Economic Surpluses in the U.S. Sugar Market

Rigoberto A. Lopez

The objective of this article is to estimate historical economic surpluses for the subsectors involved in the U.S. sugar market. Annual producer and consumer surpluses were computed based on a five-equation model and 1958–87 data. In the last decade, the welfare position of cane- and beet-sugar producers has been roughly maintained, the domestic consumer surplus and the export quasi-rents to foreign countries have both declined, and quasi-rents of the corn-sweetener industry now surpass those that accrue to the cane industry and are about the same as those of the beet-sugar industry. Some policy implications are discussed.

For two centuries the U.S. sugar program has resulted in a substantial redistribution of income among market participants. Gains from the program have primarily accrued to U.S. beet- and cane-sugar farmers as well as producers of sugar substitutes. Losses from the program have been borne by U.S. consumers, the food-manufacturing industry, refineries that relied on foreign raw sugar, and possibly foreign sugar producers. Furthermore, high sugar prices in the U.S. have encouraged the development and adoption of sugar substitutes in food manufacturing, in particular high-fructose corn syrup, which has captured nearly half of the caloric-sweetener market since it was commercially introduced in the 1970s.

The implications of the U.S. sugar program go well beyond economics into domestic and foreign politics. Several studies have provided money estimates of the welfare implications from the U.S. sugar-policy program (Borrell, Sturgiss, and Wong; Leu, Schmitz, and Knutson; Dardis and Young). Much of this work has focused on the effects of the program on the U.S. sugar market, neglecting the U.S. corn-sweetener industry as well as the separate effects on beet- and cane-sugar producers or the effects on foreign producers.

The objective of this paper is to measure the economic surpluses of various subsectors affected by the U.S. sugar program, adding information on the welfare of beet- and cane-sugar producers, the corn-sweetener industry, sugar users, and foreign nations. Real-valued estimates are presented. Although the conceptual framework draws from the work of Lopez, an updated data set is used, several conceptual and empirical features are introduced, and the focus is on economic surpluses rather than government behavior. Also, given the numerous countries (approximately forty) from which the United States has imported sugar since the Cuban embargo, the focus is narrowed to the top eight quota holders. These are: Argentina, Australia, Brazil, Colombia, the Dominican Republic, Guatemala, Peru, and the Philippines. Since 1961, these countries have accounted for approximately 73% of the U.S. sugar imports and 27% of world exports, on average.

The U.S. Sugar Program

Ever since 1789, except for 1974–81, the U.S. government has intervened in the sugar market by setting import tariffs and domestic and import quotas, and by instituting price-support mechanisms. In 1974–81, the U.S. followed a period of relatively free trade after suspending the Sugar Act for the first time.

Although a variety of policy instruments have been used, the U.S. sugar policy program has mainly relied on the domestic target price and the import quota (Lopez). The target price (e.g., loan rate) is mandated and legislated by the U.S. Congress

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through Food Security Acts or special Sugar Acts. The import quota is usually set by the executive branch of the government, such as the U.S. Department of Agriculture, with inputs from the other branches. The importance of the import quotas in implementing the mandated price became even greater when the Food Security Act of 1985 directed the executive branch to run the program at "no cost" to the U.S. Treasury (Nuttall). This was implemented solely by restricting imports without any domestic supply control. Thus, the import quota effectively became the residual between the U.S. sugar and corn-sweetener supplies and sweetener demand at the mandated sugar price.

The controversy surrounding the U.S. sugar program increased as the quota dramatically decreased in recent years. Given the nature of government intervention, sugar imports declined in part because of a decline in U.S. sugar demand to record lows as all corn sweeteners captured nearly half of the caloric market by 1987 (Table 1). Domestic sugar production, on the other hand, was at a record high. Between 1982 and 1987, the total U.S. import quota was reduced by approximately 80% across exporting countries (Womach). The overall impact of the sugar program on the quota-holding countries has been shaped by recent volatile exchange rates and inflation in many of these countries, such as the Dominican Republic, the Philippines, and Brazil.

