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Impacts of Sugar Free Trade Agreements on the U.S. Sugar Industry

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SHORT SUMMARY

We use a multi-region GTAP model to study the implications of a global sugar free trade agreement on the U.S. sugar industry. Sugar production in the U.S. would decrease by 2.8%. This is in contrast to some of the previous studies, which argued that the U.S. sugar production would increase slightly annually.

ABSTRACT

We use a multi-region GTAP model to study the implications of a global sugar free trade agreement on the U.S. sugar industry. In general, the sugar net importing countries such as the former Soviet Union, Japan, and the United States would reduce sugar production and increase their net imports from the world market. By contrast, the sugar net exporting countries such as Australia, Brazil, and Thailand would increase their sugar production and increase their net exports. Under a scenario where import tariffs and export subsidies are completely eliminated, U.S. sugar production would decrease by 2.8%. This is in contrast to some of the previous studies, which argued that the U.S. sugar production would increase slightly annually. U.S. import prices would decrease by 21.9% and U.S. domestic sugar prices would decrease slightly by 0.8%. U.S. net imports of sugar of sugar would increase 478.1 million US dollars.

Impacts of Sugar Free Trade Agreements on the U.S. Sugar Industry

1. INTRODUCTION

The U.S. sugar industry is an important part of the U.S. economy in rural area. The industry generates 146 thousand jobs and nearly \$10 billion (U.S. dollars) in nineteen states where sugarcane and sugar-beets are produced and processed (Roney 2004). According to the U. S. Department of Agriculture, sugar production in the United States averaged 5.5 million tons during 1970 – 1985 and started to increase over time afterwards. U.S. sugar production reached a record high of 8.2 million tons in 1999 and fluctuated between 7 to 8 million tons in recent years. This can be seen clearly in Figure 1. The United States was a net importer of sugar in 1970 – 2005. However, its net imports had decreased sharply prior to 1987, and fluctuated about 1.3 million ton in recent years.

The world sugar market is the most distorted commodity market in the world due to government intervention policies² in major sugar producing and consuming countries (Sheales et al 1999, Elbehri et al 2000). The major sugar producing countries dump their surplus of sugar on the world market. As a result, the world sugar prices have averaged barely half the world average cost of production over the past two decades (Roney 2004). In particular, the protectionist policies in the European Union, Japan, and the United States have resulted in domestic sugar prices up to three times greater than the world sugar price (Elobeid and Beghin 2004).

Nevertheless, trade liberalization for the world sugar market has progressed in recent years. In addition to the global trade agreement (World Trade Organization, WTO)

² For trade and domestic sugar policies in different countries, please refer to Mitchell (2004).

and the regional trade agreement (North American Free Trade Agreement, or NAFTA), the United States has concluded a number of free trade agreements (FTA) with other countries (e.g., the U.S.-Chile FTA; the Central American Free Trade Agreement, or CAFTA) since 2000. Also, the United States has been negotiating FTA with many other countries (e.g., U.S.-Thailand FTA, U.S.-Korea FTA)³ in recent years. This has signaled that the world sugar market will move toward trade liberalization sooner or later. Since the sugar markets are severely distorted by government policies in most countries, the tendency toward a freer world sugar market has instigated many agricultural economists to study the effects of FTA on the world sugar market and the U.S. sugar industry.

Many previous studies (e.g., Wohlgenant 1999, Sheales et al 1999, Beghin et al 2001, Koo 2002, and Elobeid and Beghin 2005) argued that the world sugar prices would increase if major markets move toward freer trade policies. However, the results are not conclusive. Mensbrugghe et al (2003) argued that U.S. import prices would increase under trade liberalization for the world sugar market. Theoretically, one would expect that world prices and import prices would tend to decrease with trade liberalization (all other things being equal), since free trade encourages efficient producers to produce more and inefficient producers to produce less. Many of the previous studies were based on partial equilibrium model, which has the limitation for factor mobility among industries and sectors.

