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ABSTRACT

The objective of this study is to analyze the impacts of alternative trade liberalization policies in the United States and the European Union (EU), and Mexico’s export of sugar under NAFTA on the US and world sugar industries. An econometric simulation model is used for this analysis.

This study found that the US sugar industry may be able to survive if both the United States and the EU liberalize their sugar trade. However, if only the United States eliminates its sugar programs, all US sugar producing regions would be threatened. On the other hand, the world sugar industry may be better off under both trade liberalization policies. Mexico’s sugar exports under NAFTA (250,000 tons) may not significantly affect the US sugar industry. However, potential impacts of Mexico’s unlimited export of sugar after the full implementation of NAFTA would be very significant for the US sugar industry.

Key words: sugarbeet, sugarcane, loan rates, import liberalization, sugar price, Caribbean sugar price, NAFTA

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Less than 30 percent of world sugar production is traded internationally. A substantial share of this trade takes place under bilateral long-term agreements or preferential terms, such as the US sugar quota or the European Union’s Lome Convention (Borremans). Only a small proportion of world sugar is traded without import restrictions and export subsidies. Most sugar producing countries use various trade barriers to protect their own sugar industries and/or use export subsidy programs to increase or maintain their world market shares.

Under the Uruguay Round Agreement (URA) for agricultural goods, most countries made commitments to reduce their subsidies for sugar (WTO). However, the basic structure of protection for sugar still exists in most countries. A new round of World Trade Organization (WTO) negotiations, which failed in Seattle in December 1999, will start again soon and negotiations for the Free Trade Area of Americas (FTAA) are in progress. Liberalization of the world sugar industry through the successful conclusions of these two negotiations would affect the US sugar industry.

The primary objective of this study is to analyze the impacts of alternative trade liberalization policies in the United States and the European Union (EU) and Mexico’s sugar exports to the United States under NAFTA on the US and world sugar industries. Several studies have analyzed the effects of moving to freer trade in sugar. Some of the these studies are by Borrell and Pearce; Brown, Tyers and Anderson; GAO; Kirby et al.; Roningen and Dixit; Marks, Schmitz and Christian; Wong, Sturgiss, and Borrell; and Zietz and Valdez. All of the studies found that the world sugar price rises with trade liberalization. However, the degree of price increase varies with the model used. Borrell and Pearce found that a full multilateral liberalization by the US and the EU would raise the world sugar price by 20 percent. Brown found that liberalization by the EU would raise the world sugar price by 3 percent and liberalization by either the United States or Japan would raise the world sugar price by 1 percent. Tyers and Anderson found that the world price would increase by as much as 22 percent if all industrial market economies liberalize trade. Roningen and Dixit found that a price increase would be about 50 to 55 percent. They also found that the policies of the EU have the most depressing effect on the world price. On the other hand, the liberalization policies in the US would lower domestic price of sugar in the United States. The GAO study showed that the US wholesale price of sugar would have dropped 38 percent from 26.12 cents/lb to 16.12 cents/lb, if the sugar program had been eliminated in 1998. However, the GAO study found that reductions in sugar production would be less than 5 percent due to decreased price in 1998.

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The depressed price in the United States would increase consumer surplus and decrease producer surplus - net welfare gains from trade liberalization in the country (GAO; Maskus; Leu, Schmitz and Knutson; Schmitz, Allen and Leu; and USDA (1984)). GAO (2000) and USDA (1984) estimated the annual cost of the sugar program to be $0.93 and $0.7 billion in the United States, which are substantially below the comparable $1.9 billion by Leu, Schmitz, and Knutson. Schmitz, Allen, and Leu estimated a net social cost of $1.3 billion. Markus’s estimation of the annual social cost ranges between $460 million and $1.3 billion.

1. OVERVIEW OF THE UNITED STATES AND WORLD SUGAR INDUSTRIES

Sugar is produced in over 100 countries worldwide. For the 1994-1998 period, global sugar production was approximately 119 million tons raw value (MTRV) annually with 30 percent of production exported from its country of origin (USDA-ERS 1999). The largest sugar producing region is the EU, followed by India and Brazil (Table 1).

Per capita sugar consumption is highest in Cuba (130 lb), followed by Brazil and Australia. Per capita sugar consumption in the United States is 72 lb, which is above world average per capita consumption (44 lb). Per capita sugar consumption is lowest in China at 15 lb. Global sugar consumption for the 1994-1998 period was 117 MTRV annually.

The major sugar exporting countries are the EU, Brazil, Australia, Thailand, Cuba, and Ukraine. These countries account for 73 percent of global exports from 1990 to 1995. While relatively few countries dominate world sugar exports, imports are less concentrated. Major importing countries are the EU, Russia, China, the United States, Japan, Korea, and Canada. Their imports accounted for about 46 percent of all sugar imports from 1994 to 1998. Under the Lome Convention, the EU is required to import sugar under preferential terms from certain African, Caribbean, and Pacific countries.