Domestically, the U.S. sugar program effects are mixed. The Northeast, for example, has a main stake in that it has the largest concentration of sugar consumers, a large base of food manufacturers who use sweeteners, and sugar refineries that rely on raw foreign sugar. Nonetheless, since 1980–81, the Northeast region went from near self-sufficiency in refined sugar to a 600,000-ton (raw) sugar deficit (about 43% of sugar use) in 1988 due to import restrictions (Barry, Angelo, Buzzanell, and Gray). Domestic beet sugar, which has covered the Northeastern sugar deficit, is produced in fourteen states, but mainly in California, Minnesota, North Dakota, and Idaho. Domestic cane sugar is produced in Florida (leading producer), Hawaii, Louisiana, Texas, and Puerto Rico.

Empirical Framework

For the purpose of this paper, market participants are classified into five groups: (1) U.S. producers of sugar beets, (2) cane-sugar producers, (3) corn-

Table 1. Trends in Market Shares and Prices in the U.S. Sugar Market

Year	Caloric Market Share of (%)			Ratio of Imported to Domestic Sugar	Ratio of U.S. to World Sugar Price
	Domestic Sugar	Corn Sweeteners	Imported Sugar		
1960	.460	.098	.442	.959	2.006
1970	.460	.148	.392	.852	2.152
1971	.452	.158	.389	.860	1.885
1972	.443	.161	.396	.894	1.223
1973	.451	.168	.381	.843	1.071
1974	.409	.185	.406	.994	0.984
1975	.444	.228	.328	.740	1.096
1976	.498	.224	.279	.561	1.149
1977	.451	.225	.324	.719	1.356
1978	.410	.257	.333	.812	1.781
1979	.405	.274	.321	.795	1.611
1980	.367	.292	.341	.930	1.038
1981	.388	.329	.283	.730	1.165
1982	.405	.387	.208	.513	2.366
1983	.375	.410	.215	.572	2.596
1984	.359	.422	.218	.608	4.197
1985	.351	.476	.173	.494	5.035
1986	.375	.491	.133	.355	3.463
1987	.424	.485	.090	.211	3.252

Note: Total caloric market is defined as the sum of domestic sugar production plus corn-sweetener consumption plus sugar imports. Thus, it excludes minor caloric sweeteners (honey and edible syrups) and changes in inventories.
Source: Adapted from *Sugar and Sweetener Situation and Outlook Report.*

sweetener producers,[1] (4) domestic consumers, and (5) the top eight U.S. sugar-quota-holding countries. Thus, markets for other minor caloric and noncaloric sweeteners, as well as the rest of the world not trading with the U.S., are excluded.[2]

U.S. Sugar-Producer Quasi-Rents

Two elements are important in measuring U.S. sugar producer surplus or quasi-rents. One is that sugar has traditionally been supported by a loan rate that effectively establishes a floor price. Another is that weather is an important supply shifter. Jesse and Zepp noted that beet and sugar-cane yields are predominantly determined by weather. However, variable costs, which are primarily linked to the area planted, are incurred in an ex ante fashion.

An econometric model of U.S. sugar supply response in beet and cane production is depicted as follows:

$$(1) \qquad P_t^* = \max\{\bar{P}_t, P_t^e\},$$

$$(2) \qquad \ln A_t^i = \beta_{0i} + \beta_{1i}\ln P_t^* + \sum_{j=2}^{n_i}\beta_{ji}\ln Z_{jt}^i + U_{it},$$

$$(3) \qquad Y_t^i = \hat{Y}_t^i\theta_t^i,$$

$$(4) \qquad Q_t^S = \sum_i A_t^i Y_t^i,$$

where P_t^* denotes the expected price of sugar, $\bar{P}_t$ is the Congress-legislated support price, and P_t^e is the expected market price of sugar. In other words, equation (1) states that the expected price of sugar is bounded from below by the Congress-legislated support price. However, the expected market price may exceed the support price. For example, during the years 1974–75 and 1980–81 there was no need to set up a support price as the world price well exceeded historical levels of U.S. sugar support prices.

Supply is modeled as a supply response consisting of acreage decisions and yields. It is further presumed that acreage (A_t^i, i = cane or beet) is controllable by the farmers though yields are exogenously determined because weather is not controllable or predictable. Acreage decisions are depicted by equation (2) and are expressed in logarithmic form. The logarithmic form was chosen because it forces the zero-price point to correspond with zero acreage, excluding the possibility of positive acreage with a zero price for sugar (i.e., a linear form with a negative price intercept). An alternative would be to truncate the acreage function at a threshold price that would correspond to the minimum average variable cost of the most-efficient farmer or to use a linear equation suppressing the constant term. The vector Z^i denotes other nonsugar price exogenous factors that affect acreage decisions for beet or cane (i.e., shifters of the respective supply curves).

