

Effects of Trade Liberalization on the World Sugar Market

EXECUTIVE SUMMARY

The purpose of this report is to present and discuss findings of a study of trade liberalization on the world sugar market. The study considers the following scenarios: (a) the effects of trade liberalization from the Uruguay Round Agreement (URA), (b) the effects of complete global trade liberalization, (c) the effects of partial trade liberalization, (d) the effects of complete trade liberalization in the industrialized countries, (e) the effects of partial trade liberalization in the industrialized countries, (f) the effects of complete trade liberalization in the major developing countries (Brazil, China, Indonesia, and Republic of Korea), and (g) the effects of partial trade liberalization in the major developing countries. The analysis focused on changes in the world sugar price and on changes in production, consumption, stock changes, and net trade in the 42 countries and/or regions: the United States, Canada, European Community (EC), Other Western Europe, Poland, Other Eastern Europe, Former USSR, Japan, Australia, New Zealand, Fiji, Rest of Oceania, China, India, Indonesia, the Philippines, Thailand, Malaysia, Pakistan, Vietnam, Korea, Bangladesh, Other Asia, Cuba, Guatemala, Mexico, Argentina, Brazil, Chile, Other Latin America, South Africa, Kenya, Zimbabwe, Algeria, Malawi, Tanzania, Egypt, Mauritius, Rest of Africa, Turkey, Saudi Arabia, and Other Near Eastern countries. In addition to these countries, analysis of trade liberalization on the African, Caribbean and Pacific (ACP) countries signatories to the Lomé Convention and Small Island States (SIS) aggregate was also conducted, including an analysis of the effects on these aggregates from a possible revision of the Sugar Protocol between the ACP countries and the EC.

A multi-region, non-spatial equilibrium model of the world sugar market was developed in order to project future prices, production, consumption,

stock changes, and net trade under various scenarios. Supply, demand, and stock change elasticities were obtained for each country/region either through direct estimation or from prior studies. Projection information on real per capita gross domestic product (GDP), population, and tariff changes were derived from published data. Parameters for supply changes were derived from estimated trend coefficients of econometric models of production and from expert opinions of observers of the sugar industry. Income elasticities by country were obtained from the Food and Agriculture Organization of the United Nations (FAO) and from estimates obtained from econometric analysis of consumption. The projection information was then used to simulate prices, production, consumption, stock changes, and net trade by country/region to 2000 and 2005 under the various scenarios.

The main results of this study may be summarized as follows:

1. The world sugar price (assuming full implementation of the URA) is projected to increase to US\$0.123 per pound from the baseline of US\$0.119 per pound in 1993-95. Compared to the case of no change in tariffs to 2000, the effect of the URA is to raise the real world sugar price 7.0 percent. Production is expected to decline in the United States, EC, Australia, China, Indonesia, the Philippines, Mexico, Brazil, and South Africa as a result of the URA. Consumption would rise mainly in the United States and Japan because of reduced domestic prices. Imports would increase in the United States, China, Indonesia, and the former USSR because of the URA. Exports would be lower in the EC, Australia, Mexico, and Brazil as a result of the URA; however, exports are projected to be higher in India and Cuba as a result of the URA because of unchanged tariffs to 2000.

2. The baseline price is projected to decrease to US\$0.120 per pound assuming continuation of the URA to 2005. Production and consumption are projected to be higher for most countries. The largest increase in imports is projected to occur in the former USSR because of decreased production. Australia, Cuba, and Brazil are projected to have large increases in exports.
3. With global trade liberalization, the world price is projected to increase 43.2 percent to US\$0.172 per pound from a baseline projected price of US\$0.120 per pound. The gains from freeing up trade would be large. The gains would be especially great in many of the Latin American and Caribbean countries where production and exports would rise as a result of an increase in world price, assuming that transfers to ACP and SIS are not eliminated. The United States, Japan, and India would experience the largest increase in imports.
4. Under partial global trade liberalization (20 percent reduction in tariffs across the board), the world price would increase by 6.4 percent compared to the case of no further trade liberalization to 2005. A very similar pattern of changes in production, consumption, and net trade occurs compared to the complete liberalization scenario. In neither case are changes in stock changes from the baseline large.
5. Under complete and partial trade liberalization of the developed countries (i.e., the United States, Canada, EC, other Western Europe, Australia, New Zealand, Japan, South Africa, and Israel), the world price rises by 9.8 percent and 0 percent, respectively, compared to the baseline price of US\$0.120. With minor exceptions, production would fall, consumption would rise, and net trade would decline in the developed countries; in contrast, production would rise, consumption would fall, and net trade would increase in many of the other countries. As in the other cases, the United States and Japan would experience significant increases in imports while the EC, Mexico, and Brazil show large increases in exports.
6. Complete and partial trade liberalization in selected developing countries (i.e., Brazil, China, India, Indonesia, and the Republic of Korea) would cause the world sugar price to rise 16.7 percent and 1.1 percent, respectively, compared to the baseline price of US\$0.120 per pound. Aside from the Republic of Korea, production would fall, consumption would rise, and net trade would fall in all of these developing countries. The United States, former USSR, Mexico, and other Latin America countries would gain the most in terms of increased production and net trade.
7. For the ACP countries, the impact of the URA will be to increase production, lower consumption, and increase exports. Producers receive preferential prices in the EC and the United States for large proportions of sugar exported to those countries; however, the impact of the URA will be to increase total revenue from exports slightly (by about 1 percent). Similar effects are expected in the case of the SIS aggregate, with a 3.3 percent increase in expected in export earnings as a result of the URA.
8. With no change in transfers, ACP producers would gain under complete and partial trade liberalization and under complete and partial trade liberalization in the selected large developing countries. They would lose under continued market reform in developed countries and they would lose with reduction in transfers from the EC and United States with partial trade liberalization. Assuming a 20 percent decrease in transfers to ACP countries with partial global trade liberalization, export earnings to ACP countries would decline by about 6 percent. Exports would rise in all cases except for trade liberalization only in the developed countries.
9. As in the case of the ACP countries, the SIS producers gain under both total and partial global trade liberalization as well as total and partial liberalization in the large developing countries (assuming no change in export subsidies). However, the SIS lose with trade liberalization of developed countries. Under partial global trade liberalization with a

