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WORKING PAPER NO. 381

GAINS AND LOSSES OF SUGAR PROGRAM POLICY OPTIONS

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Since the 1930s, U. S. sugar producers have been protected by government programs designed to insulate the domestic sugar market from world forces of supply and demand. The intervention of government in the domestic sugar market has had the effect of redistributing income among interest groups in a manner different than that resulting from the interaction of free economic market forces.

In establishing a framework for industry protection, politically motivated rent-seeking activities emerge as an important part of the industry. In sugar, the initial rent seekers were the producers, importers, and refiners. However, with domestic sugar prices maintained at a level substantially in excess of world prices, economic incentives exist whereby other interest groups attempt to participate in, avoid, or share the economic rents engendered by sugar policy. These other interest groups include producers and users of sugar substitutes--corn producers, corn sweetener manufacturers, noncaloric sweetener manufacturers, sweetener containing food product manufacturers (sugar users), and consumers.

The success of sugar substitute producers and users in capturing about 40 pecent of the total sweetener market by 1984 has put a new set of economic and political rent-seeking forces in motion. The economic interests in sugar policy have become realigned. In the process, questions of the need for a new approach to sugar policy are being raised.

The purpose of this article is to provide a quantitative insight into the distribution of costs and benefits associated with various sugar policy options. In the process, inferences can be drawn for the positions of each of

the major sugar policy interest groups. By contrast with previous analyses of this type, explicit consideration is given to shifts in sugar demand resulting from the substitution of corn sweeteners for sugar. In the analysis, three general policy options were considered: the program prevailing in 1983 involving a sugar price support achieved primarily by the imposition of import quotas, a tariff substituted for the quota, and a target price (deficiency payment) substituted for the quota.

Analytical Framework

The supply and demand model used as a framework for the study is given in Figure 1. The supply and demand schedule in the United States is S_0 and D_0. Assuming the excess supply curve is completely elastic, the free trade price is P_0 and imports are $Q^{sf}Q_0^{df}$. However, under a quota program, domestic price is P_1 and imports are $Q^{s}Q_0^{d}$. If the increase in the price of sugar due to the quota does not result in a shift to other sweeteners (e.g., corn sweeteners), the net cost of the quota is cabd. The distance between P_0 and P_1 is the quota price premium.

If instead of a quota a tariff were in place, the tariff policy would have cost domestic consumers P_0abP_1 and benefited domestic producers P_0cdP_1 while the tariff revenue would have been febd. The net cost of the tariff policy would have been cfd + eab--a much smaller societal cost than that imposed by a quota. The equivalent quota policy would have the same effects on domestic consumers and producers except that foreign exporters are the recipients of the tariff equivalent revenue or quota rent.

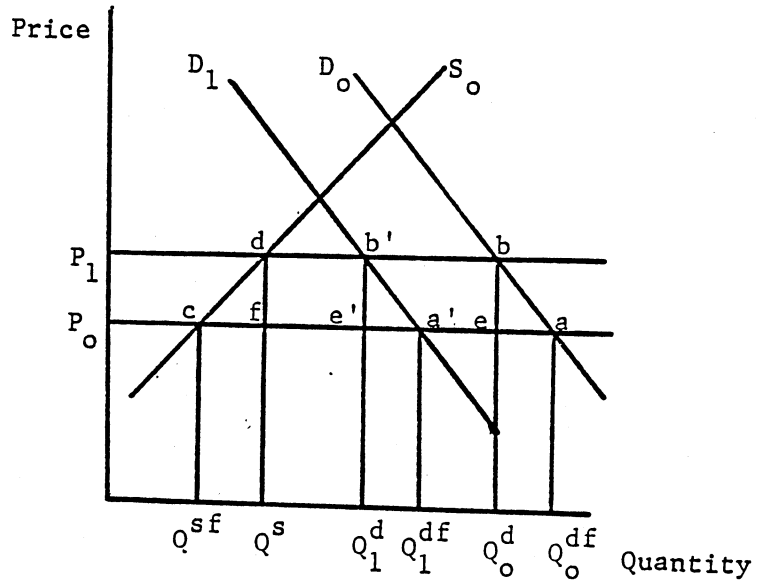

Figure 1. Effects of sugar programs

If a deficiency payment program were used to replace a quota policy and producer price were maintained at P_1, the deficiency payment program would cost the Treasury or taxpayers P_0fdP_1. Consumers would benefit by P_0abP_1 and there would be a net gain of fabd as compared to a quota policy.

