^d = \gamma_o^* + \gamma_1^* P_t + \sum_{i=2}^{no} \pi_i^* Z_{it}^o + \sum_{i=3}^{nd} \gamma_i Z_{it}^d + U_{dt}, \quad (12)$$

where $\gamma_o^* = \gamma_o + \gamma_2 \pi_o$, $\gamma_1^* = \gamma_1 + \gamma_2 \pi_1$, and $\pi_i^* = \gamma_2 \pi_i$. Since $\gamma_1 < 0$ (law of demand), $\gamma_2 > 0$ (substitution parameter), and $\pi_1 > 0$ (price umbrella effect), the equilibrium demand curve is less responsive to sugar price (since $|\gamma_1| > |\gamma_1 + \gamma_2 \pi_1|$), as implied by Just et al. for the case of substitutes. Consumer surplus is now given by

$$CS_t = \int_0^{Q_t^d} \left[(Q_t^d - \gamma_0^* - \sum_{i=2}^{no} \pi_i^* Z_{it}^o - \sum_{i=2}^{nd} \gamma_i Z_{it}^d) / \gamma_1^* \right] dQ_t^d - P_t Q_t^d. \quad (13)$$

The producer surplus that accrues to exporting countries (FS) can be computed based on their excess supply function taking into account exports to the U.S. and elsewhere.

Policy Decisions

Sugar policies are set before they become effective and are subject to amendment only under certain conditions. Assuming that policy instruments are effective, their observed levels correspond to those chosen by policymakers. Characterized by a bureaucratic time lag in policy implementation and adjustment, the selected levels of policy instruments are assumed to follow a multiyear distributed lag response. More specifically, an econometric specification of equation (4) for government behavior in setting sugar policy instruments is expressed as:

$$G_{kt}^* = \lambda_0^k + \sum_{\tau=1}^{nk} [\delta_{1\tau}^k PS_{t-\tau} + \delta_{2\tau}^k CS_{t-\tau} + \delta_{3\tau}^k FS_{t-\tau} + \delta_{4\tau}^k BS_{t-\tau}] + U_{kt}, \quad (14)$$

where τ represents a lagged period. Following Harvey, let $\delta_{j\tau}^k$ be represented by a polynomial of degree n , which is assumed to be a continuous function of τ so that it can be expressed as $\delta_{j\tau}^k = \sum_{i=1}^n \lambda_i^k \tau^i$. Substituting this into (14), equation (14) can then be expressed as:

$$G_{kt}^* = \lambda_0^k + \sum_{j=1}^4 \sum_{i=1}^{nk} \lambda_{ji}^k W_{jit}^k + U_{kt}, \quad (15)$$

where $W_{jit}^k = \sum_{\tau=1}^{nk} \tau^i X_{jt-\tau}$ ($i = 1, \dots, nk$), and $X_j = \{PS, CS, FS, BS\}$. W_{jit}^k represents the “scrambled” terms treated as ordinary regressors that

can be unscrambled after estimation to obtain the implied lag coefficients. Thus, λ_{ji}^k denotes the only parameters to be estimated.

Because of the intricacy of the sugar market and the wide variety of policy instrument options, the focus was narrowed to two policy instruments: the government's price-support level (loan rate) and import quota level. Although other policies have influenced domestic acreage planted and certain marketing decisions, they have not been applied continuously and may have had little effect on total production.

Data and Estimation

Most of the data came from U.S. government publications, including reports of the Foreign Agricultural Service, the Economic Research Service, and *Sugar and Sweetener Outlook and Situation Report (USDA)*.⁷ The federal budget balance data were obtained from the *Statistical Abstract of the United States* (U.S. Department of Commerce). Annual observations were collected for the 1955-85 period.

The expected market clearing price (P_t^{reh}) was approximated by a rationally expected price and estimated following McCallum's technique by using instrumental variables rather than the unrestricted reduced form for price.⁸ To assure boundedness of expectations, the predicted P_t^{reh} was compared with the target price (\bar{P}_t) for each year. Whenever $P_t^{reh} \leq \bar{P}_t$, the bounded rationally expected price was set equal to \bar{P}_t , so that the estimated $P_t^* \geq \bar{P}_t$. The estimated P_t^* was substituted into equations (6) and (7).

The number of cane or beet acres planted is assumed to be a function of expected sugar prices, the price of substitute crops, the price of inputs, a

trend variable, and lagged acres. The price of substitutes is measured with an index of prices received by farmers while the price of inputs is measured with an index of prices paid by farmers. Homogeneity of degree zero in prices is imposed in the beet and sugar acreage equations by normalizing prices using the inputs price index as a numeraire.

