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Effect of Sugar Price Policy on U.S. Imports of Processed Sugar-containing Foods

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Abstract

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The relationship between U.S. and world sugar prices, and U.S. import demand for four categories of sugar-containing products is examined. Results from econometric estimation indicate that U.S. intervention in the sugar market has helped to increase U.S. imports of some sugar-containing products, but that increased disposable income has played a more important role. Although some developing countries have benefitted from U.S. sugar policy by increasing their exports of sugar-containing products to the United States, U.S. sugar policy has helped imports from developed countries proportionately more than those from developing countries as a whole.

Introduction

Since May 1982, when the United States of America imposed a restrictive import quota on raw sugar imports, U.S. imports of miscellaneous sugar-containing products – sugar blends, mixtures, confectionery, bakery, and edible preparations – have increased by over 150% in volume and by over 120% in value: from US$677 million in 1982 to over US$1.5 billion in 1986. The increase in imports of these products has been largely attributed to the price differential between domestic U.S. sugar and cheaper world-price sugar (USDA, 1987; Washington Post, 1987). However, the extent to which increased imports of sugar-containing products have indeed been caused by government intervention in the sugar market, rather than by other market factors, has yet to be examined. Rising consumer income and other U.S. trade policies and programs, such as the Generalized System of Preferences, also influence the level of U.S. imports of manufactured goods. The objective of this paper is to ex-

billion (US) = 10^9.

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amine the effects of sugar protection, as well as the effects of these other factors, on U.S. demand for selected imports of sugar-containing products.

Previous analyses of government intervention in the U.S. sugar market have concentrated on examining the welfare costs to the economy and the distribution of income among some of the interest groups affected by the sugar program (Dardis and Young, 1985; Zietz and Valdes, 1986; Leu et al., 1987). This paper will extend these past economic analyses by concentrating on the relationship between U.S. processed food imports and sugar protection, and on the impact of this protection on the countries that export processed, sugar-containing foods to the United States. A key question that will be addressed is whether substitution of alternative sweeteners has allowed U.S. food manufacturers to reduce the competitive advantage provided to foreign manufacturers by U.S. sugar policies. The paper will also examine which countries – developed or developing – have benefitted from artificially high U.S. sugar prices by increasing their exports of sugar-containing products to the United States. For instance, Zietz and Valdes have documented the adverse impact of the U.S. sugar program on developing countries' sugar exports, but they did not examine whether or not the developing countries have been able to offset some of their losses in raw sugar exports through increased exports of value-added, processed sugar-containing foods.

U.S. import demand for four categories of sugar-containing processed foods – canned fruits, confectionery, sweetened cocoa and chocolate, and bakery products – will be examined. These categories of sugar-containing products accounted for approximately US$930 million of U.S. imports in 1986. The following section of the paper provides data on the extent of rising U.S. imports of sugar-containing products and on the shares of these products imported from the developing and the developed countries. The next two sections contain the theoretical framework used in deriving import demand equations and the empirical specification of the equations estimated. This is followed by the results of the analysis of factors affecting U.S. import demand. The last section provides a summary and conclusions.

Importance of the problem

Although the current import quota system was established for sugar in 1982, the U.S. government has been regulating sugar imports in one way or another almost continuously since 1789. Restrictive, country-by-country, import quotas had been abandoned in 1975, and variable fees and tariffs had been used to protect domestic producers (USITC, 1977). The 1981 Farm Bill set a 'market stabilization' price of 20 to 22 cents a pound for raw sugar. A system of tariffs and import fees was used to maintain the market price at the stabilization level.

However, the rapid decline in the world sugar price in 1981–82 resulted in a return to country-by-country import quotas in May 1982 in order to maintain

TABLE 1

U.S. imports of raw sugar and selected sugar-containing products, total and from developing and developed countries, 1970, 1980 and 1986

Commodity	Imports (US$)			Import shares (%)		
	1970	1980	1986	1970	1980	1986
Canned fruits[a]	51 019	174 935	265 785	100.0	100.0	100.0
DC's	17 652	32 569	62 031	32.6	18.6	23.4
LDC's	33 367	142 366	203 754	65.4	81.4	76.6
Confectionery[b]	51 064	129 717	315 455	100.0	100.0	100.0
DC's	49 198	115 798	277 941	96.3	89.3	88.1
LDC's	1 866	13 919	37 514	4.7	10.7	11.9
Sweetened cocoa and chocolate[c]	1 584	25 439	98 087	100.0	100.0	100.0
DC's	1 509	22 309	76 605	95.3	87.7	78.1
LDC's	75	3 130	21 482	4.7	12.3	21.9
Bakery[d]	27 631	96 707	249 855	100.0	100.0	100.0
DC's	27 493	87 429	226 038	99.5	90.4	90.5
LDC's	138	9 278	23 817	0.5	9.6	9.5
Raw sugar	729 116	1 987 730	669 745	100.0	100.0	100.0
DC's	40 458	206 755	59 119	5.5	10.5	8.8
LDC's	688 658	1 780 975	610 626	94.4	89.5	91.2