20 percent reduction in transfers from the EC and the United States, export earnings for the SIS would decline by only about 0.4 percent. In contrast to the ACP aggregate, the SIS aggregate could actually increase export earnings over the current status quo (continuation of the URA to 2005) with complete trade liberalization and complete elimination of transfers.

10. A comparison of export earnings by ACP countries and SIS aggregate under complete trade liberalization indicates that the combined value of transfers from the EC and the United States to these countries is worth between 19-20 percent of the value of their export earnings.

MAIN REPORT

INTRODUCTION

The purpose of this report is to summarize and discuss the findings of a study of trade liberalization of the world sugar market. Few studies have undertaken an analysis of the impact of the Uruguay Round Agreement (URA) at the individual country level. Moreover, there is a dearth of studies on the possible effects of further trade liberalization and agricultural policy reforms on the world sugar market and on both developed and developing countries. A quantitative analysis of further liberalization will be useful to policymakers in the next round of multilateral trade negotiations.

In the next section, the salient features of the sugar economy are summarized. The third section describes the economic model used to quantify trade liberalization of the world sugar market. The fourth section presents parameter values for the baseline projections. The fifth section presents projection results for 2000 assuming full compliance with the present URA provisions. This section also contains a discussion of the likely impact of the URA policy provisions on world price and production, consumption, stock changes, and net trade at the country level. In the sixth section, results are presented for different trade liberalization scenarios, including complete and partial global trade liberalization. The seventh section discusses implications of trade liberalization for the African, Caribbean and Pacific (ACP) countries and the Small Island States (SIS) aggregates, including implications for revision of the ACP/EC Protocol. The final section offers some concluding observations.

THE WORLD SUGAR MARKET

Sugar is important to the world economy. For 1993-95, world sugar production totalled 112.5 million metric tonnes (MT) with world trade some 28 percent of world production for those years. Despite the significance of trade, the world sugar

economy is characterized by heavy government intervention both domestically and internationally.

Sugar is produced from both sugar cane and sugar beets. Sugar cane is grown primarily in tropical and sub-tropical climates while sugar beets are grown where the climate is more temperate. Some countries (e.g., the United States) produce significant amounts of both crops while others specialize in production of either cane (e.g., Brazil) or beets [e.g., European Community (EC)]. Lower-income countries, which rely more heavily on sugar as a source of income, tend to have fewer tariff barriers than high-income countries which more heavily subsidize domestic production—often at the expense of domestic consumers (Devadoss and Kropf, 1996). In addition, protective domestic support policies for sugar have encouraged growth in High Fructose Corn Syrup (HFCS) consumption, especially in the United States and Japan.

The policy provisions of the URA for agriculture include market access, domestic support, and export competition provisions. The URA is a first step at addressing trade barriers between countries by attempting to convert market distortions to tariff equivalents. In most instances, tariff equivalents were derived based on the difference between internal prices and external or border prices (Santana-Boado, 1995).

Countries participating in the agreement committed themselves to replacing non-tariff barriers with tariffs and then reducing these tariff equivalents over a period of time. Reduction commitments are expected to be achieved through reducing domestic price supports (e.g., the United States, Japan), reducing aggregate measures of support (e.g., Australia, EC, Brazil), or through reducing export subsidies (e.g., EC, Brazil).

Aside from tariff reduction commitments, the United States and EC are subject to the market access provision of minimum imports of 3 percent of consumption, which becomes 5 percent at the end of 2000. The United States provides access to its market through quota allocations to specific countries at reduced import duties. The EC also provides access to its market through special preferences to exporting countries, especially the ACP countries. For a certain quota, ACP countries

are able to sell without paying any import duty. For certain quantities above the fixed quota of about 1.3 million per tonne, ACP countries can sell at a reduced duty of about 85 percent of the EC reference price (Santana-Boado, 1995). These regulations complicate the analysis somewhat and are considered in more detail in the last section of this report.

THE ECONOMIC MODEL

The model is a multi-region, non-spatial equilibrium model, consisting of production, consumption, and stock demand equations for each country/region. Supply and demand relationships are intended to depict market behaviour for raw sugar. Quantity produced and consumed of sugar is the raw equivalent of all sugar products. Sugar cane and sugar beets are combined into one supply response relationship. Demand for sugar is derived from final uses of sugar, both direct and indirect. The stock equations reflect combined public and private stock-holding behaviour. Net trade (exports less imports) is determined from the identity:

$$(1) \quad S - D - dI = NT$$

where S is total production, D is consumption, dI is the difference between end-of-the year and beginning-of-the year inventories, and NT is net trade.

For the most part, supply, demand, and stock demand equations were estimated econometrically with time series data. The behavioural equations estimated had the general form:

$$(2) \quad S = S(LP, t)$$

$$(3) \quad D = D(P, Y, POP, t)$$

$$(4) \quad I = I(LI, D, P)$$

where P is the real sugar price, LP is the lagged sugar price, Y is per capita income (GDP per capita), POP is population, t is a linear time trend, I is end-of-the year inventories, and LI is lagged inventories (or beginning-of-the year inventories). Given estimates of production, consumption, and stock changes (computed from (4)), equation (1) is used to compute net trade for each country/region.