The Caribbean raw sugar price is usually considered to be the world market price for sugar. Except for years with high world market prices, there is a substantial wedge between the US wholesale price of raw sugar and the world market price (USDA-ERS, various issues). Over the last decade (1988-1997), US wholesale prices fluctuated between $0.25 per pound and $0.29 per pound (Figure 1). World market prices ranged between $0.09 per pound and $0.13 per pound. Both real Caribbean raw sugar prices and U.S. raw sugar import prices have long-term downward trends.

The volatility of world sugar prices could be due to the nature of supply
response to price changes stemming from high fixed costs of sugar production. An increase in sugar production in response to rising sugar prices requires significant investments in processing facilities, and it takes some time until new production capacity becomes available. Once the facilities are in place, they tend to be used at full capacity to spread the fixed costs. Thus, when prices fall, production remains at full capacity. Sugar production is relatively unresponsive to price in the short run. Supply of sugar cane is less sensitive to prices than sugar beet supply since sugar cane is a perennial crop.

The United States produces both beet and cane sugar. Cane sugar is produced mainly in Florida, Louisiana, Texas, and Hawaii. Beet sugar is produced largely in the Great Lakes region, Upper Midwest, Great Plains, and far western states. US total sugar production increased about 34 percent from 6.1 MTRV in 1985/86 to 8.2 MTRV in 1998/99 (USDA-ERS, various issues). Beet sugar production increased 41.3 percent for the 1985 to 1998 period, while cane sugar production increased 22.7 percent.

US consumption of sugar also increased 22 percent from 8.1 MTRV in 1985/86 to 9.8 MTRV in 1997/98. The balance was imported from more than forty countries. US sugar imports were reduced 71 percent from 4.5 MTRV to 1.3 MTRV for the 1974 to 1987 period and then increased to 2.1 MTRV for the 1988 to 1998 period.

Figure 2 shows market share of different sweeteners in the United States. Sugar produced in the US accounted for about 40 percent of total domestic sweetener consumption during the 1985 to 1998 period. Market share of high fructose corn syrup (HFCS) was less than 10 percent of the domestic sweetener consumption in 1974, and increased to about 40 percent for the last 25 years. On the other hand, market share of imported sugar decreased substantially for the period. This clearly implies that production of HFCS did not affect production of sugar in the US, but did affect sugar imports. Production of HFCS has stabilized since 1995.

2. SUGAR PROGRAM AND POLICIES IN THE US, THE EU, AND OTHER COUNTRIES

Sugar programs and policies differ among countries. Table 2 shows major policies used by major sugar producing regions and countries.

2.1 The US Sugar Programs and Policies

The US sugar program was established by the Food and Agricultural Act of 1981. Several modifications have been made by the Food Security Act of 1985; the Food, Agriculture, Conservation, and Trade Act of 1990; and the Federal
Agriculture Improvement and Reform (FAIR) Act of 1996.

The core policy tools in the program are the loan program and import restrictions (Lord). The main purpose of the loan program is to maintain a minimum market price to US producers. Processors use sugar as collateral for loans from the US Department of Agriculture (USDA). The program permits processors to store the sugar rather than sell it for lower than desired prices. Loans can be taken for up to nine months. Processors pay growers for delivered beets and cane, typically about 60 percent of the loan. The final payments are made, and the loan is repaid after the sugar has been sold.

Under the FAIR Act, the sugar loan rate is set at 18 cents per pound for raw cane sugar and 22.9 cents per pound for refined beet sugar. Loans under the FAIR Act become recourse loans if the tariff rate quota (TRQ) is at or below 1.5 million tons, regardless of the price. When the TRQ is set above 1.5 million tons, the loans are non-recourse. Under the non-recourse loan, a processor is entitled to forfeit collateral (sugar) to the Commodity Credit Corporation (CCC) in repayment of the loan if market prices fall below the loan rates. The processor must pay a penalty of 1.07 cent per pound of sugar.

Processors who obtain a non-recourse loan must pay farmers an amount for their sugarbeets and sugarcane that is proportional to the loan value of sugar. The USDA is authorized to establish minimum sugarbeet and sugarcane prices that processors must pay to growers. This is the same as under previous legislation.

The URA on agriculture made minor adjustments for the sugar trade. US import quotas on sugar were converted into TRQs, implying that a specified amount of sugar can be imported at the lower of two alternative duty rates. The amount of raw cane sugar subject to the lower duty rate must be no less than 1,117,195 metric tons in a fiscal year (Lord). The minimum low-duty imports of refined sugar is 22,000 metric tons. The minimum low-duty imports for raw and refined sugar add up to 1.256 million short tons raw value of sugar per year. The high duty (about 17.62 cents per pound) is imposed on the amount of sugar imported over the import quota. The first-tier (low) duty ranges from zero to 0.625 cents per pound. The second-tier (high) duty for raw cane sugar will be reduced from 17.62 cents per pound in 1995 to 15.82 cents per pound in 2000 under the URA. The duty for refined sugar will be reduced from 18.6 cents per pound in 1995 to 16.21 cents per pound in 2000. The quota will remain at the same level for the 1995 to 2000 period.