[a]TSUSA import numbers 146.0000 to 150.0000, preserved and prepared fruits.
[b]TSUSA import numbers 156.3020, 157.1005, 157.1010, 157.1045, and 157.1050.
[c]TSUSA import numbers 156.2500, 156.3045, 156.3050, 156.3065, 156.4500, and 156.4700.
[d]TSUSA import number 182.2000.
TSUSA, Tariff Schedules of the United States, Annotated.
DC, developed country; LDC, developing country.
Source: USDC (various years).

domestic U.S. sugar prices. Due to this quota system, as well as to other factors, such as declining per-capita U.S. sugar consumption and the availability of cheaper sugar substitutes, U.S. sugar imports have been cut from a peak of over 5 million sh tn in 1981 to around 2.2. million sh tn in 1986 (USDA, 1987). The developing countries, particularly the Caribbean countries, Brazil, the Philippines and Thailand, have suffered the greatest losses in export revenues from sugar, although some developed countries, such as Australia, also export sugar to the United States.

The data in Table 1 show the decline in U.S. raw sugar imports which occurred during the 1980's. Although the U.S. government intervened in the sugar market continuously during the 1970–86 period, either through quotas, tariffs, and/or fees, the relationship between world and U.S. sugar prices was changed to some extent by the introduction of the 1982 program. U.S. sugar prices averaged about 3 times the level of the world price in the 1981–1986 period, as compared to 1.5 times the world price in the 1970–1980 period.

sh tn, short or net ton = 2000 lb ≈ 907 kg.

The rising trend in U.S. imports of four sugar-containing product categories from 1970 to 1986, and the shares of these imports captured by the developed and developing countries, are also shown in Table 1.[1] The sugar content of these products is variable. For instance, confectionery without chocolate has an estimated 50% to 80% sugar content by weight, sweetened chocolate a 50% sugar content, confectionery with chocolate a 40% sugar content, and bakery items about a 25% sugar content (USGAO, 1988). In nominal terms, the increase in the value of U.S. imports of these products since implementation of the 1982 sugar program appears to be part of a larger trend in rising imports continued from the 1970's. However, in real terms, the value of U.S. imports of these products rose at a much faster annual average rate in the 1981–86 period, about 12%, compared to an average annual rate of increase of 3% in the 1970–80 period.

The decline in the value of U.S. sugar imports of about $1 billion from 1980 to 1986 was twice as large as the increase in imports of the four sugar-containing product categories shown in Table 1. Because the developing countries' share in the imports of the processed products is relatively small, as compared to their share in U.S. sugar imports, the developing countries have only been able to offset some of their sugar export losses in the U.S. market from larger exports of sugar-containing products.[2] However, to the extent these industries are infant industries associated with externalities, then the gains to the developing countries may be greater.

The developing countries' share in U.S. imports of sugar-containing products is by far the greatest in canned fruits (over 75%). However, during the 1970–80 period, the developing countries' share in U.S. imports of all of these products rose dramatically, with bakery products and sweetened cocoa and chocolate experiencing the largest increase. In the 1980–1986 period, however, this growth in the developing countries' import share either slowed dramatically, or the developing countries' share declined. To the extent that this relatively slow 1980's import share growth is due to U.S. sugar price policy, then the developing countries' exports have been hurt through loss of market share in their exports of sugar-containing products as well as through reduced exports of raw sugar.

Determinants of import demand

Past models of import demand have expressed the real demand for imports as a function of domestic real expenditure, Y_d; the price of domestic goods

[1]Emergency import quotas were placed on imports of blended syrups and other sugar-containing products with a content of sugar derived from beet or cane of over 65% by dry weight in June 1983. Of the products examined in this paper, these quotas briefly affected imports of sweetened cocoa, which is a very minor component of the sweetened cocoa and chocolate products group.

[2]The gain in U.S. imports of all sugar-containing products was slightly larger than the $1 billion decline in U.S. sugar imports during the 1980-86 period. However, the developing countries' share in the unincluded imports is also very small.

(usually the wholesale price index), P_d; and the price of imported goods, P_m. Thus, the demand function for imports in volume terms can be written as:

$$\frac{M}{P_m} = M^* = f(Y_d, P_d, P_m) \quad (1)$$

where M and M^* stand for the nominal and real value of imports, respectively.[3] The import demand function (1) is assumed to be homogeneous of degree zero in income and prices.