To implement the model empirically, the econometric estimates are first converted to price and income elasticities because the units are dimensionless. Also, because the model is used to project from a given base period (i.e., 1993-95), it is useful to express the behavioural relationships as deviations from the base period. Therefore, equations (1)-(4) can be expressed more concretely as follows:

$$(5) \quad S_0(\Delta S/S_0) - D_0(\Delta D/D_0) - dI_0(\Delta dI/dI_0) = NT_0(\Delta NT/NT_0)$$

$$(6) \quad \Delta S/S_0 = \epsilon(\Delta P/P_0) + \epsilon_t$$

$$(7) \quad \Delta D/D_0 = \eta(\Delta P/P_0) + \eta_y(\Delta Y/Y_0) + \Delta POP/POP_0$$

$$(8) \quad \Delta dI/dI_0 = \delta_d(\Delta D/D_0) + \delta_p(\Delta P/P_0)$$

where “ Δ ” means change from the base period, the zero subscript refers to the base period, ϵ is the price elasticity of supply, ϵ_t is the elasticity of supply with respect time (a proxy for technical change), η is the price elasticity of demand, η_y is the income elasticity of demand, δ_d is the elasticity of stock change with respect to consumption, and δ_p is the elasticity of stock change with respect to sugar price.

With the wedge between the border or world price, P^w , and interior price, P , expressed in terms of an ad valorem tariff, each country’s domestic (interior) price can be related to the world price as follows (Shui, Wohlgenant, and Beghin 1993):

$$P = (1 + T)P^w$$

or, expressing this relationship in proportionate changes, we have

$$(9) \quad \Delta P/P_0 = \Delta P^w/P_0^w + [T_0/(1 + T_0)](\Delta T/T_0)$$

where T is the ad valorem tariff and the zero subscript refers to the base period when the tariff is applied.

Equation (9) assumes that the elasticity of price transmission is unity, which could be the case under completely free trade (Goodwin, Grennes, and Wohlgenant 1990), but with trade restrictions could be less than unity. While the elasticity of price transmission could be estimated, such an estimate is unreliable for policy analysis because its value is

endogenous, being determined by the particular trade policy being investigated. However, provided $P > P^w$, the true value for the elasticity of price transmission is bound by unity and a lower bound estimate obtained as the ratio of the world price to the interior price (George and King, 1971). To find a lower bound estimate, one could use equation (9), with the coefficient of unity of the proportionate change in world price replaced by the ratio of the world price to the interior price, i.e., P^w/P . Using this specification in place of equation (9) produces larger price effects both internally and at the world level.¹ Evaluation of the results by experts of the sugar industry indicates that the results obtained using equation (9) are closer to reality. Therefore, this specification of price transmission was used in the analysis, with the implication that the results presented in this study are conservative price effects or lower bound estimates of the effect of trade liberalization on the world sugar market.

The final equation of the model is the market clearing condition that the sum of all net trade across countries equal zero, i.e.,

$$(10) \sum S_0(\Delta S/S_0) - \sum D_0(\Delta D/D_0) - \sum dI_0(\Delta dI/dI_0) = \sum(\Delta NT/NT_0)$$

where the summation sign refers to summation across all countries. Given equations (5) – (10); base quantities for production, consumption, change in stocks; elasticities of the supply and demand relations; and values for tariffs in the base year; projections can be made of change in world price and production, consumption, stock changes for each country over a given time horizon for a given change in tariffs.

PARAMETER VALUES AND PROJECTION ASSUMPTIONS

Data used to develop parameter estimates and baseline quantities for the model were provided by FAO. The basic data are supply and demand balances for sugar and primary production data for

sugar cane and sugar beets obtained from FAOSTAT for calendar years 1970-95. For the most part, price data were obtained in local currencies and then converted to US dollars using IMF exchange rates. For country aggregates, indices of weighted averages of prices for individual countries were derived.²

Table 1 shows the average production, consumption, stock changes, and net trade values for 1993-95 in each of the 42 countries/regions covered in the study. The individual countries included in the model cover the major sugar producing and consuming countries in the world. The average world price over this time period (in 1995 US dollars) was US\$0.119 per pound, or approximately US\$262 per tonne.

Per capita GDP and population values for 1995 and projections for 2000 and 2005 are presented in Table 2. GDP values come from the World Bank and population values were obtained from FAO.

Table 3 contains ad valorem equivalent tariffs under the URA for all major countries and regions. Tables 4-6 contain ad valorem equivalent tariffs for the individual countries within each of the aggregate regions: other Western Europe, other Eastern Europe, other Asia, other Latin America, rest of Africa, and other Near East. As indicated previously, these tariffs are intended to represent market distortions between each country's internal price and the border (world) price. These data were obtained from schedules published by Santana-Boado (1995) and the International Sugar Organization (ISO). Tariffs for individual countries within each region aggregate are left disaggregated until simulations are performed. The proportionate change in tariff for a given region is computed by taking a simple average of the proportionate changes in tariffs of all countries within the region.³ Note also that in some instances (e.g., other

¹ The impact of the UR with a constant absolute price spread would be for the world price to increase 11 percent as opposed to 7 percent with the percentage price spread, equation (9). With complete free trade, the world price would increase 43 percent compared to 76 percent with a constant absolute spread.