2.2 Sugar Trade Under NAFTA

The sugar quota has been allocated among more than 40 quota-holding
countries, allowing imports of specific quantities of sugar at first-tier (low) duty rates. The quota allocation to these countries is based on their “Olympic average” market shares of US imports in the period 1975-81 (Skully).

Mexico’s duty free access to the US market is limited to a maximum of 25,000 tons until September 2000 and will increase to 250,000 tons as of October 1, 2000 under the terms of the side-agreement of the North American Free Trade Agreement (NAFTA). NAFTA also allows a rapid reduction in the second-tier duty for Mexican sugar over the next several years. The second-tier duty for Mexican sugar will be reduced from 16.11 cents per pound in 1995 to zero in 2008. This implies that there will be no import restrictions on Mexico’s sugar after 2008. Duties for most countries will remain at 15.36 cents for raw cane sugar and 16.21 cents for refined sugar (Henneberry and Haley). Mexico is in a unique position to increase its exports of sugar to the United States above the allocated quota. Mexico produced 5.1 million metric tons of sugar in 1998 and consumed 4.24 million metric tons. Its exports were 0.87 million metric tons in 1998. If Mexico starts to use HFCS for beverages, more of its sugar could be exported to the United States.

2.3 Domestic and Export Subsidies in the EU

The basic tools of the EU’s sugar policies are:

1. import restrictions with limited free access for certain suppliers;
2. internal support prices that ensure returns to producers for fixed quantities of production and permit the maintenance of refining capacity; and
3. export subsidies for a quantity of domestically produced sugar (Borremans).

EU member states allocate an “A” quota and a “B” quota to each sugar producing operation, each isoglucose producing operation, and each inulin syrup producing operation established in their territory. Current quota levels have been placed since the accession of Austria, Sweden, and Finland to the EU and are currently legislated at these levels until 2000/01. The total EU sugar production quotas for A and B sugar are 11.98 million and 2.61 million, respectively. Any sugar that is produced by any member of the EU that is in excess of its yearly quota is considered “C-sugar.” A and B sugar production is used for domestic consumption and for subsidized exports. C-sugar must be exported into the world market without subsidy or carried over into the next marketing year. In general, EU’s target price for white sugar is about 30 cents (Euro) per pound, and its intervention
price is 28.72 cents (Euro) per pound. The export subsidy was 20.0 cents (Euro) per pound for the 1995 to 1998 period. The EU’s internal support is about 30 percent higher than that in the United States (Landell Mills Commodities).

Since marketing year 1995, EU subsidized exports of sugar to third world countries have been limited, in volume and value, under its UR commitments. However, the EU did not make an export subsidy commitment on its subsidized exports of a quantity of sugar equal to its preferential imports under the Lomé Convention (Borremans and Steel).

2.4 Sugar Policies in Other Countries

South Africa has both internal price supports and export subsidies. South Africa is reducing its quantity of subsidized exports by 200,000 tons to 702,208 tons by the year 2000 under the URA (Steel 1999). Mexico also has subsidized exports and is subsidizing raw sugar storage (Steel 1999).

Australia’s sugar exports are handled by the Queensland Sugar Corporation (QSC), a statutory authority established under the Sugar Industry Act, 1991 (Boston Consulting Group 1996). The QSC is responsible for the domestic marketing and export of 100 percent of the raw sugar produced in the state of Queensland, which produces 95 percent of the sugar produced in Australia. The QSC supports domestic producers through buyer-seller arrangements, marketing quotas, dual pricing arrangements, and other quasi-government mechanisms that isolate domestic producers from foreign competition. State trading enterprises (STEs) were not included in the URA. Other countries, including China and India, handle their sugar trade through STEs similar to the QSC.

3. AN ECONOMETRIC SIMULATION MODEL

Although WTO members have made commitments to reduce internal supports and export subsidies, levels of these subsidies differ among countries. For instance, the EU’s internal supports (producer support prices) for sugarbeet growers are about 30 percent higher than those in the US (Table 3). Although the EU will reduce its subsidies on the basis of the committed URA schedule, the EU’s export subsidies will remain at about $499 million (Euro) in 2000/01, and subsidized exports will remain at 1.3 million tons. These subsidies have stimulated sugar production in the region and lowered sugar prices in the world market. A fundamental question is what is going to happen in the world sugar industry if the US government eliminates the sugar programs, mainly loan rates and TRQs in the United States, while other countries maintain their subsidies. There is strong
opposition to the US sugar program from food processors and consumers, and the elimination of the sugar program has been debated publicly for the last decade. A global sugar simulation model developed by Benirschka, Koo, and Lou was revised to address this question.