Clifton (1986) and Chmura (1987) explained U.S. demand for imports of manufactured goods by examining changes in industry-specific real exchange rates. These industry exchange rates were represented by the relative prices of domestic and imported goods which, in turn, are functions of the relative costs of imported and domestic goods to the domestic market. Consistent with these studies, U.S. import demand for the jth sugar-containing product, I_j, is assumed to be a function of the relative cost of domestic production of the jth sugar-containing product to imported substitutes, as represented by the relationship between U.S. and world sugar prices. It is thus assumed that the relation between U.S. and world sugar prices determines the overall cost structure and international competitiveness of the jth sugar-containing product industry.

This specification also makes the simplifying assumption that movements in relative sugar prices are exogenous to the industry. Imports of sugar-containing manufactured products are also regarded as imperfect substitutes for domestic production due to differences in quality, delivery time, credit arrangements, as well as other factors. U.S. imports of sugar-containing products from different countries and country groupings are also considered to be imperfect substitutes for each other for the same reasons.

Specification of import demand equations

The import demand equations can be written as:

$$I_{jt} = F(RS_t, Y_t, DG_t, Z_{jt}) \quad (2)$$

where I_{jt} is the value in millions of U.S. imports of the jth sugar-containing product in period t, deflated by an index of changes in the unit value import price of the jth sugar-containing product (1970 = 100); RS_t is the ratio between the U.S. wholesale price of refined sugar (Northeast), duty-inclusive to the world raw sugar price, f.o.b. Caribbean ports, adjusted for transportation to New York and for refining losses, in period t; Y_t is U.S. per-capita disposable income, deflated by the consumer price index (CPI) in period t; DG_t is a dummy

[3]For a more extensive discussion of import demand theory, see Leamer and Stern (1970) and Kohli (1982).

variable to reflect the introduction in 1976 of the Generalized System of Preferences (GSP) for manufactured goods imported by the United States; and Z_{jt} represents a vector of import demand shifters specific to product j in period t. Total import demand is further separated into two categories, demand for imports from developed countries, IO_j, and demand for imports from developing countries, ID_j.

Any government intervention that maintains U.S. prices for sugar higher than equivalent world prices would be expected to act as an export subsidy for those foreign manufacturers who have access to cheaper foreign sugar. This subsidy should cause the demand for imports of sugar-containing products to rise, ceteris paribus, and the demand for the similar domestic product to decline (shift inward) as consumers substitute lower priced imports for domestic goods. To the extent this subsidy is captured in the relative price of U.S. to world sugar, it is expected that RS_t will be positively related to I_j. Since the U.S. government intervened in the sugar market continuously during the estimation period in one way or another, no distinction was made between behavior before and after the introduction of the current sugar program. The ratio of domestic to international sugar prices is used to represent the effects of the tariff/variable fee system as well as the quotas, since both types of policies have quantifiable effects on raising U.S. domestic prices relative to world prices for sugar.

Real disposable income per capita, Y_t, is included to capture the effects of changes in real purchasing power and, to some extent, to allow for the economy's movement through the business cycle. It is expected to be positively related to I_j for a normal consumption good.

United States imports of sugar-containing products from many developing countries benefit from temporary, duty-free tariff preferences under the GSP program.[4] According to Baldwin and Murray (1977) granting tariff preferences to manufactured imports from certain beneficiary countries will result in an increase in total imports of the eligible products as imports from beneficiary countries rise, and a corresponding decline in domestic production – the trade creation effect. Thus we would expect to see a positive relationship between DG_t and I_j, and between DG_t and ID_j. However, there will also be a tendency for domestic consumers to substitute lower-priced imports from preferred sources for the imports from non-preferred sources – a trade diversion effect. Thus a negative relationship is expected between DG_t and IO_j, the real value of imports from the developed countries.

Z_{jt} represents a vector of real prices for product-specific ingredients that would be expected to shift the U.S. import demand schedule for the jth sugar-containing product. Included in Z_{jt} are the real prices of alternative sweeteners,

[4]Under the statutory competitive need provisions, a country loses GSP treatment for a product if its shipments are greater than a certain dollar value.

glucose and high fructose corn syrups, and the real price of cocoa beans. Because manufacturers often use a combination of several sweeteners in product formulas, an increase (decrease) in the prices of alternative sweeteners can lead to an increase (decrease) in the demand for imports as the domestic product becomes more expensive (or competitive) relative to imports. Movements in the prices of alternative sweeteners are expected to be positively related to imports.

Any change in the price of cocoa beans will affect both importers and domestic producers alike, since cocoa beans are not produced in the United States. However, the price of cocoa beans could affect import demand for some sugar-containing products to the extent domestic manufacturers can substitute other domestic ingredients, such as cocoa powder substitutes or extenders, for the imported sugar-containing products that contain cocoa products. Thus we would expect an increase (decrease) in the cocoa beans price to result in reduced (increased) import demand for cocoa-containing imports to the extent that domestic manufacturers utilize these substitutes in response to the price change.