Equation (3) depicts yields as determined by weather (θ_t). Thus, θ is a weather parameter that equals 1 for normal or average weather. It is greater than 1 for good weather and less than 1 for less-favorable weather.[3] $\hat{Y}_t$ denotes the normal or mean yields. Finally, equation (4) is an identity that states that the quantity of sugar supplied is the product of area planted times yield per unit of area.

Since acreage is partially determined by expected or anticipated prices but yields are determined by unanticipated weather, the resultant actual producer's surplus or quasi-rent incorporates both elements. However, one must distinguish between actual and expected producer surpluses. As a working assumption, assume that farmers use $\theta_t = 1$ (normal weather) for planning purposes when deciding to allocate variable inputs.[4]

Actual revenues are denoted as $R_t = P_t Q_t$, while expected sugar revenues are given by $R_T^* = P_t^* A_t \hat{Y}_t$. Their difference gives rise to unexpected revenues. Holding the elements in Z constant, total variable costs can be expressed as the expected sugar revenues minus the expected producer surplus obtained by $R_t^* - PS_t^*$. The expected producer surplus can be estimated by taking the antilog of (2), multiplying it by yields under normal weather

[1] An important assumption is that corn producers have not been affected by the U.S. sugar program and, hence, are not included in the analysis. Thus, one is implicitly assuming that the supply of corn is perfectly elastic to corn-sweetener producers.

[2] This paper deals with the perspective of the U.S. sugar program. Sugar policies followed by the European Community (EC) have also been singled out as important in distorting world markets and the welfare of developing countries (Valdes and Zeitz). In fact, nearly universal government intervention in the sugar market has been an effective argument against a unilateral abandonment of the U.S. sugar program.

[3] An empirical definition of such weather variables is provided by the Stallings' index, obtained as the ratio of actual to predicted yields based on a linear trend. Although this index is not based on direct weather variables such as rainfall or temperature, it may capture weather components as well as pests and diseases (Stallings).

[4] Since variable costs (except for harvesting decisions) are incurred in *an ante* fashion, while receipts are realized in an ex post fashion, several possibilities arise. (1) Price and weather are exactly anticipated, and expected producer surplus equals actual producer surplus. (2) Price is exactly anticipated ($P_t^* = P_t$) but weather is abnormal ($\theta_t \neq 1$). In a protected market environment good weather leads to greater quasi-rents (complemented with lower level of imports) and vice versa. In a free-market environment the weather effects would be partially compensated with market or price effects. (3) Weather is exactly anticipated ($\theta_t = 1$) but price is not ($P_t^* \neq P_t$). Greater-than-expected price (e.g., extreme world shortage of sugar) would result in higher-than-expected quasi-rents under inelastic demand for sugar. (4) Neither weather nor price is exactly anticipated.

($\hat{Y}_t^i$), and integrating over P_t^*. The resultant expression for producer surplus can be written as

$$(5) \quad PS_t^{i*} = \exp\{\ln\hat{Y}_t^i - \ln(\beta_{1i} + 1) + \beta_{0i} + (\beta_{1i} + 1)\ln P_t^* + \sum_{j=2}^{n_i}\beta_{ji}\ln Z_{jt}^i\},$$

where exp is the exponential operator and all variables are as defined above. Actual producer surplus can then be expressed as actual revenues minus variable cost.

Corn-Sweetener Quasi-Rents

Due to lack of data, the quasi-rents that accrue to corn-sweetener producers were computed based on a simplified economic-engineering approach rather than an econometrically based approach. Following Just, Hueth, and Schmitz, quasi-rents from corn-sweetener production can be estimated as gross revenues minus total variable costs. Four corn-sweetener products are of interest here: (1) glucose, (2) dextrose, (3) high-fructose corn syrup type 42 (HFCS42), and (4) high-fructose corn syrup type 55 (HFCS55).