Quantity demanded (Q_t^d) was measured by deliveries from sugar refineries to industrial (food processors) and nonindustrial users. Explanatory variables included current sugar price, the weighted price of all corn sweeteners, personal disposable income, a trend variable, and lagged quantity demanded to account for habit formation and partial adjustment in food processing. Homogeneity of degree zero in prices and income was imposed by deflating prices and income by the consumer price index. The price of corn sweeteners (P_{ot}) was presumed to be a function of the current price of sugar, the price of corn, and a trend variable. The parameters of equations (6), (7), (11), and (12) were estimated via the iterative Zellner's seemingly unrelated procedure (IZEF), which yields estimates that are identical and computationally equivalent to maximum likelihood estimates, consistent, and asymptotically normal.

The estimated market parameters were used to estimate domestic consumer and producer surpluses in real terms. Producer surplus was computed according to equation (9), where expected yield was based on a linear trend. Consumer surplus was computed according to equation (13), utilizing the estimated parameters of equation (11) in deflated form. Following Just et al., producer surpluses in the production of high-fructose corn syrup types 42 and 55 percent fructose (HFCS42 and HFCS55) were measured by quasirent estimates (returns over variable costs) based on the work of Car-

man and Thor, and market data.⁹ A similar procedure was used to compute the quasirent of glucose and dextrose producers. The producer surpluses in the corn sweetener sector were then added up and deflated by the price of corn and entered as an argument of the policy equations.

To estimate the excess supply equation for exporting countries, their total exports were presumed to be a function of a blend price that accounts for both the U.S. and the world price, aggregate real gross domestic product of these countries (using the improved estimates of Summers and Heston), a trend variable, and lagged exports. The price used is the weighted sum of the U.S. and the world price, where the U.S. price weight is the share of the U.S. import quota on total exports of these countries. The blend price was deflated with the wholesale price index of nonoil developing countries published by the *International Monetary Fund*. All variables were converted to natural logarithms. The ordinary least squares results were then used to estimate exporting countries' surplus based on their excess supply functions and the blend price. Finally, the U.S. federal budget surplus was expressed as a percentage of GNP.

For the import quota and target price equations, all variables were expressed in *logarithms* except for the federal budget surplus because of the negative values associated with deficits. The target price was deflated with the index of prices paid by farmers. Since the aggregate import quota is a policy instrument to implement the target price set by Congress, the real target price was included as an argument in the quota equation. However, the endogeneity of the target price variable (via the target price equation) may result in biased and inconsistent estimates. To address this, the general instrumental variable estimator (GIVE), discussed by Harvey, is applied to

the target price (\bar{P}_t) by regressing it on the GNP deflator and time, and using the predicted value (\bar{P}_t^{iv}) as an instrumental variable.

The distributed lag models are estimated by assuming a first-degree (import quota) and second-degree (target price) polynomial on the lag coefficients. A five-year lag for the target price equation and a three-year lag for the import equation were specified because they provided the highest R^2 and the most significant coefficients. In addition, given the lack of degrees of freedom, endpoint constraints were imposed. Finally, the 1975-76 and 1980-81 observations for the target price and the 1975-81 observations for the import equation equations were excluded from the sample, because these policy instruments were not in effect in those years. The parameters of the target price equation were estimated correcting for first-order serial correlation using the Cochrane-Orcutt iterative technique.

Empirical Results

This section contains the results for the market and policy instrument equations. The computed welfare figures are not reported.

Domestic Market Parameters

The empirical results for acreage decisions, corn sweeteners price, and demand parameters are presented in Table 1. All the critical parameter estimates were significant at the 10% level and most were significant at the 5% level. The estimated short-run price elasticities of supply for cane and beet sugar were 0.231 and 0.479, respectively. The beet sugar own-price elasticity is comparable to the estimates of Gemmill (0.49) and Jesse (0.40). The own-price elasticity of cane sugar supply is less comparable with

previous studies. Gemmill estimated an average U.S. cane supply elasticity of 1.57 using cross-sectional data. Hammig et al. estimated a U.S. own-price elasticity of sugar supply of 0.03 and Jesse and Zepp estimated it at 0.10. The long-run own-price elasticities evaluated at mean data values are 0.579 and 1.201 for cane and beet sugar supplies, respectively.