3.1 Econometric Simulation Model

The global sugar policy simulation model developed by Benirschka et al. was used for this analysis. This model includes 17 sugar producing and consuming countries. Some of these countries are beet sugar producing countries (Algeria, Canada, the EU, and FSU) and some are cane sugar producing countries (Australia, Brazil, Cuba, India, Indonesia, Mexico, South Africa, and Thailand). The remaining countries (China, Egypt, Japan, and the United States) produce both beet and cane sugar. These two sugars are perfectly substitutable in consumption, but are differentiated in the production process. Sugarcane is produced in tropical and subtropical climate zones. Once the cane is harvested, the sucrose starts breaking down. Thus, to minimize transport costs and sucrose losses, sugarcane mills are located close to cane fields. Mills convert sugarcane into raw sugar that is shipped to refineries for further processing into refined sugar. On the other hand, sugarbeets are produced in temperate climate zones. Since sugarbeets are bulky and costly to transport, beet processing facilities are located near the fields.

Sugar production, consumption, and carry-over stock equations in major producing and consuming countries are estimated with time series data by using econometric techniques. The market clearing condition requires that the sum of all countries’ excess demand for sugar, which is a function of the world price of sugar, is zero. This aggregate excess demand equation is solved for the equilibrium price.

3.2 Model Structure and Development

Area and yield equations determine the supply of sugar. Since sugar is divided into two classes (cane sugar and beet sugar), two separate supply equations are estimated in the United States, Egypt, Japan and China, which produce both sugar classes. Other countries have either sugarcane or sugarbeet equations.

Sugar area depends upon expected prices of sugar and alternative crops. As a proxy for price expectations, lagged prices are used in the area equation. In addition to commodity prices, the lagged area variable is included to capture dynamics associated with producers’ planting decisions. Area harvested is a function of lagged area, prices of sugar and alternative crops, and government policies as follows:
Unilateral and Multilateral Trade Liberalization on Sugar

\[ a_{i,t} = f \left( a_{i,t-1}, p_{i,t-1}, p^e_{t-1}, g_i \right) \]  

where \( a^s \) is the sugar area harvested, \( p^s \) is the world market price or domestic price of sugar, \( p^e \) is the prices of alternative crops, \( g \) is policy parameters, and \( i \) represents an index for sugar type (\( i=1 \) for cane sugar and \( i=2 \) for beet sugar).

Since sugarcane and sugarbeets are not competing directly for land, area of each type is a function of the price of the corresponding crop. Competing crops are cotton in sugarcane producing regions and wheat, barley, and oilseed crops in sugarbeet producing regions.

Assuming that sugar yields depend upon production practices and advances in technology, the total quantity of sugar produced (\( q_{p_{t-1}} \)) is the product of the area harvested and yield per hectare:

\[ q_{p_{t-1}} = a_{i,t} \cdot y_{i,t} \]  

Per capita sugar consumption is a function of the price of sugar, income and a time trend representing changes in consumers' tastes and preferences:

\[ fd^s_t = f \left( p^s_t, cy_t, t \right) \]  

where \( fd^s_t \) is per capita demand for sugar, \( p^s_t \) is the domestic price of sugar, \( cy_t \) is per capita disposable income, and \( t \) is a trend.

Total consumption of sugar is calculated by multiplying the per capita consumption by population in the country as:

\[ qd^s_t = fd^s_t \cdot pop_t \]  

where \( qd^s_t \) is the total demand for sugar and \( pop_t \) represents population.

Carry-out stocks \( (qs^s_t) \) are a precaution against unexpected shortfalls in production. These stocks, therefore, are likely related to the level of domestic production. However, since the opportunity cost of holding sugar stocks depends on the price of sugar, the stocks should respond to price changes as:

\[ qs^s_t = f \left( qs^s_{t-1}, qp^s_t, p^s_t \right) \]  

Net exports \( (qx^s_t) \) are the difference between domestic supply (domestic production plus carry-net export \( (qx^s_t) \) in a country is in stocks) and demand (domestic consumption plus carry-out stocks):

\[ qx^s_t = qs^s_{t-1} + qp^s_{t-1} - qd^s_t - qs^s_t \]  

If net export \( (qx^s_t) \) in a country is positive, the country is an exporting country. On the other hand, if negative, the country is an importing country.

A market equilibrium condition is expressed as:

\[ \sum_{n=1}^{n} qx_{1,n} = 0 \]
The equilibrium condition is solved to determine the market clearing prices of sugar. The equilibrium world price of sugar \((p_{m,s}^w)\) obtained from Equation 7 is converted into domestic prices \((p_{m,s}^n)\) using the official exchange rates \((e_{r,n})\) as follows:

\[
p_{m,s}^n = p_{m,s}^w * e_{r,n}^n \tag{8}
\]

A price equation, which was estimated by regressing the domestic price of sugar against the world price of sugar \((p_{m,s}^w)\), is used to convert world price into domestic price.