Corn-sweetener production roughly consists of two steps. In the first step, corn is broken down into gluten, feed, oil, and starch. In the second step, corn starch is converted into a corn sweetener of interest. Following Carman and Thor, the direct variable costs for producing corn sweeteners consist of No. 2 yellow corn (X_1), labor (X_2), enzymes (X_3), and energy (X_4). Although corn sweeteners are the products of interest, there are three important byproducts: corn gluten (Y_1), feed (Y_2), and oil (Y_3). Let Q denote the amount of corn sweetener of interest. It is presumed that production technology is characterized by fixed proportions between outputs and inputs and between outputs and byproducts so that $a_i = X_i/Q$ ($i = 1, \ldots, 4$) and $b_j = Y_j/Q$ ($j = 1, 2, 3$). Denote total variable cost as

$$(6) \quad TVC = \sum_{i=1}^{4} w_i X_i - \sum_{j=1}^{3} P_j Y_j,$$

where w_i and P_j are input and byproduct prices, respectively.[5] Dividing by total production of corn sweetener, the average variable cost can be expressed as

$$(7) \quad AVC = \frac{TVC}{Q} = \sum_{i=1}^{4} a_i w_i - \sum_{j=1}^{3} b_j P_j.$$

Then, the price-average cost margin for each type of corn sweetener can be multiplied by total production to obtain quasi-rents. Summing quasi-rents across types of corn sweeteners, one obtains quasi-rents that accrue to the corn-sweetener subsector.

Consumer Surplus

Most U.S. sugar consumption occurs via consumption of food-manufactured goods. The total derived demand for sugar can be denoted as

$$(8) \quad Q_t^d = \tau_0 + \tau_1 P_t + \sum_{i=2}^{m}\tau_i Z_{it}^d + U_{dt},$$

where Z^d is a vector of exogenous variables, τ parameters, and U_{dt} random disturbances. A linear mathematical form for demand is chosen over a double-log form because the latter is asymptotic toward the price axis, theoretically resulting in infinite consumer surplus. An alternative would be to assume a double-log function with a truncation point at some arbitrarily high price.

A major issue in measuring consumer surplus in a partial-equilibrium framework is that the sugar price affects several markets; that is, there is a feedback between the price of sugar and the price of its close substitutes—in particular, corn sweeteners. The price of corn sweeteners is partially pegged to the price of sugar. This not only introduces multicollinearity problems but also results in inappropriate measurement of consumer surplus if measured along a demand curve that assumes all other prices remain constant as the sugar price changes (Leu et al.).

A plausible alternative, pointed out by Just et al., is to utilize an equilibrium demand for sugar that takes into account the feedback from substitute markets. To utilize this approach, consider the following relationship between corn-sweetener price and the price of sugar:

$$(9) \quad Z_{2t}^{d*} = \pi_0 + \pi_1 P_t + \sum_{i=2}^{n}\pi_i Z_{it}^0,$$

where Z_{2t}^d is the price of corn sweeteners, P_t the price of sugar, and π denotes unknown parameters. Thus, in a sense, equation (9) is an approximation to a reduced form for the price of corn sweeteners. Substituting (9) into (8) results in

$$(10) \quad Q_t^d = \tau_0^* + \tau_1^* P_t + \sum_{i=2}^{n}\pi_i^* Z_{it}^0$$

[5] In this specification, byproduct sales are treated as reducing the cost of producing corn sweeteners. Consistent with this, government and private-firm reports often refer to the "net cost" of corn (after subtracting byproduct credits from the price of corn) when presenting production costs for corn sweeteners.

$$+ \sum_{i=3}^{m} \tau_i Z_{it}^d + U_{dt},$$

where $\tau_0^* = \tau_0 + \tau_2\pi_0$, $\tau_1^* = \tau_1 + \tau_2\pi_1$, and $\pi_i^* = \tau_2\pi_i$. Note that $\tau_1 < 0$, $\tau_2 > 0$, and $\pi_1 > 0$. The equilibrium demand is less responsive to sugar price since $|\tau_1| > |\tau_1 + \tau_2\pi_1|$ because a price increase (decrease) will cause an outward (inward) shift of demand counteracting the effect of a sugar-price change. Based on (10), consumer surplus is given by

$$(11) \quad CS_t = \left[.5(Q_t^d)^2 - Q_t^d(\tau_0^* + \sum_{i=2}^{n} \pi_i^* Z_{it}^0 + \sum_{i=2}^{m} \tau_i Z_{it}^d) \right] / \tau_1^* - P_t Q_t^d.$$