² In some instances, price data were deemed unreliable (either because the original price data may not be representative of actual market transactions or because the actual exchange rates are different than the official rates). In such cases, where price data were needed, either price data reported in local currency were used or the world sugar price (as reported by USDA, "World Agricultural Supply and Demand Estimates" WASDE-341, August 12, 1998), was used instead.

³ The formula used to compute the proportionate change in tariff for an aggregate of countries within a region is: $\{\sum [T/(1 + T)](\Delta T/T)\}/n$, where n is the number of countries within the aggregate.

Oceania) there are no tariffs available. This is because, for the most part, these countries (or regions) are not members of WTO.

Table 7 lists the basic elasticities of supply and demand used in the simulation model. Econometric estimates were obtained for all the stock equations and for many of the supply and demand equations. Details of the econometric analysis are contained in the appendix tables A.1 – A.3. A comprehensive study of demand and supply for major Asian and Pacific countries (Australia, China, Fiji, India, Indonesia, Japan, Pakistan, the Philippines, and Thailand) was conducted by FAO in late 1997, so elasticities from this study were used for those countries. In some instances, it was not possible to obtain reasonable econometric results, so elasticities from previous studies were used—see elasticity source in Table 7.

Overall, the elasticity estimates appear quite reasonable and in accord with prior knowledge. In one instance (the United States), a dynamic demand model provided the most reasonable estimates. Because the projection periods are five-year intervals, an intermediate-length elasticity of -0.44 was used for the United States.⁴ While this elasticity estimate is somewhat larger than others in the literature (see, e.g., Devadoss & Kropf, 1996), it is plausible and closer to the estimate of -0.8 obtained by Haley (1998) in a comprehensive study of sugar demand. Moreover, in Japan, where HFCS is also an important substitute, demand for sugar is also quite large.

Some of the supply elasticities were estimated using a Nerlovian supply response model, wherein supply was regressed on lagged supply, lagged sugar price, a price or price index of fertilizer (or other input cost index), and a time trend to measure technical change. Overall, the results were quite reasonable with fairly large elasticities found for a few of the countries. As in the case of dynamic demand, elasticities for the simulation model were calculated

assuming a five-year adjustment period to a change in tariff rates.⁵

Stock change elasticities are also shown in Table 7. Again, these elasticities are dynamic, so elasticities for the simulation model were calculated assuming a five-year adjustment period. Because for a five-year adjustment period to price changes speculative demand would be less important, the elasticities used in the simulation model are all smaller than those shown in Table 7. The formula used to calculate these elasticities is as follows:

$$\delta_i = \delta_s[1 - (1 - b) - (1 - b)b - (1 - b)b^2 - (1 - b)b^3]$$

where δ_i is the “intermediate-run” elasticity for consumption(price) (i.e., the elasticity over a five-year adjustment period), δ_s is the short-run elasticity of consumption(price), and b is the elasticity of inventories with respect to lagged inventories.⁶ In most instances these “intermediate-run” elasticities are at least one-half the value of their short-run counterparts.

Many of the income elasticities were estimated directly or taken from estimates provided by FAO or the study by FAO (1997) on the Asian and Pacific countries. These elasticities are shown in the first column of Table 8.

Production growth rates, also shown in table 8, were derived for each country/region in order to project future sugar supply from technical change. Because all the supply equations were estimated using a linear functional form, these growth rates were estimated by dividing the estimated parameter values by average production for 1993-95. In those

⁴ The model estimated was a partial adjustment distributed lag model so the price elasticity for a five-year adjustment period was calculated as follows: $\eta = c(1 + b + b^2 + b^3 + b^4)$, where c is the short-run elasticity and b is the elasticity of consumption with respect to the lagged dependent variable—see appendix table A.3 for parameter information.

⁵ These intermediate-run elasticities were computed in exactly the same manner as those for the demand model—see note 4; parameters used in calculating these elasticities is contained in appendix table A.1.

⁶ This formula is derived as follows: In elasticity form, the inventory adjustment equation can be written as $\Delta I = b\Delta L(dI) + \delta_s\Delta D + \delta_p\Delta P$, where Δ represents change from the base period, d represents the change in the variable from the previous time period, and L denotes the lagged operator such that $LZ_t = Z_{t-1}$. By the algebra of lagged operators, the solution to this difference equation is (assuming the absolute value of b is less than 1): $\Delta I = (1 + bL + b^2L^2 + b^3L^3 + b^4L^4 + \dots)\delta_i\Delta D + (1 + bL + b^2L^2 + b^3L^3 + b^4L^4 + \dots)\delta_p\Delta P$. Setting $D = LD$ and $P = LP$ over the projection period produces the formulas shown in the text.

countries where supply elasticities were taken from previous studies, production growth rates were estimated by estimating the relationship between production and the time trend, after adjusting for the influence of lagged price (and lagged production where relevant).⁷ Overall, the estimated growth rates represent the combined effects of

⁷ Growth rates for Australia, Indonesia, Cuba, Guatemala, Mexico, Brazil, Chile, South Africa, Egypt, and Mauritius are based on expert opinions of observers of the sugar industry.

technical change and other non-price factors influencing growth over time.⁸

In some countries, especially the EC, commitments to reductions in export subsidies are significant. The EC agreed to reduce the total value of export subsidies by 36 percent from 776.5 million ECU to 497.0 million ECU by 2000. The EC also agreed to reduce the quantity of exports subsidized by 21 percent from 1 560.4 in 1995 to 1 277.4 MT in 2000. Subsidized exports account for about 20 percent of all exports (with an export volume of about 7.5 million MT) and subsidized exports as a value of all production in the base year were estimated to be 35 percent. Therefore, in order to achieve the required reduction in export subsidies, supply would need to be decreased (vertically) by 9 percent. Therefore, the effect of a decrease in EC subsidies was taken into account by shifting the supply curve horizontally to the left by multiplying the supply elasticity by 9 percent.