The objective of this study is to examine the impacts of a global sugar free trade agreement on the U.S. sugar industry using a general equilibrium model. This would provide an alternative and a more broad-based approach to study the issue of world sugar

³ For details, please refer to [bilaterals.org](http://www.bilaterals.org) (<http://www.bilaterals.org>) or the website of the Office of the United States Trade Representative (<http://www.ustr.gov>).

market. Special attention is given to the following aspects: (1) identify important sugar trading partners for the United States, (2) study the effects of a global sugar FTA on the U.S. sugar industry, and (3) analyze trade creation and diversion effects across the countries and regions. It is hypothesized that a global sugar FTA would result in an increase in world sugar trade, but trade creation effects might differ across the countries.

There are different definitions for trade creation and diversion in the existing literature. For example, Suranovic (1998) defined that trade creation means that a free trade area creates trade that would not have existed otherwise, and trade diversion means that a free trade area diverts trade, away from a more efficient supplier outside the free trade area, towards a less efficient supplier within the free trade area. Carbaugh (1998) defined that trade creation occurs when some domestic production of one custom-union member is replaced by another member's lower-cost imports, and trade diversion occurs when imports from a low-cost supplier outside the union are replaced by purchase from a higher-cost supplier within the union. These definitions do not apply in our case, since we assume a global sugar FTA, and thus all sugar trading partners are within FTA. Trade creation (or diversion) in this study simply refers to an increase (or a decrease) in trade volume resulting from the removal of trade barriers.

The paper is organized as follows. Section two gives an overview of the previous studies on sugar free trade agreements in recent years. Section three discusses the data and model used for this study. The section also presents general economic statistics and sugar exports for the selected countries and regions in the base year 2001. Section four presents simulation results and discusses our findings. Finally, section 5 presents conclusions of the paper.

2. AN OVERVIEW OF THE PREVIOUS STUDIES

Both partial equilibrium and general equilibrium models were used in previous studies for analyzing the effects of trade liberalization on world sugar market. While the partial equilibrium model typically focuses on one sector or an industry, the general equilibrium model allows complicated interactions across various sectors or industries in an economy.

The Global Sugar Policy Simulation Model developed by Benirschka et al (1996), is frequently used in previous studies. The model is a partial equilibrium econometric simulation model, which contains eighteen sugar producing and consuming countries and regions. The model does not distinguish between raw sugar and refined sugar, and refined sugar quantities are expressed in raw sugar equivalents. Based on this model, Koo and Taylor (2005) argued that the wholesale price of U.S. sugar would decrease while the world sugar price (i.e., free on board Caribbean sugar price) would increase if the CAFTA is implemented for 2005. They projected that the U.S. sugar production would increase from an average of 7.7 million tons in 2002 -2004 to 8.2 million tons in 2013, or an average annual increase of 0.70%. U.S. net imports would increase from an average of 1.36 million tons in 2002 – 2004 to 1.52 million tons in 2013, or an average annual increase of 1.24%. They also argued that the U.S. sugar industry could face greater uncertainty mainly because of upcoming free trade agreements with the Western Hemisphere countries and Thailand.

Andino et al (2005) used the same simulation model to study the impacts of the potential reforms of the EU and some liberalization policies under the Doha agenda proposal on the U.S. sugar industry. They projected that the U.S. net imports of sugar

would increase by 17% and the U.S. wholesale sugar price is expected to decrease by 5%, given both CAFTA and NAFTA are implemented. They also argued that the U.S. sugar production would not be significantly affected under a scenario, where the EU cuts its sugar intervention price by one third and production quota by 2.5 million tons, plus a 20% cut in the import tariffs, and a 20% increase in import quota in China, Japan, and the United States. However, U.S. imports would increase by 15.4%, even if the world sugar price would increase by 39%.

Elobeid and Beghin (2005) used the CARD⁴ International Sugar Model to analyze the impacts of trade liberalization, removal of production subsidies, and elimination of consumption distortions on world sugar markets. The model is also a partial-equilibrium econometric world sugar model, which consists of twenty-nine countries and regions and specifies only raw sugar production, use, and net trade between countries and regions. They found that the removal of all trade distortions alone would drive up the world sugar price by 32.0% on average during the simulation period from 2002/03 to 2011/12. Their results indicated that the effects of sugar trade liberalization on the world sugar production and consumption would be small. The world sugar production and consumption would increase by 0.72% and 0.54%, respectively, by the year 2011/12 relative to the baseline. U.S. sugar production would decrease by 3.46% annually on average during the simulation period. U.S. sugar consumption would increase by 1.35% annually on average. U.S. net imports would increase by 620.6 thousand tons, or an average annual increase of 29.62%.