Data and estimation technique

Equation (2) was estimated using linear regression analysis for four broad groups of sugar-containing products – canned fruits, confectionery, sweetened cocoa and chocolate, and bakery products – using time series data from 1970 to 1986. Import demand for confectionery was further divided into demand for confectionery imports containing chocolate and for imports not containing chocolate. The import demands for the two categories of confectionery appear to have significantly different behavior. Import data were taken from U.S. Department of Commerce, Bureau of the Census, *U.S. Imports for Consumption* (USDC, various years).

The total import demand equations, I_j, were estimated for the jth product using ordinary least squares (OLS). Import demand equations for developed and developing countries' imports (IO_j and ID_j) were estimated using Zellner's seemingly unrelated technique (SUR). SUR provided a gain in efficiency because of interrelatedness between the two sources. SUR was also used in estimating the import demand equations for confectionery and sweetened cocoa and chocolate, since the latter is used as an input in production of the former, and in estimating the two confectionery equations. Some equations were corrected for first and second-order serial correlation as indicated by p_1 and p_2.

Results

Results from estimated import demand equations for total U.S. import demand, U.S. import demand from developed and developing countries, and U.S. import demand from selected developing country groups are discussed below.

Effect of sugar prices and other factors on total U.S. imports

The results from estimating specification (2) for total import demand, I_j, support the underlying hypothesis that changes in real income, the GSP program, as well as the relative prices of U.S. and world sugar, have affected U.S. import demand for four categories of sugar-containing products (Table 2). More specifically, the relative prices of U.S. and foreign sugar have had the greatest impact in increasing U.S. imports of sweetened cocoa and chocolate (elasticity of 0.92), followed by confectionery containing chocolate (0.72), bakery products (0.53), confectionery without chocolate (0.37), and canned fruits (0.26). The estimated weighted average elasticity with respect to this price ratio for all of these products, evaluated at the means, is 0.40. Since the average annual increase in the U.S.–world sugar price differential over the 1982 to 1986 period was about 22%, this elasticity suggests that the U.S. sugar program that was instituted in 1982 has been responsible for an average increase in the real value of U.S. imports of all of these sugar-containing products of about 9% per year during this period.

The results indicate that increased U.S. disposable income has been the most significant factor affecting the level of U.S. imports of all of these products. All of the products examined are income elastic, with sweetened cocoa and chocolate products exhibiting the highest income elasticity (12.5), followed by confectionery without chocolate (5.5), bakery products (4.4), and canned fruits (1.9). The weighted average income elasticity for the real value of U.S. imports of all of these products, evaluated at the means, is approximately 4.0. Thus, as the U.S. economy continues to grow, imports of these products will rise, all else held constant, regardless of the level of the U.S. sugar price. Moreover, if real disposable income grows at the rate of the 1982–86 period, about 3% per year, and all other factors are held constant, then the real value of U.S. imports of these products will increase by about 12% per year.

Due to substitution of corn syrup for sugar in manufacturing formulas for confectionery not containing chocolate, a change in the price of corn syrup (GL), is also an important factor affecting U.S. imports of these products. Due to this substitution of a cheaper alternative, confectionery imports as a whole are less sensitive to the differential between world and U.S. sugar prices. A change in the price of high fructose corn syrup also appears to have had an impact on U.S. imports of canned fruits. The results suggest that as the real price of high fructose corn syrup has declined since 1975, its substitution in canned fruits has allowed domestic manufacturers of canned fruits to become more competitive with imports. High fructose corn syrup is used in about 60% of U.S. consumption of canned food products (Corn Refiners Association, 1987).

The GSP program is shown to be responsible for increasing the overall level of U.S. imports solely in the case of canned fruits, the only product in which

TABLE 2

Import demand equations for sugar-containing products, 1970–86

(1) Canned fruit												
ICF_t=	−	129.4	+	10.4*RS_t	+	40.4*Y_t	+	18.8*DG_t			+	2.5HF_t	$\bar{R}^2$ =	0.90
		(−2.50)		(2.77)		(2.77)		(2.41)			+	(2.03)	DW=	1.55
													p_1 =	0.38
(2) Confectionery														
IC_t=	−	217.7	+	12.3*RS_t	+	61.7*Y_t	−	16.6*DG_t	+	10.8DD_t	+	426.1GL_t	$\bar{R}^2$ =	0.84
		(−4.84)		(4.93)		(5.36)		(−3.33)		(1.66)		(2.06)	DW=	2.21
ICC_t=	−	14.0	+	6.8*RS_t	+	8.5Y_t	−	13.1*DG_t			−	30.1GL_t	$\bar{R}^2$ =	0.88
		(0.65)		(8.18)		(1.63)		(−5.80)				(−0.42)	DW=	2.29
													p_1 =	−0.51
INC_t=	−	134.0	+	4.5*RS_t	+	36.0*Y_t	−	4.3DG_t	+	19.1*DD_t	+	357.9*GL_t	$\bar{R}^2$ =	0.81
		(−4.31)		(2.68)		(4.47)		(−1.25)		(3.90)		(2.58)	DW=	2.25
(3) Sweetened cocoa and chocolate products														
ICH_t=	−	119.3	+	4.2*RS_t	+	30.6*Y_t	+	0.01DG_t	−	10.5*CO_t	+	139.1GL_t	$\bar{R}^2$ =	0.92
		(−7.21)		(3.80)		(7.33)		(0.01)		(−3.34)		(1.72)	DW=	2.03
(4) Bakery products														
IB_t=	−	248.1	+	10.9*RS_t	+	63.3*Y_t	−	9.2DG_t					$\bar{R}^2$ =	0.87
		(−5.09)		(4.18)		(5.16)		(−1.53)					DW=	2.17
													p_1 =	0.30
													p_2 =	−0.46