The quota, which is a hidden subsidy to producers, is by far the most costly program to pursue even though the Treasury does not directly subsidize the industry. To protect domestic producers by the amount P_0cdP_1, the net cost is cabd. On the other hand, a deficiency payment which protects producers by the same amount only results in a loss of cdf. This is because with the quota the price to the user is kept at P_1 whereas with the deficiency payment the price to the users is P_0 (the world price).

The demand for sugar is a function not only of sugar prices but also of other variables including the price of corn. As a result of the price of sugar being kept above the free market equilibrium by the quota, in the 1960s and 1970s there was a marked shift to corn sweetener substitutes (mainly high fructose corn syrup, HFCS). Accordingly, the sugar demand curve in the United States has shifted leftward over a period of years and is ultimately represented by D_1. The loss in consumers' surplus in the sugar market is reduced from P_0abP_1 to $P_0a'b'P_1$; the quota rent is also reduced from febd to fe'b'd. In order to illustrate the substitution that has occurred, the empirical section gives welfare estimates for two periods of time, 1963 and 1983.

An important aspect of the model owing to this substitution in demand is the value of sugar exports to the United States and how in a dynamic context these change. At free trade, the value of exports is $Q^{sf}Q_0^{df}ac$ while with a quota and no substitution effect the export value is $Q^sQ_0^dbd$. The value of exports actually increased under a quota. This result is theoretically

possible since there exists a positive quota where, if no quota premiums are paid by exporters (as in the case in sugar), the value of exports is greater with a quota than under free trade (Allen, Dodge, and Schmitz). However, owing to the substitution effect toward increased use of corn sweeteners, the value of exports falls below the free trade level (i.e., $Q^{sf}Q_0^{df}ac > Q_sQ_1^{d}b'd$). In this model, if U. S. producers are to be protected so that price P_1 can be maintained, the sugar exporters would prefer a U. S. producer deficiency payment rather than a quota because the former would allow users to pay price P_0 and, hence, demand would remain at D_0; the quota raises the price to P_1 and causes demand to shift to D_1.

Empirical Results

Demand for Refined Sugar

The per capita annual consumption of sugar in the United States had remained quite stable at an average of nearly 100 pounds refined before 1974 but has been decreasing since then. In 1983, the annual per capita consumption of refined sugar was 71 pounds, a 30 percent decrease from 10 years earlier (U. S. Economic Research Service). The total sugar consumption has decreased 22 percent since 1973 despite a 10.6 percent growth in population.

With a relatively stable total demand for caloric sweeteners, the primary factor accounting for reduced sugar consumption is the substitution of corn sweeteners. By 1984, corn sweeteners had captured about 42 percent of the caloric sweetener market, with HFCS accounting for most of the increased market share. The demand for sugar was modeled as

$$Q_t = f(P_t, P_{t-1}, MIXP_{t-1}, T)$$

where Q_t is per capita consumption of refined sugar (pounds) and P_t is wholesale list price in cents per pound for refined sugar in the northeastern United States deflated by the consumer price index (1967 = 100). The northeastern market area was selected because it includes New York, which is the most important trading area in the United States. $MIXP_{t-1}$ is the arithmetic mean of prices of HFCS, glucose, and dextrose weighted by their consumption quantities (cents per pound); and T is the time trend.

Because of the close substitution between sugar and nonsugar sweeteners, a weighted average nonsugar sweetener price (the arithmetic mean of prices of HFCS, glucose, and dextrose weighted by their consumption quantities) was used as one of the explanatory variables to capture the substitution effect. Most refined sugar is directly consumed not by final consumers but by industrial users. In view of their commercial production, industrial users have to decide their sugar consumption technology based on the relative price between refined sugar and corn and other sweetener substitutes much earlier than do final consumers. Therefore, sugar consumption is taken as a dependent variable and specified as a function of current sugar price, lagged sugar price, and lagged weighted average corn sweetener price. Time trend is also included to take account of the consumer preference effect. Because sugar is directly consumed in refined form, sugar demand is modeled in terms of per capita consumption of refined sugar.