Elbehri et al (2000) used a tariff-rate quota (TRQ) model within the Global Trade Analysis Project (GTAP) to analyze the world sugar market. If the United States and the

⁴ CARD stands for the Center for Agricultural and Rural Development at Iowa State University.

European Union cut their over-quota tariffs by one third and other countries and regions cut tariffs by one third, the volume of world sugar trade would increase by 1.7 billion U.S. dollars. While the major countries of the Organization of Economic Cooperation and Development (OECD) would decrease their sugar output, the sugar exporting countries would increase their sugar production. For example, sugar output in the EU, Japan, and the United States would decrease by 2.2%, 4.3%, and 9.8% from the base year 1995, respectively. By contrast, sugar production in Australia, Thailand, and the Caribbean countries would increase by 7.0%, 6.5%, and 12.5%, respectively. In terms of welfare gain, the EU would gain the most (\$614.1 million), followed by the United States (\$292.2 million) and Japan (\$264.7 million). The effects on welfare in sugar exporting countries would tend to be negative. If the United States and the EU also expand their import quota volume by one third in addition to the above multilateral tariff cuts, the welfare for both sugar importing and exporting countries would improve.

Mensbrugghe et al (2003) used a mixed-complementarity-problem (MCP) programming approach with the LINKAGE model⁵ to study the effects of sugar trade liberalization on sugar prices, production, trade flows, and welfare. The LINKAGE model is a global dynamic computable general equilibrium (CGE) model maintained by the World Bank to support global trade policy analysis. In the model, the world is divided into sixteen countries and regions with twenty-two sectors, including a combined raw and refined sugar sector. Under a scenario where tariffs in all countries are cut by one third and the EU, Japan, and the United State expand their import quota by one third, they found that U.S. sugar production would decrease by 9.28% and U.S. import prices would increase by 17.9%. U.S. GDP and welfare would increase by \$207 and \$63 million,

⁵ For details about the LINKAGE model, please refer to Mensbrugghe (2005).

respectively. Under a scenario of full multilateral trade liberalization (i.e., tariffs in all countries are completely eliminated and import quotas in the EU, Japan, and the United States are unlimited), U.S. sugar production would decrease by 14.6% and U.S. import prices would increase by 36.5%. U.S. GDP would increase by \$324 million, but U.S. welfare would decrease by \$78 million. The global welfare would increase by about \$3.0 billion.

3. DATA AND MODEL

Since free trade agreements on sugar would not only directly affect sugar trade but also would indirectly affect other traded goods (e.g., processed food products that use sugar as a primary input). Lower domestic sugar prices would lead sugar producers to reduce sugar production, resulting in a decrease in input demand for sugar cane and sugar beets. This in turn would induce farmers to shift from sugar cane or sugar beets to other crops. As a result, a decrease in production of sugar cane and sugar beets in a country translates into an increase in production of other crops in the country. A general equilibrium model would excel partial equilibrium model in the sense that the former would capture these interaction effects across various sectors in an economy.

In this study, a multi-region GTAP model is used to analyze the impacts of a global sugar free trade agreement on the U. S. sugar industry. GTAP model is a static general equilibrium model, and thus simulation results using the model are comparative static in nature (Hertel 1997; DeRosa and Gilbert 2005). The assumptions for the GTAP model include constant return to scale and perfect competition. These are similar to basic trade models and theories (e.g., the Ricardian model, the Heckscher-Ohlin model, and the

Stolper-Samuelson theorem). Also, input factors such as labor and capital are assumed to be mobile across the various sectors in a country. Bilateral demand for trade is based on the Armington (1969) assumption, which says that internationally traded products are differentiated by country of origin.