I_j denotes U.S. import demand for the jth sugar-containing product; CF denotes canned fruit; C, all confectionery; CC confectionery containing chocolate; NC confectionery not containing chocolate; CH, chocolate products; and B, bakery. RS is ratio of the U.S. wholesale refined sugar price to the world raw sugar price, adjusted for processing and transportation costs. Y is U.S. per-capita disposable income, deflated by the consumer price index (CPI). DG denotes U.S. GSP program: =1,1976–1986, =0, all other periods. CO is world cocoa beans price, c.i.f. New York, deflated by the U.S. wholesale price index (WPI). GL is price of corn syrup, deflated by the WPI. HF is price of high fructose corn syrup, deflated by the WPI. DD = 1, 1986; =0, all other years. * indicates coefficients are statistically different from zero using a 0.05 level two-tailed t-test. p_1, Cochrane–Orcutt correction for first-order serial correlation; p_2, Cochrane–Orcutt correction for second-order serial correlation. ( ) t values.

TABLE 3

Estimated import demand equations for sugar-containing products, developing and developed country groups, 1970–86

(1) Canned fruit												
$IOCF_t =$	−	50.9	+	$5.8*RS_t$	+	$16.7*Y_t$	−	$7.1*DG_t$				$\bar{R}^2 =$ 0.78
		(−2.75)		(4.90)		(3.09)		(−2.85)				DW = 2.33
$IDCF_t =$	−	68.5	+	$3.7RS_t$	+	$29.7*Y_t$	+	$22.5*DG_t$			+ $1.9HF_t$	$\bar{R}^2 =$ 0.77
		(−2.41)		(1.40)		(2.70)		(3.97)			(2.08)	DW = 1.61
												$p_1 =$ 0.26
(2) Confectionery												
$IOC_t =$	−	176.4	+	$11.9*RS_t$	+	$50.1*Y_t$	−	$13.8*DG_t$	+	$11.7DD_t$	+ $345.4GL_t$	$\bar{R}^2 =$ 0.85
		(−4.50)		(5.48)		(5.00)		(−3.17)		(2.07)	(1.91)	DW = 2.25
$IDC_t =$	−	58.2	+	$1.3*RS_t$	+	$14.3*Y_t$	+	$0.8DG_t$	+	$3.8*DD_t$	+ $139.5*GL_t$	$\bar{R}^2 =$ 0.92
		(−8.09)		(3.30)		(7.74)		(1.02)		(3.31)	(4.26)	DW = 2.27
(3) Sweetened cocoa and chocolate products												
$IOCH_t =$	−	81.7	+	$2.6*RS_t$	+	$21.7*Y_t$	+	$0.1DG_t$	−	$8.0*CO_t$	+ $69.5GL_t$	$\bar{R}^2 =$ 0.88
		(−5.72)		(2.71)		(6.03)		(0.08)		(−3.19)	(0.99)	DW = 2.21
$IDCH_t =$	−	39.0	+	$1.6*RS_t$	+	$9.3*Y_t$	−	$0.7DG_t$	−	$2.8*CO_t$	+ $70.4*GL_t$	$\bar{R}^2 =$ 0.89
		(−7.13)		(4.26)		(6.73)		(−1.09)		(−2.39)	(2.62)	DW = 2.48
(4) Bakery products												
$IOB_t =$	−	238.2	+	$10.2*RS_t$	+	$58.9*Y_t$	−	$12.0*DG_t$				$\bar{R}^2 =$ 0.87
		(−6.01)		(5.04)		(6.15)		(−2.58)				DW = 2.24
												$p_1 =$ 0.20
												$p_2 = -0.41$
$IDB_t =$	−	35.0	+	$1.6*RS_t$	+	$10.6*Y_t$	+	$0.7DG_t$				$\bar{R}^2 =$ 0.89
		(−6.58)		(4.37)		(6.20)		(0.83)				DW = 2.15
												$p_1 =$ 0.70
												$p_2 = -0.60$

Notes: O denotes developed countries; D developing countries. All other variables are defined as in Table 2.

developing countries provide the largest share of U.S. imports. The positive coefficient estimated for DG in the canned fruit equation suggests a real, annual trade creation effect of $19 million (in 1970 dollars). The negative coefficients estimated for DG in the total confectionery and bakery import equations, which are contrary to theory, suggest that this variable may be picking up the effect of some other variable not included in these equations. For instance, foreign companies often relocate their production in the United States after an imported product becomes established in the U.S. market. The DG variable may be picking up this effect, considering that U.S. imports from developed countries exhibit a decline greater than the increase in imports from the developing countries with respect to this variable (Table 3).