Using time series data from 1961 to 1983, the per capita consumption for the refined sugar equation (after correcting for autocorrelation) was estimated in linear form[1] as

$$Q_t = \underset{(15.18)}{111.84} - \underset{(-4.76)}{0.3288P_t} - \underset{(-6.15)}{0.4192P_{t-1}} + \underset{(2.92)}{0.4759MIXP_{t-1}} - \underset{(-2.39)}{1.1638T}$$

$$ro_1 = \underset{(14.62)}{1.74}, \; ro_2 = \underset{(-7.02)}{-0.84} \qquad R^2 = 0.98$$

where ro_1 and ro_2 are first and second autocorrelation coefficients and the figures inside the parentheses are t values.

When setting all explanatory variables except current sugar price at 1963 and 1983 levels, respectively, the 1963 and 1983 per capita demands for refined sugar equations were simplified as

$$Q_{63} = 100.825 - 0.3288\ P_{63},\ Q_{83} = 74.525 - 0.3288\ P_{83}.$$

The U. S. 1983 total demand curve for refined sugar where per capita demand for refined sugar is multiplied by U. S. population is

$$Q_t^d = 7{,}920.356 - 34.944P_t.$$

When adjusted by 1983 population, the total 1963 U. S. demand is

$$Q_t^d = 10{,}715.427 - 34.944P_t$$

where Q_t^d is U. S. total refined sugar demand in 1,000 metric tons and P_t is refined sugar price deflated by the consumer price index (1967 = 100). The total demand curve was estimated to have shifted left by 737,052 metric tons from 1963 to 1983 and by 2,795,071 metric tons from 1963 to 1983 when 1963 consumption was adjusted by 1983 population.

Sugar Supply

The sugar supply estimates used are taken from Gemmill. His raw sugar supply estimates are converted to refined sugar supply responses by using a factor of

1.07, which is the units of raw sugar needed to produce one unit of refined sugar. Gemmill estimated separate supply equations for the sugar cane producing areas of Florida, Louisiana, Texas, and Hawaii and for aggregate U. S. sugar beet production. By aggregating these five equations and converting to refined sugar, the estimated U. S. refined sugar supply curve for 1983 is

$$Q_t^s = 1{,}061.062 + 341.829P_t$$

where Q_t^s is total U. S. refined sugar supply (in 1,000 metric tons) and P_t is refined sugar price deflated by the consumer price index (1967 = 100). The associated price elasticity is 0.645.

Because supply price estimates are sensitive to model specification, the following illustrates the effect of using an elasticity greater than 0.645, namely, 1.20. For a quota price premium of 7.49 cents per pound, the producer gain from a quota is $709.7 million for an elasticity of .645. The gain is $670.9 million for a price elasticity of 1.2. The difference of $38.8 million is less than 6 percent of the mean of the two producer welfare estimates.

Sugar Program Alternative Effects

If the government did not intervene in the sugar industry, it would only be necessary to consider the economic markets to understand the industry; world sugar supply and demand would determine sugar price which would allocate resources accordingly. However, Congress has tried to (1) maintain a domestic sugar industry, (2) assure sugar supplies to consumers, and (3) promote general export trade. To achieve these objectives, a mixture of policy instruments--including domestic and foreign marketing quotas, direct payments to producers, and tariffs and excise taxes--has been used (Johnson).

Domestic protection of sugar producers is one of the objectives of the sugar program. The difference between the world price (f.o.b. the Caribbean) converted to a New York basis and the actual domestic price of raw sugar in the United States represents the premium of the U. S. market to the world market due to the import quotas, fees, and duties in operation for the current sugar program. However, quotas are the main policy instrument protecting U. S. producers. The magnitude of this premium has varied considerably, but it has also widened significantly in recent years. In 1984, domestic sugar prices were easily four times higher than the world price.

The distribution of costs and benefits associated with the sugar program or its alternatives is obviously dependent on the assumptions made concerning quota premiums--the difference between the domestic price and the world price. That difference has averaged as much as 15 cents per pound (e.g., 1984). Basing an estimate of sugar program costs and benefits on this 15 cents per pound raw (16.05 cents per pound refined) quota premimum would provide a maximum short-run indicator of the economic impact of the program.

If the United States were to do away with the quotas, the world price of sugar would rise. The magnitude of that increase is a subject of considerable speculation and debate. Considering the observations of other sugar analysts (e.g., Gemmill) if the United States were an unrestricted trade participant, the world price would rise into the 12 to 15 cents per pound range on a raw basis. With this equilibrium price, the quota premium, if quotas were in effect, would be from 7 to 10 cents per pound on a raw basis (7.49 to 10.70 cents per pound on a refined basis). Accordingly, the costs and benefits of quota premiums of 7.49, 10.70, and 16.05 cents per pound on a refined basis were explicitly evaluated.