### 3.3 Assumptions and Data Collection

The baseline simulation is grounded on a series of assumptions about the general economy, agricultural policies, and technological changes in exporting and importing countries for the simulation period (2000-2004). Macro assumptions are based on forecasts prepared by WEFA group and Project Link. Some of the macro variables are GDP growth rates, interest rates, exchange rates, and inflation rates in the countries. It is generally assumed that current agricultural policy will be continued in all countries in the baseline simulation. Average weather conditions and historical rates of technological change also are assumed in this simulation. The price of sugar in individual countries and the world market are endogenous, while the prices of other crops are exogenous. Thus, the baseline simulation is based on forecasted world prices of crops that have substitute and complementary relationships with sugarbeets and sugarcane. The forecasted prices of other crops were obtained from the Food and Agricultural Policy Institute (FAPRI) baseline solution.

### 3.4 Alternative Scenarios

Alternative scenarios are developed on the basis of possible policy changes in the United States and the EU. The scenarios are:

1. The US eliminates its TRQ and loan rates on sugar for the 2001 to 2004 period, while other countries maintain their subsidies and import restricting programs (Scenario 1).
2. Both the US and the EU eliminate import restrictions and subsidies, respectively, for the 2001 to 2004 period, while other countries maintain their subsidies and import restricting programs (Scenario 2).
3. Mexico exports the maximum of 250,000 metric tons annually to the US beginning in 2001 under the terms of the side agreement to NAFTA (Scenario 3).

The results from these alternative scenarios are compared with those from the base scenario to evaluate impacts of the stated policy changes on the US sugar industry.
The estimated price elasticities of harvested area are 0.22 for sugar beet and 0.13 for sugar cane (Benirschka et al.). In the US price elasticities in sugar beet regions are more elastic than sugar cane regions mainly because sugar beet regions have more substitute crops than sugar cane regions. If the domestic wholesale price of sugar decreases below approximately 15 cents/lb in the United States, sugar beet and cane production may cease. However this shut-down price may differ among regions. Under Scenarios 1 through 3, kinked supply response equations are used with a supply elasticity of 2.5 for the price of sugar less than 15 cents/lb and inelastic supply elasticities in the base scenario for the the price of sugar higher than or equal to 15 cents/lb.

4. THE US SUGAR INDUSTRY UNDER THE BASE AND ALTERNATIVE TRADE POLICIES

In the base scenario, sugar production in the United States is expected to increase about 3.5 percent for beet sugar and 0.3 percent for cane sugar in 2004 compared to the actual production in 1998 (Table 4). Sugar consumption in the US is expected to increase about 2.7 percent, which is slightly larger than average production. As a result, US imports of sugar are projected to increase 5.4 percent in this time period.

The Caribbean sugar price is expected to increase 3.0 percent for the 1998 to 2004 period in the base scenario (Table 4). The US domestic wholesale price of sugar is expected to remain nearly unchanged during the same time period, mainly because the US government controls its sugar imports to stabilize the domestic price of sugar.

4.1 Elimination of Import Restrictions and the Loan Program in the US

Under the US trade liberalization scenario in which the United States eliminates its import restrictions while other countries maintain their sugar programs (Scenario 1), the Caribbean price of sugar is expected to increase about 28.9 percent in 2004 compared to the base scenario because increased US sugar imports raise demand for sugar in the world market. At the same time, the US wholesale price decreases 28.2 percent because increased imports raise the supply of sugar in the United States.

Under the US trade liberalization scenario, US sugar production is expected to decrease 21.2 percent for beet sugar and 14.1 percent for cane sugar in 2004 compared to production in the base scenario. Sugar consumption is expected to increase about 10.3 percent compared to the base scenario in 2004 (Table 4). US sugar imports would increase 83.2 percent under this scenario.
4.2 Elimination of Domestic Programs and Trade Liberalization in the US and the EU

When both the United States and the EU liberalize their sugar trade, the Caribbean price of sugar is expected to increase 63.1 percent from 9.98 cents under the base scenario to 16.28 cents per pound in 2004. This increase is mainly because (1) sugar production in the EU decreases substantially and the EU starts to import sugar and (2) the United States also increases its sugar imports, resulting in the increased demand for sugar in the world market. The US wholesale price of sugar decreases only 10.1 percent in 2004 under this scenario.

Sugar production in the United States is reduced 12.5 percent for beet sugar and 6.3 percent for cane sugar, which is much smaller than under the US trade liberalization scenario. Sugar consumption would increase 6.1 percent. As a result, sugar imports would increase 38.8 percent, which is much smaller than under the US trade liberalization scenario. This implies that impacts on the US sugar industry are not significant if both the United States and the EU liberalize their sugar policies.

4.3 Mexico’s Exports Under NAFTA

If Mexico exports a maximum of 250,000 metric tons annually to the United States beginning in October 2000 under the terms of the side agreement to NAFTA, US domestic price of sugar is expected to decrease about 9.6 percent to 23.6 cents per pound in 2004, compared to the baseline projection. As a result, domestic production of sugar is expected to be about 3.2 percent lower than under the baseline scenario in 2004, while consumption is expected to increase about 4 percent. Caribbean price of sugar is expected to remain at the same level as the price in the baseline scenario.