The estimated negative coefficient on the price of cocoa beans indicates that U.S. imports of sweetened cocoa and chocolate decline with an increase in this price. This result reflects the reduced demand for these products as candy and chocolate manufacturers increase their use of cheaper chocolate substitutes as the price of cocoa beans and other cocoa products rise. The estimated results show that U.S. import demand for imported sweetened chocolate products is inelastic with respect to the price of cocoa beans (elasticity of -0.60). Thus developing countries, who are the sole producers of cocoa beans, may experience some short run revenue gains from an increase in this price.

Effect of sugar prices on developing and developed country import shares

The results of Table 3 suggest that the U.S.–foreign sugar price differential has contributed to increased U.S. imports of sugar-containing products from both developed and developing countries. In Table 3, the estimated relationship between RS_t and the real value of U.S. imports from the developed countries is positive and statistically significant at an acceptable level for each product analyzed. The estimated relationship between RS_t and U.S. imports from the developing countries is statistically significant in the case of all of the products except canned fruits.

Elasticities associated with the estimated income and price responses of the developed and developing countries are shown in Table 4. From Table 4 it is clear that the developing countries' exports have been more responsive with respect to an increase in the U.S.–foreign sugar price differential in the case of sweetened cocoa and chocolate products (elasticity of 1.5 as compared to 0.8 for the developed countries) and of bakery products, but exports from the developed countries have been more responsive for the other products examined. This result helps to explain the decline in the developing countries' share of U.S. imports of canned fruits, and the slow growth in their market share for confectionery from 1980 to 1986 (see Table 1).

Because U.S. imports from the developing countries largely consist of canned fruits and confectionery products, for which the developing countries have a

TABLE 4

Estimated U.S. import demand elasticities for selected sugar-containing products, total and from developing and developed countries

Commodity	U.S. import demand elasticity with respect to	
	RS_t	Y_t
Canned fruits		
Total imports	0.26	1.93
DC's	0.62	3.00
LDC's	0.12	1.93
Confectionery		
Total imports	0.43	4.12
with chocolate	0.72	1.70
without chocolate	0.37	5.55
DC's	0.50	3.80
LDC'	0.30	7.00
Sweetened cocoa and chocolate		
Total imports	0.92	12.50
DC's	0.77	6.50
LDC's	1.54	16.77
Bakery		
Total imports	0.53	5.30
DC's	0.67	8.25
LDC's	0.57	5.57

relatively lower price response elasticity, the developed countries appear to have been the primary beneficiaries of U.S. sugar policy as regards increased U.S. imports of the processed sugar-containing products shown. On average, a 1% increase in the U.S.–foreign sugar price differential has resulted in a 0.20% increase in U.S. imports of these products from the developing countries, as compared to a 0.50% increase for the developed countries. This implies that the U.S.–foreign sugar price differential has contributed to an average annual real increase in U.S. imports of these products from the developing countries of about 4% since 1982, whereas U.S. imports from the developed countries have increased at an average annual rate of about 11% per year. Specifically, the European countries, Canada, Japan and Australia have been primary developed country beneficiaries in terms of increased U.S. imports of sugar-containing products.

In Table 3, the estimated coefficient for DG in the IDCF equation indicates that the GSP program has been associated with an average annual increase in U.S. imports of canned fruits from the developing countries of about $22.5

million (in real terms). Because the estimated negative coefficient for DG in the IOB equation is so much larger that the estimated positive coefficient for DG in the IDB equation, DG may reflect the effect of an omitted variable in this equation as discussed previously. The estimated effect of DG on U.S. imports of confectionery from the developed countries indicates a decline in confectionery imports (possibly from transferring production to the U.S.).

Effect of U.S. sugar prices on imports from developing country groups

The effects of sugar prices and other factors on U.S. imports of sugar-containing products from different groups of developing countries are shown in Table 5. Country groupings in this table include African countries (AF), Asian countries with relatively large import quotas under the current U.S. sugar program (ASQ), other Asian countries (AS), South American countries (SA), and the Caribbean countries (CB).[5] The most important countries in the ASQ group are Thailand, the Philippines, and Taiwan, whereas the principal countries in the AS group are South Korea, Singapore and Hongkong.