The 1983-84 Sugar Program

In Figure 2, the U. S. total sugar demand curves for refined sugar for 1963 and 1983 are D_0 and D_1, respectively, or D_0' and D_1', respectively, on a raw basis. The total refined sugar supply curve for 1983 is S_0 in refined form (or S_0' on a raw basis).[2] Suppose the current quota sugar policy raises the refined sugar price from P_0 to 32 cents per pound or the raw sugar price from P_0' to 22.04 cents per pound in 1983.[3] The consumer cost, producer gain, and net program cost are derived by estimating areas P_0abP_1, P_0cdP_1, and cabd, respectively, in Figure 2 for the year 1963. For 1983, the relevant demand curve is D_1, and the net cost becomes ca'b'd. The quota rent (i.e., the rent going to exporters) is fe'b'd. Estimates are provided (Table 1) for 1963 and 1983 for three different quota price premiums. The year 1963 is included in the analysis to isolate the effect of market penetration by HFCS.

Consider the case of a long-run equilibrium price of 15 cents per pound compared with the 1984 support price of 22 cents--a 7 cents per pound raw basis (7.49 cents per pound refined) quota price premium. With this premium, the consumer cost is $1,253.2 million while the producer gain is $709.7 million. The net cost of the quota is $543.5 million. Of course, the net cost increases when the quota price premium increases. For example, with a quota premium of 15 cents per pound raw (16.05 cents per pound refined), the consumer cost is $2,703.2 million, and the net cost of the program is $1,355.9 million.[4]

To obtain an estimate of the gain derived by the substitution into corn sweeteners, the demand schedule in 1983 was compared with 1963--before the HFCS substitution began. In 1983, the consumer cost of the sugar program based on 1963 consumption levels would have been $3,692.2 million. In 1983,

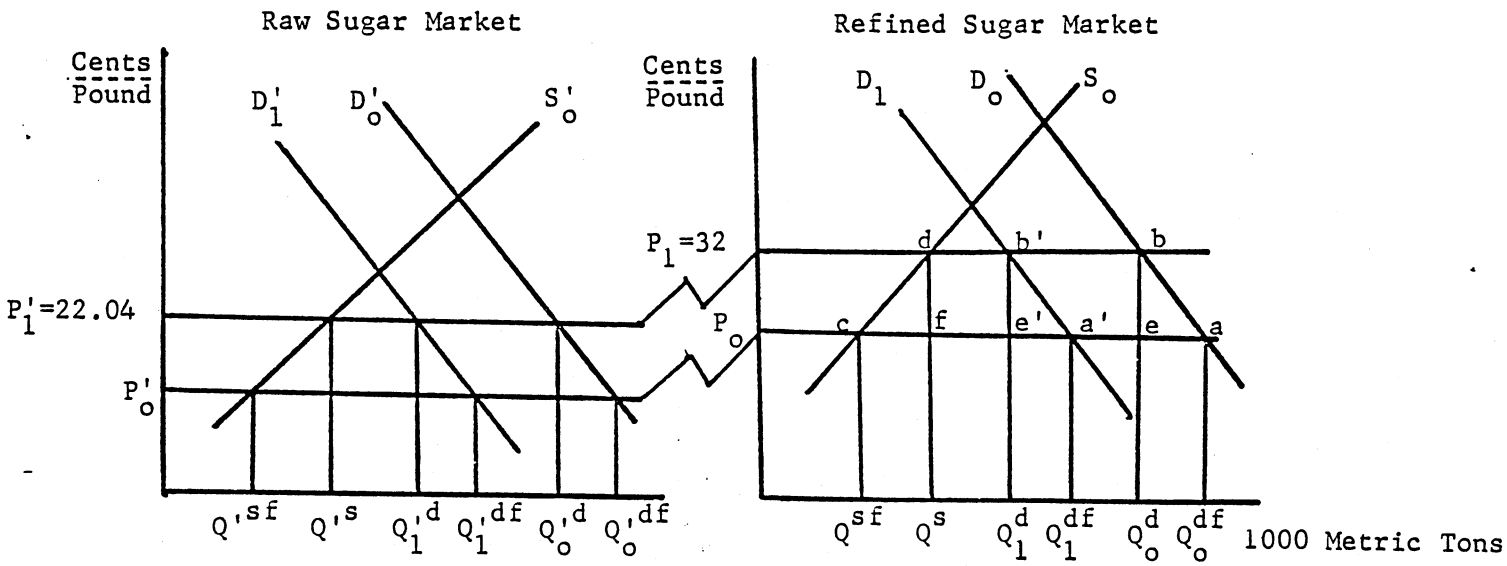

Figure 2. Sugar demand and supply, 1963 and 1983

Table 1. U. S. Costs and Benefits of the Sugar Quota Program, 1963 and 1983[a]