A final special consideration in modelling the impact of trade liberalization on the world sugar market is to recognize that certain ACP countries export a large share of their sugar to the EC and the United States where they receive substantially reduced duties. In particular, both Mauritius and Fiji export about 98 percent of their production. Of this 98 percent, Mauritius sells 80.2 percent to the EC as "Preference Sugar," 14.9 percent as "Special Preference Sugar," 4 percent to the United States under the TRQ, and 1 percent on the world market. Fiji sells about 41.3 percent to the EC as "Preference Sugar," 8 percent as "Special Preference Sugar," 3.7 percent to the United States under the TRQ, and 47 percent on the world market. The export effects of these two countries were handled by calculating a blended price of exports sold on the various market outlets and by

multiplying the changes in this blended price by each country's elasticity of supply.⁹

Finally, in developing the projections to 2000 and 2005, there were assumed to be no further changes in agricultural policy and no other changes in supply, demand, or stock changes not already accounted for by production growth, income changes, or population changes.¹⁰ Moreover, all the elasticities were assumed to remain constant over the projection periods.¹¹

PROJECTIONS TO 2000 UNDER THE URUGUAY ROUND AGREEMENT (URA)

Given the previous projection assumptions, the economic model of the world sugar market was used to simulate effects of the URA to 2000.¹² Table 9 gives projections under the URA assuming full compliance to the reduced commitments indicated in tables 4-6. The world price under this scenario is expected to increase approximately 3.2 percent from its base in 1993-95, or increase to US\$0.123 per pound from US\$0.119 per pound in 1993-95.

⁹ The formula used to calculate the blend price is given in the section entitled, "Impact of Trade Liberalization on ACP and Small Island States (SIS)."

¹⁰ For many of the estimated demand functions for sugar, time trends were included in the econometric analysis to control for taste changes and other factors shifting demand over time. These trend effects are assumed to be zero for projection purposes. Also, for the United States the price of maize (a proxy for HFCS) was found to be a significant determinant of demand. An analysis of recent maize prices, however, suggested that the overall effect on demand would be small so this effect has also been ignored in the projections.

¹¹ In other words, elasticities are assumed to be constant rather than variable, as is often done by linearizing the supply and demand functions around the base period quantities and prices. Given the length of the time horizon for projections, it seemed more prudent to assume constant elasticities in developing future forecasts of the endogenous variables.

¹² In applying the simulation model at the base quantities, equation (10) was not completely satisfied because of exclusion of some (small) countries from the model and because of the cumulative effects of errors in production, consumption, stock changes, and net trade reporting in each country. This error, NT = -2253991, is only about 5 percent of total imports and was not accounted for in the simulations.

⁸ Other factors include, but are not necessarily limited to, changes in input costs, changes in other product prices, and changes in agricultural policies. While elasticities with respect to fertilizer prices are available, recent changes in prices suggest that, aside from abrupt changes in energy prices, future fertilizer price changes would have a small effect on future production. With respect to other commodity prices, because these commodity prices are also affected by future changes in GATT, any possible influence of other prices on supply response were ignored. If other commodity prices change little (in real terms), then ignoring these effects will have negligible effects on supply forecasts.

Production and consumption are expected to rise in many countries over this time period. Production is expected to fall only in the United States, the former USSR, Argentina, Zimbabwe, and Mauritius; consumption is expected to fall only in the former USSR. For net importing countries, imports are projected to increase for all countries. Exports are expected to decline in many countries; the exceptions to this are Australia, Fiji, Thailand, Pakistan, Cuba, Guatemala, Mexico, Brazil, and South Africa.

To estimate the impact of URA alone on price and on quantities, it is necessary to compare the projections under the URA with those assuming no change in tariffs. Table 10 presents projection results by country under this scenario, and Table 11 shows the effects on production, consumption, stock changes, and net trade due to reduced commitments under the URA. In the counter-factual situation of total non-compliance to the URA the world price decreases to US\$0.115 per pound in 2000 from US\$0.119 per pound in the base period. The projected increase to US\$0.123 per pound under the URA is very close to FAPRI's projection of US\$0.124 per pound and to Devadoss & Kropf's estimate of US\$0.120 per pound to 2000. Compared to the case of non-compliance to the URA, the world sugar price is expected to increase 7.0 percent due to the URA. This is smaller than Devadoss and Kropf's estimates of 8.8 percent, but it is larger than UNCTAD's estimate of 5 percent (Santana-Broado, 1995). Table 11 shows the impact on different quantities by country from the URA. Production would be lower in many countries, including the United States, EC, Japan, Australia, China, Indonesia, the Philippines, Mexico, Brazil, and South Africa. This is because of reduced net domestic prices from decreased tariffs under the URA. For the EC, reduced export subsidies are a major contributing factor to reduced production. Consumption would be much higher in many countries because of lower (internal) prices to consumers.

The results with regard to net trade changes are broadly consistent with other studies by Devadoss &

Kropf and Tuan, Fan, and Zhi. Imports in the major net importing countries of the United States, China, and Indonesia would be expected to be higher as a result of the URA because of increased consumption due to lower interior prices. One major disagreement with Devadoss and Kropf is that they indicate smaller imports in Japan with URA, while these results indicate imports would be higher as a result of the URA. In the major net exporting countries of EC, Australia, and Brazil, exports would be lower because of lower production and higher consumption. In contrast to Devadoss & Kropf, Cuba is projected to have higher exports as a result of the URA. Because this country does not have reduction commitments under the URA, production would rise and consumption would fall under URA, so that with negligible changes in stock changes exports would be expected to be higher under the URA. Thus, the directions of changes predicted by the model appear reasonable.