Although the developing countries' export response to the U.S.–foreign sugar price differential may be relatively low on average, the results of Table 5 indicate that some developing countries have clearly benefitted from this price differential through increased exports of sugar-containing products to the United States. Developing countries in Africa, the Caribbean, and South America appear to have benefitted from increased U.S. imports of sweetened cocoa and chocolate products, with U.S. imports from South American and African countries experiencing the largest response to RS_t (elasticities of 1.8 and 1.5, respectively). U.S. imports from the newly industrializing countries of Asian (NIC's), on the other hand, have been the most responsive for all of the other products.

For instance, in bakery products, Taiwan and the other Asian NIC's (Singapore, Hongkong and the Republic of Korea) have the highest elasticities with respect to RS_t, 1.5 and 1.2, respectively. These countries also have the largest price responses for confectionery (0.5 and 0.9, respectively), as well as for canned fruits (0.3 for the non-sugar-quota Asian NIC's). Elasticities with respect to RS_t for these same products for all other developing country groups are much lower. With the exception of Taiwan, none of the Asian NIC's is a major producer or exporter of raw sugar. These countries have been able to take advantage of the U.S.–world sugar price differential by buying sugar on the world market, processing it in the form of sugar-containing products, and then exporting these products to the United States. The increased trade generated for most of these countries from U.S. intervention in sugar pricing is a net benefit, since they have lost little in foreign exchange earnings through reduced sugar exports.

[5]The Caribbean countries include all countries so designated under the Caribbean Basin Economic Recovery Act of 1983.

TABLE 5

Estimated U.S. import demand equations for sugar-containing products, developing country groups, 1970–86

(1) Canned fruit															
$ASQCF_t =$	−	36.6	+	$3.3RS_t$	+	$19.1Y_t$	+	$19.1*DG_t$			+	$1.5HF_t$	$\bar{R}^2 =$	0.67
		(−1.66)		(1.44)		(1.97)		(3.77)				(1.93)	DW =	1.76
				[0.12]									$p_1 =$	0.37
$ASCF_t =$	−	13.2	+	$0.8*RS_t$	+	$3.8*Y_t$	+	$0.3DG_t$			+	$0.2HF_t$	$\bar{R}^2 =$	0.73
		(−3.31)		(2.83)		(3.29)		(0.44)				(1.92)	DW =	1.67
				[0.33]										
$SACF_t =$	−	6.5	−	$0.4RS_t$	+	$5.4*Y_t$	+	$2.3*DG_t$	−	$2.0*D_t$	+	$0.1HF_t$	$\bar{R}^2 =$	0.58
		(−2.65)		(−1.20)		(3.39)		(2.73)		(−4.73)		(0.76)	DW =	1.42
													$p_1 =$	0.60
(2) Confectionery														
$ASQC_t$[a] =	−	3.7	+	$0.2*RS_t$	+	$0.8*Y_t$	+	$0.1DG_t$	+	$1.0*DD_t$	+	$8.1*GL_t$	$\bar{R}^2 =$	0.96
		(−7.39)		(6.17)		(6.44)		(1.06)		(11.36)		(3.60)	DW =	2.06
				[0.88]										
$ASC_t =$	−	4.9	+	$0.2*RS_t$	+	$1.3*Y_t$	+	$0.1DG_t$	+	$0.5DD_t$	+	$9.0GL_t$	$\bar{R}^2 =$	0.86
		(−4.07)		(3.75)		(4.06)		(0.89)		(2.21)		(1.66)	DW =	1.88
				[0.47]										
$SAC_t =$	−	30.5	+	$0.7*RS_t$	+	$7.2*Y_t$	+	$0.4DG_t$	+	$1.8DD_t$	+	$92.0*GL_t$	$\bar{R}^2 =$	0.86
		(−6.38)		(2.67)		(5.85)		(0.85)		(2.20)		(4.29)	DW =	2.22
				[0.33]										
(3) Sweetened cocoa and chocolate products														
$AFCH_t =$	−	7.5	+	$0.2*RS_t$	+	$1.9*Y_t$	−	$0.3DG_t$	−	$0.5CO_t$	+	$7.4GL_t$	$\bar{R}^2 =$	0.84
		(−6.34)		(2.56)		(6.38)		(−2.14)		(−1.79)		(1.31)	DW =	1.91
				[1.50]										
$SACH_t =$	−	45.1	+	$1.3*RS_t$	+	$7.0*Y_t$	−	$0.6DG_t$	−	$2.5*CO_t$	+	$60.3*GL_t$	$\bar{R}^2 =$	0.94
		(−9.45)		(5.74)		(8.77)		(−1.59)		(−3.29)		(3.55)	DW =	2.29
				[1.85]									$p_1 =$	−0.52
$CBCH_t =$	−	3.7	+	$0.1RS_t$	+	$0.6*Y_t$	+	$0.2*DG_t$	−	$0.4*CO_t$	+	$7.8GL_t$	$\bar{R}^2 =$	0.81
		(−3.76)		(2.25)		(3.44)		(2.39)		(−2.64)		(2.13)	DW =	2.37
				[0.79]									$p_1 =$	−0.40
(4) Bakery products														
$ASQB_t$[a] =	−	9.4	+	$0.4*RS_t$	+	$2.2*Y_t$	+	$0.01DG_t$					$\bar{R}^2 =$	0.89
		(−6.99)		(5.69)		(6.25)		(0.08)					DW =	1.78
				[1.46]									$p_1 =$	0.53
													$p_2 =$	−0.63
$ASB_t =$	−	9.5	+	$0.6*RS_t$	+	$2.6*Y_t$	−	$0.04DG_t$					$\bar{R}^2 =$	0.84
		(−6.58)		(6.18)		(5.99)		(−0.18)					DW =	1.98
				[1.23]									$p_1 =$	0.92
													$p_2 =$	−0.85
$SAB_t =$	−	13.2	+	$0.4RS_t$	+	$3.4*Y_t$	+	$1.8*DG_t$					$\bar{R}^2 =$	0.86
		(−3.42)		(1.70)		(3.33)		(3.54)					DW =	2.17
				[0.26]									$p_1 =$	0.28
													$p_2 =$	−0.38
$CBB_t =$	−	2.9	+	$0.01RS_t$	+	$0.3*Y_t$	+	$0.01DG_t$					$\bar{R}^2 =$	0.76
		(−3.20)		(1.62)		(3.06)		(1.00)					DW =	1.74
				[0.41]									$p_1 =$	0.73
													$p_2 =$	−0.78