The estimated short-run price elasticity of demand at mean data values is -0.111. The implied long-run price elasticity of demand is -.597. The price elasticities for the *equilibrium* demand (equation (12)) are -0.063 in the short run and -0.339 in the long run. These findings agree with those of previous studies. Carman and Thor estimated own-price elasticity of demand for *all* sweeteners at -0.05 in the short run and -0.27 in the long run. Lopez and Sepulveda estimated quarterly elasticity of -0.16 for nonindustrial use of sugar, and -0.15 and -0.04 for industrial use before and after the introduction of HFCS55. Gemmill estimated the demand price elasticity of -0.04 while George and King estimated it at -0.24. The estimated short-run and long-run income elasticities of demand are 0.092 and 0.494, respectively. The coefficient associated with lagged quantity demanded shows a low degree of partial adjustment ($0.186 = 1 - \hat{\alpha}_3$) among consumers and food processors. In the long run, demand becomes about five times more price elastic as consumers and food manufacturers adjust sugar use to desired levels, and as sugar substitutes and new processing formulas are developed.

In general, the results for the domestic sugar market parameters were reasonable. The results in Table 1 were used along with producer surplus from the corn sweetener market and sample data to compute domestic

producer and consumer surpluses.

Foreign-Countries Export Supply Parameters

The coefficient estimates of the export supply function of quota-holding countries are presented in Table 2. Except for gross domestic product, all the coefficients were significant at the 5% level. By taking into account quota rents in the computation of average price received, the blend price used incorporates the political variables of interest, i.e., the U.S. target price level and the level of aggregate import quota. The estimated price elasticity of exports by quota-holding countries was 0.050. The estimate used by Leu et al., which is based on the work of Hammig et al., is 2.37. A way to reconcile these estimates is to consider the different approach used in the present study; the highly politicized nature of the world sugar trade, in which unrestricted free trade accounts only for about 10 to 20% of total production but about 50 percent of total trade (Maskus); and that the estimate used by Leu et al. involves the rest of the world rather than quota-holding countries only. Similarly, Roe et al. argue that government intervention has resulted in low import price elasticity of demand in the international wheat and rice markets. Besides, low price elasticity of exports implies, under certain conditions, high-quantity flexibility of export price. This is consistent with the extreme volatility of sugar prices in world markets (Womach). The results in Table 2 and sample data were used to generate yearly observations on foreign countries' surplus (FS_t).

Target Price Results

The polynomial distributed lag results for the target price equation

are presented in Table 3. To test structural change up to and after 1974, a Chow-test was conducted because since that year the program has undergone more changes, including sporadic program suspensions, than in any period since 1934 (U.S. Department of Agriculture, 1984). The resultant F-test showed a strong to moderate structural change (significant at the 10% but not at the 5% level). Given the lack of degrees of freedom, the target price equation was augmented only by adding a slope shifter (D74). The coefficients associated with sugar producer surplus were the only ones not statistically significant at the 10% level.

The empirical results fail to show a significant statistical association between sugar producer surpluses (PS) and target price level choices. In addition to methodological shortcomings, multicollinearity, or lack of degrees of freedom, other reasons can explain this result. One is that the model does not take into account producers' lobbying efforts, which may be a primary force behind target prices. Another reason is that previous criteria for price support, based on parity prices, may have become inappropriate as a proxy for producers' welfare (Teigen). Finally, in the last decade, the sugar program has not involved the use of domestic marketing quotas. As a result, domestic sugar production is at record high, shifting supply and increasing production surplus. Understandably, a significant negative statistical association was found between corn sweetener producer surplus (PSCORN) and sugar target price levels. That is, Congress tends to set higher sugar target prices when the corn sweetener producers are worse off. Supporting the sugar price partially supports the price of corn to the extent of the corn sweeteners' share of the corn market.

A statistically significant association was found between consumers' sur-

plus (CS) and target-price levels. That is, Congress tends to set lower target prices when consumers and sweetener user manufacturers are worse off. Although consumers are not organized to lobby on target prices, sweetener users and manufacturers are. The positive relationship between target price and consumers' surplus may partially capture the parity principle applied in the past sugar target price decisions.

A statistically significant association was found between foreign countries' surplus (FS) and Congress' decisions on target-price levels. That is, as sugar export rents of quota-holding countries decline, Congress tends to set lower target prices. Although this may seem paradoxical, as stated by Leu et al., higher target prices are a mixed blessing. Although they increase the quota rents for a given quota size, they also expand domestic production (depending on U.S. supply response elasticity) and indirectly reduce the size of the quota. Thus, coupled with import decisions, it seems to be in the best interest of foreign countries to have lower target prices and increased access to the U.S. sugar market.