TRADE LIBERALIZATION TO 2005

This section presents a number of trade liberalization scenarios, assuming for the baseline projections a continuation of the URA to 2005. These baseline quantity projections are presented in Table 12. The baseline price for 2005 is projected to be US\$0.120 per pound, or about 2.8 percent below the 2000 price of US\$0.123 per pound, assuming full compliance with the URA. With the exception of the EC, other Western European countries, the former USSR, Argentina, Chile, Zimbabwe, and Mauritius, production is projected to be higher for 2005 compared to 2000. Changes in consumption are also expected to be positive for most countries because of population and income growth. The United States is expected to show an increase in imports, and it will remain above the 3 percent minimum access level. The largest increase in imports is projected for the former USSR due to decreased production. Australia, Cuba, and Brazil are projected to have large increases in exports to 2005.

Complete Global Trade Liberalization

Table 13 shows the effect on production, consumption, stock changes, and net trade assuming trade barriers between all countries are eliminated. The world price of sugar would rise to US\$0.172 per pound, which represents a 43.2 percent increase in price compared to the baseline price of US\$0.120 per pound for 2005.

Table 14 shows the net effect of complete trade liberalization on production, consumption, stock changes, and net trade. In many countries, production would fall and consumption would rise as a result of complete trade liberalization. This is because of reduced tariffs and initially relatively high protection rates.

In countries with small trade barriers, price increases lead to decreases in consumption and increases in production.¹³ This occurs predominately in Latin American and Caribbean countries, other Oceania, Asian, and near Eastern countries. The United States, Japan, and India experience the largest increases in imports because of relatively high consumer response to price changes. Notice also that, as in the other projections, the policy change would have little impact on stock changes.

Partial Global Trade Liberalization

The effects of partial global trade liberalization are examined assuming a uniform 20 percent reduction in tariffs across all countries. The results of this simulation are shown in Tables 15 and 16. The world sugar price is projected to rise 6.4 percent to US\$0.128 per pound compared to the 2005 baseline price of US\$0.120 per pound. Most quantity changes have the same sign as in the case of total liberalization.

Complete and Partial Trade Liberalization in (Industrialized) Developed Countries

This section considers the impact of complete and partial (20 percent reduction in all tariffs) in the developed countries: the United States, Canada, EC, other Western Europe, Australia, New Zealand, Japan, South Africa, and Israel.¹⁴ Tables 17-18 contain the effects on all countries for complete trade liberalization in all the developed countries; tables 19-20 contain the effects on all countries for partial trade liberalization in all the developed countries.

In the case of complete liberalization, the world price increases to US\$0.135 per pound compared to the baseline of US\$0.120 per pound, implying the price would rise 9.8 percent if trade was completely liberalized in the developed countries. Tables 17 and 18 show that production would fall and consumption would rise (except for Canada, EC, other Western European countries, and Australia), and net trade would decline in all developed countries (except for Canada, EC, and New Zealand); in contrast, production would rise, consumption would decline, and net trade would increase in many other countries. As in the other cases, the largest changes in imports occur in the United States, Japan, India, and China. Large decreases in exports would occur in the EC and Australia. India, Mexico, and Brazil would experience large increases in exports.

For partial liberalization in the developed countries, the price would essentially remain unchanged if tariffs were reduced by 20 percent in the developed countries. Tables 19 and 20 indicate the same directions of effects in all countries, but with substantially smaller changes compared to the case of complete trade liberalization.

Complete and Partial Trade Liberalization in Selected Developing Countries

The final set of trade scenarios to consider in this section consists of complete and partial trade liberalization in the developing countries of Brazil, China, India, Indonesia, and the Republic of Korea.

¹³ Trade liberalization is only assumed for those countries that belong to the WTO. Therefore, production increases and consumption decreases can be expected for those countries not belonging to the WTO.

¹⁴ Israel is included in the category "other Near Eastern countries"; in calculating the impact of a change in tariff for these scenarios, the formula in note 3 was used with the proportionate change in tariffs of the other countries within that region set to zero.

In the case of complete trade liberalization in these developing countries, the world sugar price would increase to US\$0.14 per pound from the baseline price of US\$0.120 per pound, for an increase of 16.7 percent. The trade patterns in Tables 21 and 22 show that, aside from China, India, Indonesia, and Brazil, production would rise, consumption would fall, and net trade would rise in all the developing countries being considered. China and India show the largest changes among the developing countries. The United States, EC, former USSR, Mexico, and other Latin America would gain the most in terms of increased production and net trade.

In the case of partial trade liberalization in these selected developing countries, the world sugar price would rise to US\$0.121 per pound, which implies an increase of 1.1 percent from the projected baseline price of US\$0.120 per pound. The effects on production, consumption, stock changes, and net trade (Tables 23 and 24) have the same signs as those for the case of complete trade liberalization, but with smaller changes compared to the case of complete liberalization in these countries.

IMPACT OF TRADE LIBERALIZATION ON ACP AND SMALL ISLAND STATES (SIS)

Both the ACP and SIS aggregates are given preferential treatment in sugar trade. In the EC, the ACP countries can sell a certain quota without import duties (called “preferential sugar (PS)”); and for certain quantities above quota, the ACP countries can sell at reduced imported duties (called “Special Preference Sugar (SPS)”). The United States has a tariff rate quota (TRQ) on raw sugar. In essence, this policy gives quotas to certain countries selling sugar to the United States at reduced tariffs. While the EC market is the most important outlet for exports of ACP countries, a significant volume is also exported to the United States. In 1996, about 62 percent of the sugar exported from these countries went to the EC, 22 percent went to the United States, and the remaining 16 percent was sold on the world market (Ryberg).