The eighty-seven countries and regions covered in GTAP Version-6 database are aggregated into fifteen countries and regions: the United States, Australia, Brazil, Canada, China (mainland), the European Union⁶, Former Soviet Union, India, Indonesia, Japan, Mexico, South Africa, South Korea, Thailand, and the rest of world (ROW). The fifty-seven industries and commodities covered in the database are aggregated into six sectors: sugar, sugar cane and sugar beet, processed food, primary agriculture, manufacturing goods, and services. For details about industrial sector aggregation, please refer to Appendix A.

Table 1 summarizes the general economic statistics of the fifteen countries and regions in the base year 2001⁷. U.S. GDP ranks the first and is far more than those in any other countries and regions. U.S. endowments of primary factors (e.g., land, capital, natural resources) are also the highest in among the selected countries and regions. The output values of sugar (raw and refined sugar combined) in 2001 for the United States, the European Union, and Japan were \$30.1, \$19.7, and \$10.8 billion, respectively. The output value of U.S. sugar cane and sugar beets combined for these same countries were \$2.3, \$3.9, and \$1.3 billion, respectively.

Table 2 summarizes sugar exports in each country and region in 2001. The trade flows among the selected countries and regions provide the following three evidences.

⁶ European Union 15

⁷ The reference year of GTAP version-6 database is 2001.

First, Canada, Japan, and Mexico are the most important sugar markets for U.S. sugar exports. U.S. sugar exports to Canada, Japan, and Mexico in 2001 reached \$98.7, \$63.2, and \$53.6 million, respectively, or a sum of \$215.5 million, which accounted for 61.5% of total U.S. sugar exports in that year. Second, U.S. sugar imports are mostly sourced from ROW, Canada, Mexico, Brazil, and Australia. U.S. sugar imports from these countries and regions combined reached \$746.5 million or 91.1% of total U.S. imports in 2001. U.S. imports from ROW alone reached \$430.9 million, or 53.4% of total U.S. imports. This is because ROW includes Caribbean countries, which are important sugar exporters in the world. However, these countries are not listed separately in the GTAP database. The United States is the primary market for Canadian and Mexican sugar exports. While Canadian sugar exports to the United States reached \$134.7 million, or 82.5% of total Canadian sugar exports, Mexican sugar exports to the United States was \$78.9 million, or 70.6% of total Mexican sugar exports. Third, U.S. net import volume of sugar was \$469.2 million in the base year 2001, reflecting that the United States was a net sugar importer in history as we discussed earlier.

This study uses the standard general equilibrium (GE) closure, which is the classification of the variables in the model as either endogenous or exogenous. For the standard GE closure, the variables for import tariffs and export taxes are exogenous; thus these variables may be subjected to a shock in order to examine the effects of the changes of these exogenous variables on the endogenous variables of interest. It is assumed that all fifteen countries and regions in the world have agreed to a free trade agreement for sugar and all other things such as population, endowment of primary factors, and technology, etc. remain unchanged from the observations for the base year 2001. Two

scenarios for sugar trade liberalization are considered in this study. The first scenario is a complete elimination of import tariffs (including tariff equivalents of bilateral non-tariff barriers) and export subsidies in the sugar sector across all countries and regions. The second scenario is that import tariffs and export subsidies are cut by one third or 33%, as comparable to some of the previous studies (e.g., Elbehri et al 2000, Mensbrugghe et al 2003). Note that domestic agricultural policies such as sugar production subsidies are not considered in this study. The solution method is “Gragg 2-4-6 with auto accuracy”⁸.

4. RESULTS AND DISCUSSION

First, trade creation and trade diversion effects of a global sugar FTA on the selected countries are discussed. Second, effects of the FTA on GDP, national welfare, sugar production, and sugar prices for selected countries are presented. Finally, effects of the FTA on production in various sectors in the United States are illustrated.

4.1. Trade Creation and Trade Diversion Effects

Table 3 summarizes the changes of sugar exports for the selected fifteen countries and regions. Under scenario one, where import tariffs and export subsidies are completely eliminated, the world sugar trade would increase by \$6.5 billion. A global sugar FTA would increase sugar trade volume (trade creation) essentially for all countries and regions except for Canada. While the net exporting countries would increase their net exports, the net importing countries would increase their net imports. The results are

⁸ GTAP offers a variety of different solution methods. For details, please refer to Hertel (1997) or RunGTAP Help/Content/Solve/Solution Method.

qualitatively consistent with the findings in previous studies (Elbehri et al 2000; Mensbrugghe et al 2003).