The sign associated with the federal budget surplus (BS), deficit if negative, is contrary to expectations because it implies that larger budget deficits lead to a higher target price. On the other hand, the intercept-shifter coefficient (D74) shows that target prices have been generally set lower in real terms after 1974. This may reflect the increasing challenge and criticism of the role of the U.S. sugar program (U.S. Department of Agriculture, 1985; Johnson) and the more recent platform to promote free markets.

Import Quota Results

The polynomial distributed lag results for the import quota equation are presented in Table 4. The signs of the coefficients associated with sugar producer surplus and consumer surplus are contrary to expectations. A Chow-test was conducted to test structural change up to and after 1974. The resultant F-test failed to indicate a significant structural change at the 5% level.

A possible explanation of the producer and consumer surplus signs is that the welfare sensitivity by the executive branches in setting import quotas may have been partially captured by the target price. Another is that if the amounts of money, time, and effort spent on campaign contributors, lobbying, advertising, and other political activities, increase with economic surpluses, then import quota levels may reflect this pressure rather than a pure response to welfare. However, the results for target prices did not show unexpected signs as in the import quota results. The results indicate that the U.S. government has been inclined to restrict imports when domestic sugar and corn sweetener producers are better off, *ceteris paribus*. Paradoxically, the results also show that the U.S. import quotas have been responsive to the interests of consumers and food-manufacturing industries that use sugar and corn sweeteners. Regarding consumers, it is obvious that they are not effectively represented in lobbying efforts. Sweetener-using manufacturers, however, have been organized by a lobbying group (Sweetener Users Association) to pressure the government to remove import quotas and reduce domestic sugar prices. Like the corn sweetener producers, food manufacturers who use sugar are more concerned with the price of sugar than with the import quota *per se*.

The empirical results suggest that the U.S. government has allowed more imports of sugar when quota-holding countries were worse off, but has restricted imports when these countries were faring better. This type of response may have changed after 1985 (postsample period), with the implementation of the "no-cost" mandate by which only the residual, after unrestricted domestic supply, is imported. Consistent with the conclusions of Leu et al., Maskus, and the recent no-cost-to-the-Treasury policy, the U.S. government has utilized import quotas as a substitute for policies requiring Treasury outlays depending on the federal budget balance. Thus, one could conclude that the implementation of the recent no-cost policy exclusively through restriction of sugar imports is, for the most part, a result of high federal budget deficit, such as at present. A quota response to the deficit attains two of Nuttall's governmental objectives simultaneously; it protects domestic producers' interests and reduces the burden on the Treasury by avoiding the direct use of subsidies.

The results also show that import quotas are effectively used to implement the target price. For an imported commodity, a target-price support level can be administered with import quota management as has been true with the implementation of the no-cost-to-the-Treasury mandate. An analogous case is the variable duties imposed by the European Community, in which target prices are coordinated with self-adjusting tariffs to support the EC target prices.

Concluding Comments

This article investigated the behavior of the U.S. government in setting

levels of domestic support prices and import quotas for sugar. A political-economic decision-making framework was developed based on the economic surpluses of pressure groups and the federal budget deficit.

Target-price decisions were found to be significantly linked to past consumers' surpluses, corn sweetener producer surpluses, and export quasirents of quota-holding countries. The data failed to show a significant linkage between domestic sugar producers' surplus and target prices. This may be explained by past use of parity prices in setting target prices which may not have permitted adequate representation of producers' welfare, the lack of domestic supply control in recent legislation, and the exclusion of lobbying efforts in the model. The results also show that in real terms, target prices have been lower than previous to 1974.

Import quota decisions were found to be significantly linked to producers' and consumers' surpluses, the export quasirents of quota-holding countries, the level of federal budget surplus (deficit), and the price objective set by Congress. The impact of federal budget deficits on quota decisions is clear. Restricting quotas is a convenient and politically expedient way of supporting domestic producers while minimizing federal Treasury outlays at the expense of domestic consumers and foreign nations.