In order to quantify the effects of trade liberalization on these countries, it is useful to view the price received by exporters from the countries receiving special treatment as a blended price. In other words, the price received by producers can be viewed as a weighted average of the price received for PS, net price received for SPS, the net price received under the TRQ, and the price received on the world market; that is,

$$P_{acp} = (Q_{ps}/Q)P_{eu} + (Q_{sps}/Q)(P_{eu} - T_{sps}) + (Q_{us}/Q)(P_{us} - T_{us}) + (Q_w/Q)P_w$$

where P_{acp} is the weighted-average price received by ACP countries on exports, P_{eu} is the EC guaranteed price, P_{us} is the United States price, Q_{ps} is the quantity of sugar sold under PS quota, Q_{sps} is the quantity of sugar sold under SPS quota, Q_{us} is the quantity of sugar sold under the TRQ, Q_w is the quantity sold on the world market, T_{sps} is the import duty on SPS sugar, and T_{us} is the import duty on sugar imported into the United States under the TRQ.

ACP Countries

Aggregate production, consumption, and net trade in 1993-95 for the ACP countries¹⁵ were 3 263 100 MT, 1 382 395 MT, and 1 921 383 MT, respectively.¹⁶ In US dollars per metric tonne, the EC price at about that time was US\$610, the US price was US\$421, and the world price was US\$262 per pound. The EC duty on SPS was US\$92 per MT and the United States duty for sugar under the TRQ was about US\$14 per MT.¹⁷

¹⁵ The ACP aggregate analyzed consists of Barbados, Belize, Fiji, Guyana, Côte d'Ivoire, Jamaica, Madagascar, Malawi, Mauritius, Zimbabwe, St. Kitts Nev, Swaziland, Tanzania, Trinidad & Tobago, and Zambia.

¹⁶ Given the small share of stocks in production and consumption, changes in stocks are ignored in this analysis.

¹⁷ Sources for these data include Agra Europe, “CAP Monitor,” August 19, 1997, and “F.O. Licht’s International Sugar and Sweetener Report,” April 14, 1997 for EU data; and USDA, “Sugar and Sweetener: Situation and Outlook,” May 1998 for the USA and world data. An exchange rate of US\$1.17/ECU was assumed in converting to US dollars.

Based on data in “F.O. Licht’s International Sugar and Sweetener Report (FOL)” (April 14, 1997), it is estimated that about 23 percent of the total sugar sales to the EC are SPS, implying approximately 48 percent of total exports of ACP countries goes for PS, 14 percent for SPS, 22 percent for TRQ sales, and 16 percent for the world market. Given these proportions and the above price information, this implies (using the above formula) that the ACP blend price for exported sugar was about US\$497 per MT in 1993-95. With an export volume of about 2.2 million MT in 1995, this implies total revenue from export sales of about US\$109 million compared with total revenue of about US\$58 million if it was all sold on the world market.

In order to project future changes in production and consumption, supply and demand elasticities for the ACP aggregate are required. Given that Fiji, Malawi, Mauritius, and Zimbabwe comprise a large proportion of production, consumption, and net trade in these countries, composite supply and demand elasticities of 0.17 and -0.13, respectively, were constructed by taking quantity weighted shares of the individual country elasticities.¹⁸ Exogenous changes to aggregate production and consumption of 0.39 percent and 2.4 percent, respectively, were estimated by regressing logarithms of production and consumption on prices (lagged price for production) and a linear time trend and using the coefficients on the trend variable to represent annual growth in supply and demand. Average tariff changes for the ACP countries for the various scenarios were constructed as an average of the changes across countries within the aggregate.¹⁹

¹⁸ Econometric estimates obtained directly with the aggregate data indicated an elasticity of supply of 0.08 and an elasticity of demand of -0.01. Since these estimates are too small, the constructed estimates based on aggregating over individual country elasticities were used.

¹⁹ The formula used to compute the percentage changes in tariffs for the ACP aggregate is shown in note 3. Rates for the individual countries included in the calculation are shown in appendix Table 4.

Several scenarios were considered in the simulation of the impact of trade liberalization on the ACP countries and the results of these simulations are shown in Table 25. The first two rows of the table show the probable impact of the URA on ACP countries. In the absence of the URA, production would be lower, consumption would be higher, and exports (net trade) would be lower. While the blend price would be higher in the absence of the URA, the world price would be lower. Because the percentage increase in exports is larger than the percentage change in blend price under the URA, producers can expect to gain about 1.2 percent of their export earnings due to the URA.

The third through seventh rows of Table 25 show the effects of the various aggregate trade policies assuming no change in the status of the ACP protocol or the TRQ. Comparing rows 4-7 with row 3 suggests that ACP producers would gain under complete and partial global trade liberalization and under complete and partial trade liberalization in the selected large developing countries. They would lose under continued market reform in developed countries (because of lower internal prices in the EC and the United States) and they would lose with reduction in transfers from the EC and the United States. With a 20 percent decrease in transfers to ACP countries with partial global trade liberalization of 20 percent, export earnings to ACP countries would decline by about 6 percent. Exports would go up in all cases except for trade liberalization only in the developed countries and for partial trade liberalization in all countries. Under complete trade liberalization and complete elimination of transfers (last row), export earnings would fall by about 7.8 percent. A comparison of row 4 with row 11 in Table 25 indicates that transfers under free trade would be approximately 20 percent of their export earnings, compared to the case of complete free trade.