Quasi-Rents of Quota-Holding Countries

Quasi-rents from sugar exports that accrue to U.S. sugar-quota-holding countries have two sources: exports to the United States under the U.S. sugar policy program (import quota, U.S. price, and fees) and exports to the rest of the world. As the U.S. import quota is usually fulfilled, the marginal (incentive) price for exports is the world price. Thus, the export equation for quota-holding countries is expressed as

$$(12) \quad \ln X_t^f = \psi_0 + \psi_1 \ln P_t^w + \sum_{i=2}^{k} \psi_i \ln Z_{it}^f + U_{ft},$$

where X^f is total exports, P^w is the world price, and Z_i^f is a vector of other relevant variables. The quasi-rents can then be expressed as

$$(13) \quad PS_t^f = PS(P_t^w, Z_i^f) + (P_t - P_t^w)M_t^0,$$

where the first term denotes quasi-rents based on (12) and the world price, while the second term denotes scarcity rents from exports to the U.S. under an import quota (M_t^0).

Data and Estimation

Annual data for the1955–87 period were collected from governmental reports, including *Sugar and Sweetener Outlook and Situation Report* (U.S. Department of Agriculture), *Statistical Abstract of the United States* (U.S. Department of Commerce), *U.S. Agricultural Statistics*, and reports by the Foreign Agricultural Service. Other data sources included *International Financial Statistics* reports.

To operationalize equation (1), the expected market price, P_t^e, was estimated with instrumental variables using lagged prices, predicted cost of production, and predicted consumer's income as instruments,[6] where the latter two were estimated by first-order autoregression forecasts. Expected price was either the support price ($\bar{P}_t$) or the estimated P_t^e, depending on which one was higher.

Area of sugar cane or sugar beet plantings in equation (2) was presumed to be a function of expected sugar price, a price index of substitute crops, a price index of inputs, a trend variable, and lagged acres. The latter four define the vector Z^i. All prices were deflated with the input price index. To estimate equation (9), a price of corn sweetener was measured as a weighted average of the prices of sucrose and dextrose (HFCS42 and HFCS55), where the weights were their share of total corn-sweetener consumption.[7] Corn-sweetener price was then presumed to be a function of the price of sugar, the price of corn, and a time variable.

Quantity demanded in equation (8) was presumed to be a function of the price of sugar, the price of corn sweeteners, personal disposable income, a trend variable, and lagged quantity demanded. Prices and income were divided by the implicit gross domestic product (GDP) deflator for consumption expenditures.

To estimate the excess-supply function for quota-holding countries (12), their total exports were presumed to be a function of the world price, GDP of these countries, a trend variable, and lagged exports. The model was operationalized treating the top eight quota holders in the post-1960 period as one region. A weighted exchange rate and GDP price deflator indexes were computed for eight sugar-quota-holding countries, using as weights their sugar-export shares. These indexes were used to express the world-price domestic-currency equivalents, and both the world price and aggregate GDP were deflated by the weighted GDP price deflator.

The parameters of equations (2), (8), (9), and (12) were estimated via the iterative Zellner's seemingly unrelated procedure (IZEF), which yields

[6] This price-expectation specification can be used as a proxy for an expected price under a Rational Expectation Hypothesis regime (see McCallum). Other price-expectation specifications based on past prices were attempted but yielded less-satisfactory results. The alternative specifications included a Cobweb (lagged price) and a second-order autoregressive regime.

[7] HFCS42 was first introduced in 1967 while HFCS55 was introduced in the mid-'70s. Although their corn-sweetener market shares were zero previous to their introduction, sucrose and dextrose had positive shares throughout the sample period. Due to missing data, the price of HFCS42 was forecasted for the 1967–74 period based on the U.S. sugar price, corn price, dextrose price, and a time variable.

estimates that are identical and computationally equivalent to maximum-likelihood estimates. The estimated parameters were used to compute economic surpluses for U.S. cane- and beet-sugar producers, quasi-rents to quota-holding countries' exports, and U.S. consumer surpluses.