[a]Asian countries in this group are primarily represented by Tawain.

AF denotes African countries; ASQ, Asian countries that export raw sugar to the United States under the sugar quota; AS, other Asian countries; SA, South American countries; and CB, countries eligible for trade benefits under the Caribbean Basin Initiative. D = 1, 1981 and 1983; = 0, all other years; DD = 1, 1986; = 0, all other years. [ ] denotes elasticities with respect to RS_t calculated at the means. All other variables are defined as in Tables 2 and 3.

The results of Table 5 also indicate selected developing country beneficiaries of the GSP program with respect to the products shown. In particular, the increase of about $19 million (in real terms) in U.S. imports of canned fruits from the Asian quota countries (ASQCF) accounts for the bulk of additional U.S. imports of canned fruits under the GSP program. This increase represents about 40% of the real, average value of U.S. imports of canned fruits from these countries during the 1976–86 period. South American exports of canned fruits and bakery products also have benefitted from the GSP program, as well as Caribbean exports of sweetened cocoa and chocolate. The results also suggest that the GSP program has resulted in decreased U.S. imports of sweetened chocolate products in favor of increased confectionery imports from the developing countries, although the estimated coefficients are not statistically significant.

Conclusions

Results from econometric estimation indicate that the differential between U.S. and world sugar prices maintained by government intervention in the U.S. sugar market has contributed to increased U.S. imports of some sugar-containing products, but that growth in U.S. disposable income has played a larger role. In addition, the availability of cheaper, substitute sweeteners appears to have reduced the impact of the U.S.–foreign sugar price differential on imports of some types of confectionery and, to a smaller extent, on imports of canned fruits, products in which these sugar substitutes are used.

The results also suggest that the U.S.–foreign sugar price differential has resulted in increased U.S. imports of processed, sugar-containing products from both the developing and the developed countries, but that the latter disproportionately benefitted. This differential has provided an umbrella under which the developed countries have been able to expand their exports to the United States. At the same time, the developing countries' share in the U.S. market for some of these products declined or grew more slowly than in the 1970's when the U.S.–foreign sugar price differential was much smaller. Thus, for these products, the price differential has helped the developed countries to overcome some of the competitive factors that had been working to increase developing country shares in U.S. markets for these products, such as the GSP program.

However, some developing countries have become net beneficiaries from U.S. sugar policy. These developing countries are the Asian NIC's which, with the exception of Taiwan, are not major sugar producers. These countries have been able to take advantage of the U.S.–foreign sugar price differential by buying sugar on the world market, processing it in the form of sugar-containing products, and then exporting these products to the United States.

The results of this paper suggest another reason why it would be in the in-

terest of the developing countries to actively participate in the current round of multilateral trade negotiations to reduce trade-distorting agricultural protection. As shown by Valdes (1987), the developing countries could gain directly from developed country reduction in protection in both temperate and tropical products through increased trade and higher prices for exports. In addition to these raw commodity gains, however, reduced agricultural protection might also benefit the developing countries by enabling them to regain developed country market share for their exports of value-added, processed foods. While it is not possible to generalize from this study, which only covers sugar, this might be an area for fruitful future research.

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