SIS Aggregate

Aggregate production, consumption, and net trade for the SIS²⁰ in 1993-95 were 2 100 075 MT,

²⁰ The SIS aggregate consists of Antigua & Barbados, Bahamas, Barbados, Solomon Islands, Cape Verde, Cook Island, Comoros, Cyprus, Dominica, Dominican Republic, Fiji, Grenada, Haiti, Jamaica, Maldives, Malta, Mauritius, Vanuatu, Samoa, St. Kitts

947 440 MT, and 1 205 745 MT, respectively.²¹ Although there are 25 countries included in this aggregate, Fiji and Mauritius account for about 81 percent of total exports. Because these two countries receive preferential trade concessions from the EC and the United States, a blend export price was constructed as in the case of the ACP countries. Based on F.O. Licht's data, about 41.3 percent of Fiji's exports go for PS, another 8 percent for SPS, 3.7 percent for TRQ sales, and 47 percent are sold on the world market. It is estimated that 80.2 percent of Mauritius's exports are sold as PS, 14.9 percent are sold as SPS, 4 percent as TRQ to the United States, and only 1 percent are sold on the world market. Combining these two countries yields aggregate shares of 50 percent for PS, 9 percent for SPS, 3 percent for TRQ, and 38 percent for world sales.²² Given this information and the price information reported in the previous section, the export blend price for SIS is estimated to be about US\$463 per MT, slightly lower than the ACP's average blend price of US\$497. With an export volume of about 1 500 000 MT in 1995, this implies export sales of about US\$69 million compared with total revenue of about US\$39 million if it was all sold on the world market.

Aggregate supply and demand elasticities for the SIS of 0.16 and -0.13, respectively, were constructed as quantity-share weighted sums of the elasticities for Fiji and Mauritius.²³ Per annum growth rates for exogenous shifts in supply and demand were estimated to be -2.0 percent and

2.1 percent, respectively. As in the case of the ACP countries, average tariff changes for the SIS were constructed for each scenario. The tariff schedules under the URA for the countries within this aggregate are in appendix Table 5.

Table 26 presents the results for the same scenarios as the ACP countries. The effect of the URA on the SIS's export earnings is an increase of 3.4 percent. As in the case of the ACP, the SIS producers gain under both total and partial global trade liberalization as well as total and partial liberalization in the large developing countries (assuming no change in export subsidies). However, the SIS lose in both instances of trade liberalization of developed countries. As in the case of the ACP, export earnings would decline under trade liberalization with a 20 percent reduction in transfers from the EC and the United States. In this case, the blend price is projected to decrease about 4.5 percent, exports are projected to increase about 4.2 percent, and total revenue from export sales to decline by about 0.4 percent. With a complete elimination of transfers, total export earnings would actually increase by 13.8 percent because the increase in exports offsets the decline in price. The value of transfers from the EC and the United States would be approximately 19 percent of their export earnings under complete free trade.

CONCLUDING REMARKS

While many other simulations could be performed, it should be clear from the results presented in this report that there are substantial gains to be reaped from trade liberalization, and that the URA has only moved us a small way toward total free trade. It was somewhat surprising to find that the effects of trade liberalization would be much more dramatic if the major developing countries would further liberate trade compared to the developed countries. On the other hand, the consequences of trade liberalization would be quite unevenly distributed. With respect to the ACP and the SIS, mixed results were also obtained. While both the ACP and SIS would lose from partial revision of the Protocol, the ACP would lose and the SIS would gain if the transfers were eliminated completely. What is significant to these countries,

Nev, St. Lucia, St. Vincent, Sao Tome, Seychelles, and Trinidad & Tobago.

²¹ As in the case of the ACP countries, changes in stock changes are ignored in the analysis.

²² The estimates were obtained by multiplying each country's share by its share of exports in all SIS countries and adding the two results together. Fiji has 38 percent of total exports and SIS have 43 percent of all exports.

²³ As in the case of the ACP countries, this approach produced more reasonable estimates of the elasticities. Econometric estimates with aggregate data indicated supply and demand elasticities of 0.04 and -0.005, respectively.

however, is the loss in transfers under complete free trade which would be worth between 19-20 percent of the value of their export earnings under complete free trade.

Projections to 2000 and 2005 indicate that the raw sugar price is expected to only increase modestly from its level in 1993-95, assuming full compliance with the URA. These forecasts are quite close to others (e.g., FAPRI). While the model assumes a unitary elasticity of price transmission, the results appear quite robust to this assumption and the price changes presented can be viewed as lower bound estimates to the true effects. Therefore, the model can be quite useful for analysis of policy changes, particularly for the country and sub-aggregates analyzed here.

No analysis was undertaken on the effects of removal of trade barriers within common trading areas (e.g., NAFTA). Analysis of such changes would require specification of trade flows between countries, and the present model cannot accommodate such a feature. While the present model is intended to capture most of the policy distortions within the major countries though specification of ad valorem equivalent tariffs, the model does not capture the gains from reduction in total domestic support in the broader agricultural sector. In order to compute those gains, a CGE model would be required. What is clear, though, is that the gains from liberalizing trade would be expected to be even larger than those presented here.

Appendix

Econometric Estimates

Tables A.1-A.3 report supply, demand, and stock change elasticities estimated by the author for selected countries. These supply and demand functions were estimated generally with linear equations over the time period 1970-95. Results are expressed in elasticities evaluated at the sample means.

Ad Valorem Equivalent Tariffs

Tables A.4 and A.5 list ad valorem equivalent tariffs by country for ACP countries and the SIS aggregate.

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