Carman and Thor's variable cost estimates per item in equation (7), $a_i w_i$, were computed by extrapolating input prices (w_i) with No. 2 corn price (w_1), food-manufacturing wages (w_2), a price index for chemicals (w_3), and the price of petroleum as a proxy of energy price (w_4). Yields of byproducts (b_j) were obtained from *Connell Commodities* and their prices from the U.S. Department of Agriculture. Thus, different average variable costs estimates were computed for HFCS42, HFCS55, sucrose, and dextrose. The price-average variable-cost differential and total production of each type of corn sweetener were used to compute aggregate quasi-rents of the corn-sweetener industry.

Results and Discussion

Sugar-Market Parameters

The empirical parameter estimates for the acreages, corn-sweetener price, sugar demand, and foreign supply equations are presented in Table 2. All critical parameters were significant at the 10% level, and most were significant at the 5% level. Furthermore, the estimated parameters are consistent with previous findings (e.g., Gemmill; Leu et al.; Carman and Thor). Thus, the estimated sugar-market parameters appeared to be reasonable and were used for estimating economic surpluses in the U.S. sugar market.

The estimated short-run, own-price elasticities of U.S. cane- and beet-sugar supply were 0.103 and 0.246, respectively. The long-run estimates were 0.254 and 0.354, respectively. The price elasticity of export supply by quota-holding countries

Table 2. Estimates of Sugar-Market Parameters

Equation	Parameter	Variable	Coefficient	Standard Error
Cane acreage	α_0	Intercept	2.194**	0.651
	α_1	$\ln(P_t^*/D_t)$	0.103*	0.053
	α_2	$\ln(S_t^*/D_t)$	−0.167	0.132
	α_3	$\ln(A_{t-1}^c)$	0.595**	0.112
	α_4	Time	0.006*	0.003
Beet acreage	β_0	Intercept	4.330**	0.654
	β_1	$\ln(P_t^*/D_t)$	0.246**	0.055
	β_2	$\ln(S_t^*/D_t)$	−0.538**	0.144
	β_3	$\ln(Ab_{t-1})$	0.305**	0.094
	β_4	Time	−0.003	0.003
Corn-sweeteners price	π_0	Intercept	−9.539**	2.519
	π_1	P_t	0.738**	0.146
	π_2	$PSCORN_t$	−0.108	1.215
	π_3	Time	0.641**	0.132
Demand	τ_0	Intercept	93956.49**	31583.26
	τ_1	P_t/D_{2t}	−929.426**	272.809
	τ_2	P_{0t}/D_{2t}	789.752**	265.692
	τ_3	Qd_{t-1}	0.597**	0.108
	τ_4	I_t/D_{2t}	0.003	0.031
	τ_5	Time	−2709.188	2132.012
Foreign supply	ψ_0	Intercept	1.460	1.322
	ψ_1	$\ln(P_t^f/D_{3t})$	0.044	0.033
	ψ_2	$\ln(GDP_t)$	−0.020	0.033
	ψ_3	$\ln(X_{t-1})$	0.864**	0.141
	ψ_4	$\ln(Time)$	0.090	0.129

Notes: D_{it} denotes respective price deflators defined in the text (1987 = 1); S_t^* is expected index of prices received by farmers; and $PSCORN_t$ is a weighted price index for corn sweeteners. All other variables are as defined in the text. One and two asterisks next to the estimated coefficient indicate significance at the 10% and 5% levels, respectively. Results are based on 30 observations (1958–87).

was 0.035, which is quite low but somewhat consistent with a lack of price responsiveness in the presence of government intervention (Roe, Shane, and Vo). Finally, the estimated short- and long-run own-price elasticity of demand, evaluated at mean data values, were −0.141 and −0.412, respectively. The corresponding equilibrium demand values were −0.061 and −0.178, respectively.

Of interest here is the significant degree of association between the weighted corn-sweetener's price and the U.S. sugar price. It indicates that the price of sugar strongly affects this price, underlying a price-umbrella effect of the sugar price. If the price of sugar increases, the price of corn sweeteners increases, causing an outward shift of the sugar demand curve. The opposite would occur with a sugar price decline.