Quota Price Premium	Consumer Cost		Producer Gain		Net Societal Cost	
	1963	1983	1963	1983	1963	1983
cents per pound	million dollars					
7.49	1,714.7	1,253.2	709.7	709.7	1,005.1	543.5
10.70	2,454.0	1,794.7	970.4	970.4	1,483.6	824.3
16.05	3,692.2	2,703.2	1,347.2	1,347.2	2,345.0	1,355.9

[a]In 1983 dollars.

Source: Estimated.

based on 1983 consumption levels, the consumer cost was $2,703.2 million. The net cost of the program is $2,345 million. Part of the difference of $989 million (area a'abb' in Figure 1) is the gain from substitution to corn sweeteners. Thus, as a lower limit, the net cost of the sugar program for a 15 cents per pound premium is $1,355.9 million while the upper bound is $2,345 million.[5]

Quota policies generate quota rents to exporters (e.g., fe'b'd in Figure 2), the magnitude of which is indicated in Table 2. These quota rents may be captured by the exporting country, market intermediaries, or refiners. Available evidence suggests that about half of the quota rent is received by countries exporting raw sugar to the United States. When the world price is 7 cents per pound on a raw basis and the U. S. raw sugar price is maintained at 22 cents per pound (16.05 cents per pound refined basis difference), quota rents total $997.4 million. In the long run with a higher average world price, the importer quota rent would total $465.5 million.

Over time, the effect of the sugar program has been to reduce the quota rents. For example, based on 1963 consumption without the substitution to HFCS, the quota rent would have been $1,986.4 million (not shown in Table 2). The effect of HFCS substitution has been to reduce the size of the quota thus reducing the value of the quota rents. Interestingly, while countries holding sugar quotas once favored a restrictive U. S. sugar policy which generated high quota rents, they are now joining with sugar user and consumer groups in support of lower sugar price support as a means of maintaining a market for sugar in the United States. The above point can also be seen by comparing the value of exports under free trade with the value of exports including the quota rents (Table 2). The value of free trade exports exceeds the value of exports including quota rents. The point to emphasize here is that a free trade

Table 2. Sugar: U. S. Import Volume, Value, and Quota Rent Under Alternative Quota Programs, 1983[a]

U. S. Import	Unit	Quota Price Premium (cents per pound)		
		7.49	10.70	16.05
Volume[b]				
Quota	1,000 metric tons	2,818.8	2,818.8	2,818.8
Free trade	1,000 metric tons	6,559.6	6,964.9	7,640.4
Value[c]				
Quota	million dollars	1,988.6	1,988.6	1,988.6
Free trade	million dollars	3,544.5	3,270.6	2,686.6
Quota rent	million dollars	465.5	644.9	997.4

[a]In 1983 dollars.

[b]At the 32 cents refined price, volume on a refined basis is the distance $Q^s\ Q_1^d$; at the P_0 refined price, volume on a refined basis is the distance $Q^{sf}\ Q_0^{df}$ (see Figure 2).

[c]At the 32 cents refined price, value is the area Q_1^d b'd Q^s which includes quota rents; at the P_0 refined price, value is the area Q_0^{df} ac Q^{sf} (see Figure 2).

Source: Estimated.

policy may not hurt exporting countries as in this case they are assured of a long-run market for their product.