Total U.S. sugar imports and exports would increase by \$598.6 and \$120.5 million, respectively. As a result, U.S. net imports would increase by \$478.1 million. The increase of U.S. imports would mainly come from Australia, Brazil, and ROW. By contrast, U.S. imports from Canada and Mexico would decrease sharply by \$49.3 and \$41.2 million, respectively. A global sugar FTA would decrease the competitiveness of Canada and Mexico relative to other countries due to the already existence of NAFTA. Since the United States has served as the primary market for Canadian and Mexican sugar exports thanks to NAFTA, a global sugar FTA would not do much help for these two countries' sugar exports. On the contrary, a global sugar FTA would lead the United States to increase sugar imports from other countries (e.g., Australia and Brazil) and divert imports from Canada and Mexico.

U.S. sugar exports to Japan and EU would decrease by \$61.4 and \$22.1 million, respectively, while its exports to all other countries and regions except Indonesia would increase by different volume, ranging from \$0.9 million in Australia to \$89.9 million in ROW. Also, U.S. imports from EU would decrease by \$27.1 million.

EU sugar exports to all destinations would decrease with a total drop of about \$1.2 billion, while imports would increase by a total of \$3.5 billion. As a result, total EU net imports would increase by about \$4.7 billion. This is because EU not only imposed high import tariffs but also exercised large export subsidies in the base year 2001. Removal of import tariffs favors imports, and elimination of export subsidies disfavors exports. Thus, a complete elimination of these high tariffs and export subsidies in the EU

would sharply reduce its competitiveness in the world sugar market relative to other countries and regions. The EU would sharply increase its sugar imports from Brazil and ROW.

Sugar imports and exports in Japan would increase by \$783.6 and \$58.9 million, respectively, resulting in an increase of net imports by \$724.7 million. In contrast to the case for the EU, Japan would increase its imports mainly from Australia and Thailand since Japan is geographically closer to these two exporting countries.

Canada would decrease its sugar exports by \$61.2 million and also decrease its imports slightly by \$1.0 million. As a result, Canadian sugar trade would decrease by \$62.2 million (trade diversion). Canada would decrease sugar exports, since the United States would divert its imports from Canada to other more efficient sugar producing countries such as Australia and Brazil, as discussed earlier. Thus, a global sugar FTA would erode Canadian market access to the United States from NAFTA.

While Mexico would decrease sugar exports by \$9.9 million due to a sharp decrease in exports to the United States, it would increase sugar imports by \$21.8 million. As a result, the net exports of sugar in Mexico would decrease by \$31.7 million.

Sugar net exporters would increase their sugar net exports. For example, Australia, Brazil, and Thailand would increase their net exports by \$690.4, \$1015.7, and \$523.9 million, respectively. In particular, the ROW would increase sugar exports by about \$5.0 billion and increase sugar imports by \$1.0 billion. As a result, the net exports in the ROW would increase by \$4.0 billion.

Under scenario two where import tariffs and export subsidies are cut by one third or 33%, the world sugar trade would increase by \$955.1 million. While trade creation

would still occur for most countries, trade diversion would occur for Canada, the EU, Mexico, and South Korea. U.S. sugar imports and exports would increase by \$125.3 and \$12.0 million, respectively, resulting in an increase of \$113.3 million in net imports. While EU sugar exports to all destinations would decrease, with a total decrease of \$514.6 million, its imports would increase by \$343.9 million. As a result, sugar trade in EU would decrease by \$170.7 million, and thus trade diversion occurs.

4.2. Changes in GDP, Welfare, Sugar Production, and Sugar Prices

Table 4 summarizes the changes in GDP, national welfare, sugar production, and sugar prices across the countries and regions. Under scenario one, GDP in sugar net importing countries would decrease and GDP in sugar net exporting countries would increase. Specifically, GDP in the EU, Japan, and the United States would decrease by \$4.44 (0.06% of GDP in 2001), \$1.90 (0.05%), and \$1.98 billion (0.02%), respectively. GDP in Australia, Brazil, Thailand, and ROW would increase by \$636.2 (0.18% of GDP in 2001), \$1215.2 (0.24%), \$242.0 (0.21%), and \$1994.0 million (0.05%), respectively.