Economic Surpluses

The econometric results in Table 2, the sample data, and the corn-sweetener quasi-rent estimation method presented above were used to compute economic surpluses in nominal dollar values. The welfare estimates for U.S. groups were deflated by the U.S. GDP price deflator (1987 = 1.0). The quasi-rents for the top eight quota-holding countries were multiplied by a weighted dollar exchange rate index and divided by a weighted GDP price deflator index (1987 = 1.0). The results are presented in Table 3.

The results in Table 3 show that U.S. cane- and beet-sugar producers have managed to maintain their quasi-rents at levels comparable to the late '70s in spite of declines in U.S. sugar consumption. It is clear that 1974 represented windfall and unprecedented gains for the sugar-producing groups, both in the U.S. and in the quota-holding countries. The quasi-rents attributable to corn sweeteners have increased fivefold since 1960 as a consequence of increased market share. Furthermore, their quasi-rents are comparable to those of either cane- or beet-sugar producers. As in sugar production, they have also benefited from higher sugar prices, especially in 1974, 1975, and 1980. Since the sugar program was reinstated in 1982, cane-sugar producers have experienced a modest decline in quasi-rents, while quasi-rents to beet-sugar producers increased. This is likely due to increased supplies of beet sugar to cover the Northeastern region's deficit created by the decline of raw foreign sugar imports that had previously been refined in the region for its own needs.

The consumer-surplus figures indicate a steady decline since 1981, after which sugar import quotas

Table 3. Economic Surpluses in the U.S. Sugar Market

Year	U.S. Producer Surplus for			U.S. Consumer Surplus	Quota-Holding Countries	
	Cane Sugar	Beet Sugar	Corn Sweeteners		Scarcity Rents	Quasi-Rents
	1987 U.S. Dollars (Millions)				1987 Currency (Millions)	
1960	2,812	870	358	53,529	387	1,118
1970	1,960	1,143	619	63,200	879	2,052
1971	1,677	1,365	683	65,252	828	2,158
1972	1,823	1,044	424	69,038	310	3,643
1973	1,601	2,092	671	71,966	103	2,857
1974*	5,389	5,530	1,213	64,205	0	7,644
1975*	2,978	1,070	1,441	63,662	150	5,713
1976	1,476	952	999	54,087	162	2,766
1977	1,110	1,237	801	61,219	374	1,974
1978	1,420	1,235	738	61,901	509	2,409
1979	1,445	1,417	845	61,360	472	2,366
1980*	2,559	2,172	1,528	55,674	68	4,825
1981	1,553	1,337	1,465	56,346	205	2,845
1982	1,504	1,305	1,175	52,099	365	1,687
1983	1,434	1,278	1,246	45,570	553	2,024
1984	1,462	1,260	1,434	45,049	830	1,711
1985	1,266	1,224	1,370	43,861	705	1,513
1986	1,357	1,189	1,660	41,275	417	1,379
1987	1,356	1,610	1,589	42,594	218	1,093

Notes: An asterisk denotes years of abnormally high world sugar prices. The quota-holding countries included in the estimation are Argentina, Australia, Brazil, Colombia, the Dominican Republic, Guatemala, Peru, and the Philippines.

were reinstated. This decline could also be due to the exclusion of imports of sugar-containing manufactured products in the period of analysis. In the 1980s, the imports of manufacturing products containing sugar gained market share, possibly due to favorable exchange rates, changes in consumer preferences, and access to favorable sugar prices by foreign manufacturers. Jabara notes, for example, that since 1982 imports of miscellaneous sugar-containing products (sugar blends, mixtures, confectionery, bakery, and edible preparations) have increased over 150% in volume and by over 120% in value.

For the peak year, 1973, consumer surplus was estimated at approximately $7.2 billion (1987 dollars) or $342 per capita, while the 1987 consumer surplus was estimated at approximately $42.6 billion or $125 per capita. There is a possibility that U.S. consumer preferences may have shifted away from sugar and caloric sweeteners in general (Lopez and Sepulveda). If this is the case, a lower measured consumer surplus may not indicate a loss in consumer welfare or happiness. In fact, the consumer-surplus method may become inappropriate as an index of welfare when consumer preferences change significantly. If consumers' preferences remain unchanged, the decline in consumer surplus may reflect declines in quasi-rents to domestic food manufacturers who have lost market shares due to increasing imports of sugar-containing products. The later argument seems plausible and is consistent with the arguments presented by Jabara and Barry et al.[8]

The level of quasi-rents that accrues to quota-holding countries has fallen to pre-Cuban embargo levels. These results underline the importance of scarcity rents (U.S./world price differential times imports) in determining the quasi-rents of these countries. The 1976–79 period corresponds to relatively higher quasi-rents, which is precisely when the U.S. was following a period of relatively unrestricted sugar imports and world prices were at moderate levels. In real terms, 1974 corresponds to a peak historical level of quasi-rents in that year of sugar shortage and abnormally high world prices.