4.3 Welfare Effects of Trade Liberalization Policies

To investigate welfare effects of the sugar trade policies, consumer and producer surpluses are calculated on the basis of expected US wholesale price of sugar in the base and trade liberalization scenarios. Producer surplus is divided into surplus for beet sugar producers and cane sugar producers. Because price elasticity of supply of beet sugar is more elastic than that of cane sugar, each producer group has different welfare effects.

Since the US trade liberalization scenarios lower the wholesale price of sugar in the US, consumer surplus in Scenarios 1 and 3 are larger than in the base scenario. Increase in consumer surplus is $1,856 million in Scenario 1 (the US trade liberalization scenario) and $935 million in Scenario 3 (the US and EU trade liberalization scenario).
(Table 5). However, producer surplus is reduced as a result of the decreased domestic price of sugar in these two scenarios; $1.263 million in Scenario 1 and $683 million in Scenario 3. Net changes in social welfare are positive, implying that increases in consumer surplus are larger than losses in producer surplus.

Under the EU trade liberalization scenario, welfare effects on US sugar producers and consumers are relatively small compared to other scenarios. Producer surplus is increased by $31 million, while consumer surplus reduced by $254 million, resulting in the net welfare loss of $223 million.

Additionally, there will be increases in the production of substitute crops when idle land in Scenarios 1 and 3 is used to produce substitute crops, such as wheat, corn, and soybeans in the beet sugar producing regions and cotton in most cane sugar producing regions. Welfare effects of substitute crops are not calculated in Florida, Hawaii and California, mainly because Florida does not have substitute crops and the sugar production in the other regions is relatively small. Prices of these substitute crops will decrease as production increases, which will increase consumer surplus and decrease producer surplus. In this case, loss in producer surplus is larger than gains in consumer surplus since the United States is an exporting country of these crops. This implies that welfare gain from the elimination of the sugar program may be smaller than the estimated values if welfare losses from other crops are considered. Welfare losses from production of other crops are $37 million for Scenario 1 and $21 million for Scenario 3. Under Scenario 2, increased sugar cane and beet production lowers area for other crops. This raises the prices of alternative crops, resulting in decreases in consumer surplus and increases in producer surplus. This scenario has the welfare gain of $2.6 million. Thus, net changes in social welfare, after adding welfare effects on other crops, are $555 million under Scenario 1, -$220.4 million under Scenario 2, and $232 million under Scenario 3. This implies that unilateral trade liberalization in the United States and trade liberalization in both the US and EU increase welfare values in the US while trade liberalization in the EU decreases welfare values in the United States. Increased welfare values indicate that Scenario 1 is more welfare enhancing than Scenario 3. However, Scenario 3 may be a more desirable option for US sugar producers, mainly because this scenario provides fair competition for US sugar producers, while Scenario 1 penalizes US sugar producers and provides an unfair advantage to sugar producers in the EU.
5. CONCLUDING REMARKS

The US sugar industry has been protected by the US sugar program in the 1996 FAIR Act and the TRQ under the URA. As a result, the domestic sugar price is about 23 cents, whereas the world sugar price is 9 cents per pound in 1999. Of concern is what the US sugar industry will face with the expected changes in the US sugar programs in the next round of WTO negotiations on agriculture.

In the base scenario, sugar production in the United States is expected to increase about 3.5 percent for beet sugar and 0.3 percent for cane sugar during the 1998 to 2004 period. However, sugar consumption in the US is expected to increase about 2.7 percent. As a result, US imports of sugar are projected to increase 5.4 percent in this time period.

The Caribbean sugar price is expected to increase 3 percent during the 2001 to 2004 period in the base scenario. However, the US domestic wholesale price of sugar is expected to remain nearly unchanged. This is mainly because the US government controls its imports to stabilize the domestic price of sugar.

Under the US trade liberalization scenario in which the United States eliminates its import restrictions while other countries maintain their sugar programs, the Caribbean price of sugar is expected to increase about 28.8 percent in 2004 compared to the base scenario because increased US sugar imports raise demand for sugar in the world market. At the same time, the US wholesale price decreases 28.2 percent. US sugar production is reduced substantially due to decreased domestic sugar price, resulting in increases in sugar imports. When both the US and the EU liberalize their sugar trade, the Caribbean price of sugar is expected to increase 63.1 percent from 9.98 cents under the base scenario to 16.28 cents per pound in 2004, and the US wholesale price of sugar decreases 10.1 percent. As a result, its impacts on the domestic sugar industry are not significant. These results imply that the US sugar industry may be able to survive if both the United States and the EU liberalize their sugar trade. Under the EU’s trade liberalization scenario, welfare effects on US sugar producers and consumers are small ($31 million increase in producer surplus and $254 million reduction in consumer surplus).