An important issue concerns the short-run political horizon of sugar policymakers facing reelection. Although a sugar program may be effective in attaining the objectives of the policymakers or those of their constituents in the short run, in the long run, these policies involve a trade-off because of their inducement of technological and institutional changes. For example, high sugar prices have induced and will continue to induce the development and adoption of sugar substitutes, thus decreasing long-term demand for

sugar, and reducing imports. If the current trend continues, a zero-import situation may be attained in less than a decade. In that event, political choices would involve a direct trade-off among domestic interest groups as well as Treasury outlays. Finally, this article finds some evidence to reinforce the widespread view that decisions in the policy arena are as much a matter of larger political considerations as it is economics. Attesting to this view are the weak linkage found between domestic sugar producers' surpluses and target prices and the strong linkage between federal budget deficits and import quota choices.

Footnotes

- 1 Pressure groups shaping U.S. policymaking include domestic producers and processors of raw sugarcane and beets, domestic consumers, beet and cane, sugar refiners, producers of other sweeteners, corn producers, sugar users (food manufacturing), and foreign nations.
- 2 Three major modifications to the model of Riethmuller and Roe are introduced. First, it is assumed that the government is concerned with the overall budget balance, excluding contributions to other countries through international trade policy. In the case of sugar, for instance, the quota revenues resulting from the difference between the domestic and the world price are captured by exporting countries. Second, an index of welfare of foreign countries is incorporated to account for the lobbying efforts of the State Department and of foreign countries. Third, policy instrument levels are a function of *direct* economic surpluses measures rather than of exogenous variables embodied in producer and consumer surpluses.
- 3 Two weaknesses of the present approach should be cited. First, the approach does not explicitly account for the impact of political pressure and lobbying on policy decisions. There is no rent seeking in the model, i.e., government preferences are exogenous. Second, a free trade solution as in Kreuger's theoretical model is directly precluded.
- 4 A truly structural approach which includes all exogenous variables that are embedded in consumer and producer surpluses (prices, changes in technology, taste, and preferences, etc.) may not only result in a

highly nonlinear form, but it would also exacerbate the multicollinearity problem. A working assumption is to assume a linear relationship between the choices and the exogenous variables, as in the papers by Riethmuller and Roe and by Godek.

- 5 Equations (6) and (7) are expressed in double-log because, when the expected sugar price is zero, domestic sugar supply is presumed to be zero, which is not necessarily implied by a linear acreage response specification. Preliminary results with linear acreage responses revealed that A_t^c and A_t^b were large and positive at $P_t^* = 0$, which results in substantial overestimation of producer surpluses. Similarly, a linear mathematical form for demand is chosen over a double-log one because the latter is asymptotic toward the price axis, resulting in infinite consumer surplus, unless a truncation point is assumed.
- 6 Another way of dealing with the multimarket welfare concern is to utilize a total market sweetener demand curve. This approach has the advantage that when all sweeteners are converted to sweetness-equivalent units, the sweetener input can be viewed as a necessary input while at the same time measuring total consumer surplus. This approach was considered here, but it provided less satisfactory results than the equilibrium demand approach.
- 7 The target price was proxied with the loan rate used by the Commodity Credit Corporation (CCC) and for recent years, the Market Stabilization Price (MSP) was used. The MSP is the loan rate plus handling, transportation, and interest costs. The purpose of the recent intro-

duction of the MSP to monitor target prices is to avoid forfeitures of sugar to the CCC (Angelo). The market price was measured with the New York spot price Contract No. 12 (subsequently No. 14).

- 8 This technique yields consistent estimators of the rationally expected price provided the final equation is free of autocorrelation. The P_t^{reh} estimates were obtained by regressing current price on prices in the two previous periods, lagged cost of production, and lagged consumers' income. The Durbin-h statistic test failed to reject the null hypothesis of no autocorrelation at the 5% level.
- 9 This was necessary due to the lack of data and, in particular, few observations on high-fructose corn syrup prices and costs. Following Carman and Thor, per unit *direct* variable costs consist of No. 2 Yellow Corn, labor, enzymes, and energy. Carman's cost estimates are projected with price indexes for food manufacturing wages, chemicals, and utilities. Yields of byproducts per bushel of corn (corn gluten, feed, and oil) were obtained from *Connell Commodities* and their prices directly from USDA. The net costs of producing high fructose corn syrup types 42 and 55 were then computed by subtracting byproduct credits from the direct variable costs and adjusted on a dry basis. Quasirents were then estimated by multiplying the price-cost margin times total production of HFCS42 and HFCS55, respectively.