Quasi-rents to exporting countries have steadily declined after 1981, when a sugar program restricting imports was reinstated. The period of the "no cost to the Treasury" sugar policy (1985–87) has had an adverse effect on sugar exporters as their quasi-rents fell to historical record lows, with 1987 showing the lowest level of quasi-rents. Since these figures include the effects of exchange rates and foreign price inflation, they are affected also by volatile exchange rates and hyperinflation in most of the eight sugar-exporting countries considered.

Concluding Remarks

The findings of this article show that in spite of drastic declines in the United States' demand for sugar, the welfare positions of cane- and beet-sugar producers have been roughly maintained at the same levels in the last decades. The producer surplus that accrues to corn-sweetener producers has increased several times over, mainly because of the introduction of high-fructose corn syrup in the 1970s. Further, the quasi-rents of corn-sweetener producers are now comparable to those of cane- or beet-sugar producers. Thus, it is not surprising that they are active in sugar-policy lobbying, along with U.S. sugar producers.

The computed aggregate consumer surplus steadily declined in the 1980s. Since figures included U.S. food manufacturing use but did not consider imports of sugar-containing manufacturing products, part of the decline may be due to increased imports of these products in the 1980s, resulting in a loss of quasi-rents to domestic food manufacturers. The quasi-rents from sugar exports of quota-holding countries declined after severe cuts in the import quota in the 1980s. The post-1981 sugar program benefited beet-sugar producers because they increased production to cover the Northeastern region's deficit of sugar which was created by the decline of raw foreign sugar that has historically been refined in the region for its own needs.

In the 1990s two institutional arrangements will play a major role in shaping U.S. sugar policy and, hence, in repositioning economic surpluses in the sugar market. These are: (1) the 1990 Farm Bill, which Congress will soon consider, and (2) the Uruguayan Round of negotiations under GATT, scheduled to conclude in December 1990.

The 1990 farm legislation presents formidable challenges to sugar policymakers because, without considering direct government outlays, options involve a trade-off between the welfare of domestic sweetener producers (including the corn-sweetener industry) and that of domestic consumers, food manufacturers, and refineries that rely on foreign sugar. A major issue is whether or not the sugar program is sustainable. If domestic production continues to outpace consumption of sugar, then the

[8] The consumer-surplus measurement method used takes into account sugar and its corn-sweetener substitutes. An alternative approach would be to estimate an aggregate caloric sweetener's demand and estimate consumer surplus based on some weighted price. This approach may yield quite different results.

U.S. could eventually become self-sufficient. This implies that one can no longer resort to the import quota to support the domestic price, possibly requiring budgetary outlays and/or domestic supply control. Also, high sugar prices will continue to stimulate the development and use of new sweeteners, some of which are pending approval or are at a development or market-test stage. Thus, it is conceivable that domestic sugar consumption could be further displaced as happened in the 1970s with the introduction of high-fructose corn syrup.

In June 1989 the GATT Council declared that the U.S. import quotas were in violation of GATT rules. The ultimate goal of GATT, however, is to gradually remove all trade distortions. The United States, a keen supporter of this position, would have to phase out the sugar program to comply with GATT. The implementation of such a proposal would undoubtedly hurt domestic sweetener producers and benefit consumers and food manufacturers. The Northeast, especially, stands to gain if trade barriers are removed. The effects across quota-holding countries, however, would be mixed. Historically, the United States has paid a premium (the U.S.) price to quota holders, and the quota has been allocated on a political, rather than on a competitive, basis. Thus, countries favored in the past through preferential quota allocations could lose quasi-rents because they would have to compete in the open market and receive the world price for their exports.

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