The global welfare measured by Equivalent Variation in income would increase by \$3.50 billion, which is similar to the magnitude for a global welfare gain found by Mensbrugghe et al (2003) under full multilateral trade liberalization for sugar. The national welfare would increase for all countries and regions except for China, Indonesia, Mexico, and the United States. The changes of welfare differ significantly across the countries. The EU would gain most (by about \$1.39 billion), followed by Japan (\$884.3 million) and ROW (\$730.0 million). The welfare of the United States would decrease slightly by \$53.2 million. In terms of per capita welfare gain, Thailand would gain the

most (an increase of 0.11%), followed by Brazil (0.05%) and Australia (0.04%). Per capita welfare changes in the United States, Canada, and Mexico are very small and negligible.

As we expected, sugar production in net exporting countries would increase while that in net importing countries would decrease, since free trade encourages more efficient producers to produce more and less efficient producers to produce less. Specifically, sugar production in Australia, Brazil, Thailand, and ROW would increase by 48.3%, 25%, 36.9% and 11.3%, respectively. Sugar production in Canada, the EU, and Japan would decrease by 26.2%, 39.5%, and 14.5%, respectively. U.S. sugar production would decrease slightly by 2.8%, which is close to the findings by Elobeid and Beghin (2005).

The world prices (border prices before tariffs are imposed) would increase for all countries and regions except the EU. The results are consistent with the results from previous studies qualitatively, but the magnitude of increase in the world sugar prices we found are smaller than those from many previous studies (e.g., Elobeid and Behign 2005, Andino et al 2005). This is because partial equilibrium analyses tend to provide larger price increases (Mensbrughe et al 2003). The world sugar prices in ROW (which include Caribbean countries) would increase by 2.3%. The world sugar price at the U.S. border would increase slightly by 0.6%. The world sugar price in the EU would decrease slightly by 0.2% due to the elimination of export subsidies in the region.

Import prices (world prices plus tariffs) would decrease essentially for all countries and regions except for Australia. The decrease of import prices would differ dramatically across the countries and regions because each country imposed very different tariff rate in the base year. For example, while the import prices in Japan and the

EU would decrease by 73.9% and 50.4%, respectively, the import prices in Canada would decrease by only 0.3%. The sharp decrease of import prices for Japan and EU are due to the removal of their original very high tariffs imposed on sugar imports. In contrast to all other countries and regions, the import price in Australia would increase slightly by about 0.7%. This is because that Australia has originally imposed no tariffs or very low tariffs relative to other countries. After all countries have removed their trade barriers, the increase of world prices dominates tariff reduction in the case for Australia.

Domestic sugar prices for net exporting countries would increase while those for net importing countries would decrease. As a result, sugar production in net exporting (importing) countries would increase (decrease) in response to increased (decreased) domestic sugar prices. Specifically, domestic prices in Australia, Brazil, and Thailand would increase by 0.3%, 0.6%, and 4.5%, respectively. Domestic prices in the EU, Japan, and the United States would decrease by 3.8%, 18.3%, and 0.8%, respectively.

Under scenario two, where import tariffs and export subsidies are cut by one third or 33%, changes in GDP, welfare, sugar production, and sugar prices across the countries and regions would be smaller in quantity, but qualitative changes are essentially the same as in the case for scenario one. U.S. GDP would decrease by \$399.0 million, and U.S. sugar production would decrease slightly by 0.8%, in response to a slight decrease of 0.2% in domestic sugar price. However, U.S. welfare would increase slightly by \$14.7 million.