Table 1: Estimates of U.S. Sugar Market Parameters

Equation	Parameter	Variable	Coefficient	Standard Error
Cane Acreage	α_0	Intercept	1.800**	.738
	α_1	$\ln(P_t^*/D_t)$	.231*	.125
	α_2	$\ln(S_t^*/D_t)$	-.204*	.146
	α_3	$\ln(A_{t-1}^c)$	.601**	.116
	α_4	Time	.006*	.0035
Beet Acreage	β_0	Intercept	1.606*	.874
	β_1	$\ln(P_t^*/D_t)$	.479**	.150
	β_2	$\ln(S_t^*/D_t)$	-.411**	.169
	β_3	$\ln(A_{t-1}^b)$	.601**	.103
	β_4	Time	-.003	.002
Corn Sweeteners Price	π_0	Intercept	-9.282**	2.728
	π_1	P_t	.671**	.211
	π_2	$PCORN_t$	.310	2.166
	π_3	Time	.628**	.181
Demand	γ_0	Intercept	58077.800*	34650.060
	γ_1	P_t/CPI_t	-1570.533**	545.661
	γ_2	P_{ot}/CPI_t	1016.771**	.509.463
	γ_3	Q_{t-1}^D	.814**	.129
	γ_4	I_t/CPI_t	.017**	.062
	γ_5	Time	-1390.661	2433.614
Log of Likelihood			-304.518	

Note: D_t is an index for prices paid by farmers (1977=1); S_t^* is expected index of prices received by farmers (1977=1); CPI_t is the consumers' price index; I_t is consumers' disposable personal income; and $PCORN_t$ is the price of corn. All other variables are as defined in the text. An asterisk and double asterisks next to the estimated coefficient indicate significance at the 10 and 5% levels.

Table 2: Parameter Estimates for the Export-Supply Function of Quota-Holding Countries

Variable	Coefficient	Standard Error
Intercept	5.140**	2.083
Log of Average Price Received	.050**	.016
Log of Gross Domestic Product	-.091	.109
Log of Time	.609**	.171
Log of Lagged Exports	.550**	.275
R^2	.973	
F-ratio	228.525	
n	30	

Note: Sample years include 1959-85. Double asterisks indicate significance at the 5% level.

Table 3: Parameter Estimates for the Target Price Equation

Variable	Coefficient (Standard Error) in Lag						Sum Lag
	$\tau = 0$	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$	$\tau = 5$	
$PS_{t-\tau}$		-.006 (.013)	-.009 (.021)	-.010 (.024)	-.009 (.021)	-.006 (.013)	-.039 (.093)
$PSCORN_{t-\tau}$		-.020 (.010)	-.032 (.016)	-.036 (.017)	-.032 (.016)	-.020 (.010)	-.139 (.068)
$CS_{t-\tau}$		.092 (.020)	.147 (.032)	.166 (.036)	.147 (.032)	.092 (.020)	.645 (.139)
$FS_{t-\tau}$		.019 (.008)	.031 (.012)	.035 (.014)	.031 (.012)	.019 (.008)	.135 (.053)
$BS_{t-\tau}$		-3.079 (.388)	-4.927 (.621)	-5.543 (.699)	-4.927 (.621)	-3.079 (.388)	-21.556 (2.718)
$D74$	-.315 (.028)						
<hr/>							
$R^2 = .948$							
$F = 27.132$							
$\rho = .478$							
$DW = 2.059$							

Note: All variables are expressed in natural logarithms, except for $FS_{t-\tau}$, and $D74$, and are expressed in real terms. Sample includes 1963-85, except for 1975-76 and 1980-81 when there was no target price in effect.

Table 4: Parameter Estimates for the Import Quota Equation

Variable	Coefficient (Standard Error) in Lag				Sum Lag
	$\tau=0$	$\tau=1$	$\tau=2$	$\tau=3$	
$PS_{t-\tau}$		-.454 (.060)	-.303 (.040)	-.151 (.020)	-.908 .119
$PSCORN_{t-\tau}$		.049 (.040)	.033 (.027)	.016 (.013)	.0982 (.084)
$CS_{t-\tau}$		.501 (.076)	.334 (.051)	.167 (.025)	1.002 .152
$FS_{t-\tau}$		-.074 (.026)	-.049 (.017)	-.025 (.009)	-.148 (.052)
$BS_{t-\tau}$		6.689 (1.033)	4.460 (.689)	2.230 (.344)	13.379 (2.065)
\bar{P}_t^{iv}	-4.041 (1.017)				
<hr/>					
$R^2=.959$					
$F=46.77$					
$DW=1.540$					

Note: All variables are expressed in natural logarithms, except for $FS_{t-\tau}$. Sample includes 1960-85, except 1975-81, because there were no quotas in those years.

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