When Mexico increases its exports of sugar under NAFTA, the US domestic wholesale price of sugar decreases about 9.6 percent, with no impacts on the world sugar prices. However, Mexico’s sugar exports after the full implementation of NAFTA would be very significant for the US sugar industry.
REFERENCES


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Table 1. World Sugar Supply and Utilization, 1995 to 1998 Average

<table>
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<tr>
<th>Country</th>
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<td>10</td>
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<td>-902</td>
<td>96</td>
</tr>
<tr>
<td>Australia</td>
<td>C</td>
<td>5,252</td>
<td>884</td>
<td>4,293</td>
<td>221</td>
</tr>
<tr>
<td>Brazil</td>
<td>C</td>
<td>13,256</td>
<td>8,180</td>
<td>5,080</td>
<td>679</td>
</tr>
<tr>
<td>Canada</td>
<td>B</td>
<td>134</td>
<td>1,243</td>
<td>-1,114</td>
<td>160</td>
</tr>
<tr>
<td>China</td>
<td>B/C</td>
<td>7,177</td>
<td>8,209</td>
<td>-1,327</td>
<td>2,560</td>
</tr>
<tr>
<td>Cuba</td>
<td>C</td>
<td>3,970</td>
<td>646</td>
<td>3,300</td>
<td>304</td>
</tr>
<tr>
<td>Egypt</td>
<td>B/C</td>
<td>1,120</td>
<td>1,735</td>
<td>-665</td>
<td>320</td>
</tr>
<tr>
<td>European Union (I 2)</td>
<td>B</td>
<td>17,562</td>
<td>14,006</td>
<td>3,721</td>
<td>2,395</td>
</tr>
<tr>
<td>Former Soviet Union</td>
<td>B</td>
<td>5,708</td>
<td>9,755</td>
<td>-3,795</td>
<td>1,714</td>
</tr>
<tr>
<td>India</td>
<td>C</td>
<td>15,037</td>
<td>14,808</td>
<td>-242</td>
<td>6,012</td>
</tr>
<tr>
<td>Indonesia</td>
<td>C</td>
<td>2,226</td>
<td>2,955</td>
<td>-815</td>
<td>537</td>
</tr>
<tr>
<td>Japan</td>
<td>B/C</td>
<td>815</td>
<td>2,489</td>
<td>-1,662</td>
<td>135</td>
</tr>
<tr>
<td>Mexico</td>
<td>C</td>
<td>4,576</td>
<td>4,238</td>
<td>421</td>
<td>630</td>
</tr>
<tr>
<td>South Africa</td>
<td>C</td>
<td>1,958</td>
<td>1,399</td>
<td>552</td>
<td>366</td>
</tr>
<tr>
<td>South Korea</td>
<td>-</td>
<td>0</td>
<td>1,104</td>
<td>-1,113</td>
<td>134</td>
</tr>
<tr>
<td>Thailand</td>
<td>C</td>
<td>5,176</td>
<td>1,517</td>
<td>3,673</td>
<td>575</td>
</tr>
<tr>
<td>United States</td>
<td>B/C</td>
<td>6,897</td>
<td>8,690</td>
<td>-1,744</td>
<td>1,268</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>B/C</td>
<td>28,950</td>
<td>34,452</td>
<td>-7,662</td>
<td>6,242</td>
</tr>
<tr>
<td>World Total</td>
<td></td>
<td>119,825</td>
<td>117,228</td>
<td>34,888</td>
<td>24,346</td>
</tr>
</tbody>
</table>


Table 2. Policies and Practices Affecting Sugar Trade

<table>
<thead>
<tr>
<th>Countries</th>
<th>Practice/Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Loan program, TRQ</td>
</tr>
<tr>
<td>EU, South Africa, Mexico</td>
<td>Internal support, export subsidies</td>
</tr>
<tr>
<td>Australia, China, India</td>
<td>State trading enterprises (STEs)</td>
</tr>
<tr>
<td>Developing Countries</td>
<td>High tariffs, lower labor costs and standards, weak</td>
</tr>
<tr>
<td></td>
<td>Environmental standards</td>
</tr>
<tr>
<td>Non-WTO Members</td>
<td>Independence from WTO rules on market access, internal</td>
</tr>
<tr>
<td></td>
<td>support, and export subsidies</td>
</tr>
</tbody>
</table>

Table 3. US-EU Sugar Policy Comparison

<table>
<thead>
<tr>
<th>Item</th>
<th>United States</th>
<th>European Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade Status</td>
<td>Net importer</td>
<td>World’s largest Exporter</td>
</tr>
<tr>
<td>Producer Support Price (refined sugar)</td>
<td>22.90¢/lb</td>
<td>30-31¢/lb(^a)</td>
</tr>
<tr>
<td>Retail Price(^b) (refined sugar)</td>
<td>41¢/lb</td>
<td>61¢/lb</td>
</tr>
<tr>
<td>Export Subsidies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Production or Marketing Controls on Sugar</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Production or Import Controls on Corn Sweeteners</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Storage Payments to Producers</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>National Aids to Producers(^d)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Refiner Subsidies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Subsidy for Nonfood Uses of Sugar</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\(^a\) Weighted average of “A,” “B,” and “C” quotas; dollar value rises with exchange rates.


\(^d\) Italy and Spain pay their producers additional subsidies.