Tariff Program

Suppose a tariff were used to support the sugar price at 32 cents per pound in refined form or at 22.04 cents per pound on a raw basis. The consumer cost, producer gain, government tariff revenue, and program net cost under three different tariffs are presented in Table 3. The consumer cost and producer gain would have been the same as with an equivalent quota program except that now the U. S. government receives the tariff revenue. For example, in the short run based on a 16.05 cents per pound tariff, government revenue would have totaled $997.4 million in 1983. As a result of this revenue, the net costs of the tariff program are smaller than those of an equivalent quota program. In the above example, net costs fall to only $358.5 million. However, care must be taken in using such numbers in the context of a long-run revenue generator for the government. Just as in the case of the importer quota rents declining over time, tariff rents will decline when domestic sugar prices are maintained above HFCS competitive levels.[6]

Target Price Deficiency Payment Option

If a sugar deficiency payment program were used to replace a quota program and producer prices were maintained at the quota level, the consumer gain, producer effect, Treasury expenditure, and net gains from this replacement are shown in Table 4. Sugar producers lose nothing while consumers gain from consuming more sugar at a lower sugar price. The Treasury would have to pay sugar producers $1,672.5 million at 1983 world sugar prices. However, a deficiency payment scheme would generate a net societal gain of $1,525.2 million at a 16.05 cents per pound price premium relative to a quota policy.

Table 3. U. S. Costs and Benefits of a Sugar Tariff Program, 1963 and 1983[a]

Tariff Price Premium	Consumer Cost		Producer Gain		Government Revenue		Net Societal Cost	
	1963	1983	1963	1983	1963	1983	1963	1983
cents per pound	million dollars							
7.49	1,714.7	1,253.2	709.7	709.7	927.0	465.4	78.1	78.1
10.70	2,454.1	1,794.7	970.4	970.4	1,324.3	664.9	159.3	159.3
16.05	3,692.2	2,703.2	1,347.2	1,347.2	1,986.4	997.4	358.5	358.5

[a]In 1983 dollars.

Source: Estimated.

Table 4. U. S. Costs and Benefits of a Sugar Deficiency Payment Program Replacing a Sugar Quota Program, 1983[a]

Costs or Benefits	Quota Price Premium (cents per pound)		
	7.49	10.70	16.05
	million dollars		
Consumer gain[b]	1,483.9	2,124.4	3,197.7
Producer effect	0	0	0
Treasury expenditure	780.5	1,115.0	1,672.5
Net societal gain[c]	703.4	1,009.4	1,525.2
Gain in export earnings[d]	1,555.9	1,282.0	698.0

[a]In 1983 dollars.

[b]Average gains in 1963 and 1983 (base period = 1983).

[c]When comparing net societal cost of Deficiency Payment Program with that of Quota Program.

[d]Difference between area Q_1^d b' dQ^s and area Q_0^{df} acQ^{sf} (Figure 2).

Summary and Conclusions

The net societal costs of the different programs (import quotas, tariffs, and deficiency payments) are summarized in Table 5. Note that tariffs result in a net cost of roughly the same magnitude as a deficiency payment. Both types of policies result in a small cost relative to quotas. The cost of the current quota policy is roughly four times that of either a deficiency payment or tariffs.

The main instrument of U. S. sugar policy is an import quota. Quotas are not the least-cost way to protect domestic producers. Alternatives to quotas were discussed including the use of deficiency payments. The net cost of deficiency payments is much less than that incurred under quotas. With deficiency payments, U. S. consumers and sugar users pay the world price for sugar--unlike in the quota case. The major reason the costs with a deficiency payment are less than under a quota is that there are no quota rents; hence, the exporters of sugar to the United States receive only the world market price. Based on economic considerations, even a tariff as a policy instrument is preferred to a quota because it generates U. S. government revenue while protecting producer returns. Clearly in policy decisions, the government deficit is of major concern; this is, perhaps, the reason sugar quotas are used rather than the other policies discussed. With quotas, the government does not have to spend major amounts on the sugar program. However, it would not have expenditures under a preferential tariff program either.

In the choice of a policy instrument, no mention was made of the effect of exchange rates. Owing to the rising strength of the U. S. dollar in the 1980s, imports of sugar became cheaper relative to domestic sources. Thus,

Table 5. Net Cost of U. S. Sugar Import Quotas, Tariffs, and Deficiency Payment Programs, 1983[a]

	Quota or Tariff Price Premium (cents per pound)		
	7.49	10.70	16.05
	million dollars		
Current quota policy	543.5	824.3	1,355.9
Tariff	78.1	159.3	358.5
Deficiency payment	70.8	144.6	325.3

[a]In 1983 dollars.

Source: Estimated.

ceteris paribus, as the dollar appreciates, a tariff stated in U. S. dollars must be increased in order to maintain a given U. S. price. In the 1980s, the exchange rate movement was a factor in moving away from tariff protection to a quota system. To keep producer welfare unchanged, tariffs had to be increased as the U. S. dollar appreciated.