Table 4. Sugar Price, Production, Consumption, and Imports under the Base and Trade Liberalization Scenarios in the United States

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beet sugar '000 tons</td>
<td>32,496</td>
<td>33,640</td>
<td>26,503</td>
<td>29,358</td>
<td>32,395</td>
</tr>
<tr>
<td>Cane sugar '000 tons</td>
<td>30,024</td>
<td>30,129</td>
<td>25,890</td>
<td>28,167</td>
<td>29,385</td>
</tr>
<tr>
<td>Consumption '000 tons</td>
<td>9,647</td>
<td>9,913</td>
<td>10,932</td>
<td>10,476</td>
<td>9,952</td>
</tr>
<tr>
<td>Imports '000 tons</td>
<td>1,816</td>
<td>2,160</td>
<td>3,957</td>
<td>2,998</td>
<td>2,136</td>
</tr>
<tr>
<td><strong>Price:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarbeets $/ton</td>
<td>38.29</td>
<td></td>
<td>28.90</td>
<td>34.54</td>
<td>36.73</td>
</tr>
<tr>
<td>Sugar cane $/ton</td>
<td>26.96</td>
<td>29.92</td>
<td>18.75</td>
<td>23.69</td>
<td>26.17</td>
</tr>
<tr>
<td>Caribbean €/lbs</td>
<td>9.68</td>
<td>9.98</td>
<td>12.86</td>
<td>16.28</td>
<td>9.70</td>
</tr>
</tbody>
</table>

Farm & Business: The Journal of the Caribbean Agro-Economic Society
### Table 5. Costs and Benefits under the Base and Alternative Trade Liberalization Scenarios (millions of 1998 dollars)

<table>
<thead>
<tr>
<th>Welfare Values</th>
<th>Base</th>
<th>Trade Liberalization in the US (Scenario 1)</th>
<th>Trade Liberalization in EU (Scenario 2)</th>
<th>Trade Liberalization US &amp; EU (Scenario 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Surplus</td>
<td>6,499</td>
<td>8,354</td>
<td>6,245</td>
<td>7,734</td>
</tr>
<tr>
<td>Producer Surplus</td>
<td>1,513</td>
<td>841</td>
<td>1,541</td>
<td>1,144</td>
</tr>
<tr>
<td>Beet sugar</td>
<td>1,606</td>
<td>1,050</td>
<td>1,609</td>
<td>1,294</td>
</tr>
<tr>
<td>Cane sugar</td>
<td>9,618</td>
<td>10,210</td>
<td>9,395</td>
<td>9,872</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Changes in Welfare Values</th>
<th>Base</th>
<th>Trade Liberalization in the US (Scenario 1)</th>
<th>Trade Liberalization in EU (Scenario 2)</th>
<th>Trade Liberalization US &amp; EU (Scenario 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Surplus</td>
<td>0</td>
<td>1,856</td>
<td>-254</td>
<td>935</td>
</tr>
<tr>
<td>Producer Surplus</td>
<td>0</td>
<td>0</td>
<td>28</td>
<td>-370</td>
</tr>
<tr>
<td>Beet sugar</td>
<td>0</td>
<td>-672</td>
<td>28</td>
<td>-313</td>
</tr>
<tr>
<td>Cane sugar</td>
<td>0</td>
<td>-591</td>
<td>3</td>
<td>-313</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>592</td>
<td>-223</td>
<td>253</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Changes in Welfare Values in Other Crop Industries</th>
<th>Base</th>
<th>Trade Liberalization in the US (Scenario 1)</th>
<th>Trade Liberalization in EU (Scenario 2)</th>
<th>Trade Liberalization US &amp; EU (Scenario 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>0</td>
<td>-7</td>
<td>1.4</td>
<td>-4</td>
</tr>
<tr>
<td>Soybeans</td>
<td>0</td>
<td>-16</td>
<td>0.3</td>
<td>-10</td>
</tr>
<tr>
<td>Wheat</td>
<td>0</td>
<td>-3</td>
<td>0.6</td>
<td>-2</td>
</tr>
<tr>
<td>Cotton</td>
<td>0</td>
<td>-11</td>
<td>0.3</td>
<td>-5</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>-37</td>
<td>2.6</td>
<td>-21</td>
</tr>
</tbody>
</table>

Price elasticity of domestic demand for sugar = -0.39  
Price elasticity of domestic supply of sugar beet = 0.22  
Price elasticity of domestic supply of sugar cane = 0.12  
Wholesale price of sugar = $510/ton  
Average annual sugar consumption = 9.9 million tons  
Average annual sugar production of beet sugar = 4.3 million  
Average annual sugar production of beet sugar = 3.5 million

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Figure 1. US Wholesale Sugar and HFCS Price

Source: USDA-ERS, *Sugar and Sweetener Situation and Outlook*, various issues.
Figure 2. Market Share for Sweeteners in the United States

Source: USDA-ERS, Sugar and Sweetener Situation and Outlook, various issues.