Policies affect relative product and input prices in different ways. A quota policy keeps the price of sugar high relative to domestic corn prices. This is not the case with deficiency payments. The high price of domestically used sugar relative to corn was a factor in the substantial growth of corn sweeteners. This brought about a reduction in sugar imports. In terms of interest groups, it is clear why corn producers and corn sweetener manufacturers like the quota system and why users, such as candy manufacturers who rely heavily on sugar, would prefer some form of a deficiency payment scheme as this type of a program lowers sugar prices to users. However, there are other groups to be considered. With quotas, the U. S. government has no Treasury exposure; this is not true with respect to deficiency payments. Also, with deficiency payments, exporters of sugar to the United States receive no quota rents. This poses an interesting dilemma for exporters. The U. S. quotas give exporters quota rents, but they also reduce the volume of trade--partly because of the substitution toward corn sweeteners. Therefore, quotas are a mixed blessing. In the long run, sugar exporters may be better off to give up their quota rents in order to achieve the gains from expanded exports to the United States under a free market price. This is what a deficiency payment program would help bring about.

Footnotes

The authors are, respectively, postgraduate research agricultural economist and professor of agricultural and resource economics, University of California, Berkeley; and professor of marketing policy, Texas A&M University.

[1]The general form of demand for refined sugar is $Q = Q(P, q, Z)$, where P is the price vector which will change due to the contemplated sugar policy, q is the other price vector which will remain constant when sugar policy changes and can be reasonably assumed to be proportional to some fixed vector q^o so that $q = cq^o$ for some scalar c, and Z is a vector of socioeconomic characteristics. A first-order Taylor expansion of this equation would lead to the econometric specification (Hausman, p. 670), $Q = rZ + \Sigma_{i=1}^{N} (\alpha_i P/q_i)$. By Hick's composite commodity theorem, the latter equation can be rewritten as $Q = rZ + [\Sigma_{i=1}^{N} (\alpha_i/q_i^o)] P/c$ and $Q = rZ + \beta(P/c)$, where $\beta = \Sigma_{i=1}^{N} (\alpha_i/q_i^o)$ and P/c is real price when c is regarded as a price index.

[2]The area above the refined sugar supply curve also includes rents to sugar processors.

[3]Usually, the quota premium is discussed in terms of raw sugar. The program effects for 7-cent, 10-cent, and 15-cent premium levels were studied. As the quantity of refined sugar is derived by dividing the quantity of raw sugar by 1.07, the equivalent premiums in refined sugar form are 7.49 cents, 10.70 cents, and 16.05 cents. Also, under equilibrium conditions, the 32 cents per pound of refined sugar can be regarded as equivalent to 22.04 cents per pound of raw sugar.

[4]It needs to be remembered that the 16.05-cent quota premium is a short-run proposition. While it was a very real situation in the mid 1980s, in all probability it would not exist if the United States were in a free trade posture. If it did exist over the long run, production in the United States would probably fall to zero. Thus, the production estimates in this instance must be viewed in a short-run context.

[5]To determine the exact gain to consumers from substitution to corn sweeteners and, in addition, isolate the gain to corn producers and corn processors from this effect, a general equilibrium welfare analysis is needed. The framework has been provided by Just, Hueth, and Schmitz.

[6]The HFCS price and cost data suggest that, if the sugar price support were reduced to 15 cents per pound, sugar would be in a longer run competitive relationship with HFCS.

References

Allen, R.; C. Dodge; and A. Schmitz. "Voluntary Export Restraints as Protection Policy," Amer. J. Agric. Econ. 65(May 1983):291-97.

Gemmill, Gordon. "The World Sugar Economy: An Econometric Analysis of Production and Policies," Ph. D. thesis, Michigan State University, 1976.

Hausman, J. A. "Exact Consumer's Surplus and Deadweight Loss," Amer. Econ. Rev. 71(Sept. 1981):662-76.

Johnson, D. Gale. The Sugar Problem: Large Costs and Small Benefits. American Enterprise Institute for Public Policy Research, Washington, D. C., 1974.

Just, R. E.; D. L. Hueth; and Andrew Schmitz. Applied Welfare Economics and Public Policy. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1982.

U. S. Economic Research Service. Sugar and Sweetener Outlook and Situation Report. Washington, D. C.: U. S. Government Printing Office, various issues.