4.3. Effects of a Global Sugar FTA on U.S. Production across the Sectors

Table 5 presents the effects of a global sugar free trade agreement on the six different sectors in the United States. Under scenario one, where import tariffs and export subsidies are completely eliminated, the output value of U.S. sugar production would decrease by \$853.5 million, or a decrease of 2.8% from the base year 2001. The output value of sugar cane and sugar beets in the United States would decrease by \$64.9 million, or a decrease of 2.8%. Under scenario two, where import tariffs and export subsidies are cut by one third or 33%, U.S. sugar output value would decrease by \$238.8 million, or a decrease of 0.8%. U.S. sugar cane and sugar beet output value would decrease slightly by \$18.2 million, or a decrease of 0.8%. Trade liberalization would result in a decrease in the U.S. production of sugar cane and sugar beet. This is consistent with the results found in previous studies (e.g., Koo 2002).

The output values in the sectors of primary agriculture and manufacture would increase by \$137.3 and \$731.0 million, respectively, under scenario one. The corresponding output values for the two sectors under scenario two would be \$25.1 and \$176.5 million, respectively. Based on the GTAP model structure, a decrease in production of sugar, sugar cane and sugar beets implies a decrease in use of the primary factors (labor, capital, land and natural resources) in the two sectors, and these unused primary factors are necessarily reallocated to other sectors (e.g., primary agriculture and manufactures sectors) to close the model. Therefore, output of primary agriculture products and manufacturing goods would increase. However, the increase or decrease of output value in all other sectors (except the sectors of sugar and sugar cane and sugar

beets) would be are very small. Thus, we conclude that the effects of a global sugar FTA on other sectors are minor and negligible.

5. SUMMARY AND CONCLUSIONS

In this study, we have identified the major sugar trading partners for U.S. sugar imports and exports. We have used a multi-region GTAP model (a general equilibrium approach) to examine the impacts of a global sugar free trade agreement on the U.S. sugar industry.

Canada, Japan, and Mexico are the most important sugar markets for U.S. sugar exports. U.S. sugar exports to Canada, Japan, and Mexico in 2001 totaled \$215.5 million, which accounted for 61.5% of total U.S. sugar exports in that year. U.S. sugar imports are mainly sourced from ROW (Caribbean countries), Canada, Mexico, Brazil, and Australia. U.S. sugar imports from these countries and regions combined reached \$746.5 million or 91.1% of total U.S. imports in 2001.

A global sugar FTA with a full elimination of import tariffs and export subsidies would increase sugar trade volume essentially for all countries and regions except for Canada. The world sugar trade volume would increase by \$6.5 billion. Total U.S. sugar imports and exports would increase by \$598.6 and \$120.5 million, respectively. If import tariffs and export subsidies in all countries and regions are cut by one third, the world sugar trade volume would increase by \$955.1 million. Total U.S. sugar imports and exports would increase by \$125.3 and \$12.0 million, respectively. In any case, the net exporting countries would increase their net exports, while the net importing countries would increase their net imports.

Under a global sugar FTA, GDP in sugar net importing countries would decrease, and GDP in sugar net exporting countries would increase. Sugar production in net exporting countries would increase while production in net importing countries would decrease, since free trade encourages more efficient producers to produce more and less efficient producers to produce less. For scenario one, U.S. GDP would decrease by \$1.98 billion or 0.02% of GDP in the base year 2001. U.S. national welfare would decrease slightly by \$53.2 million, which is negligible in terms of per capita welfare gain. U.S. sugar production would decrease slightly by 2.8%. For scenario two, U.S. GDP would decrease by \$399.0 million, but U.S. national welfare would increase slightly by \$14.7 million. U.S. sugar production would decrease slightly by 0.8%.

While the world sugar prices would increase by 2.3%, the import prices would decrease essentially for all countries and regions except for Australia. The decrease of import prices would differ dramatically across the countries and regions because each country imposed very different tariff rates in the base year. U.S. import prices would decrease by 21.9%. Domestic sugar prices for net exporting countries would increase but those for net importing countries would decrease. U.S. domestic sugar price would decrease slightly, by 0.8% and 0.2% under scenarios one and two, respectively.

Under scenario one, U.S. sugar output value would decrease by \$853.5 million, or a decrease of 2.8% from 2001. The output value of U.S. sugar cane and sugar beets would decrease by \$64.9 million, or 2.8%. Under scenario two, U.S. sugar output value would decrease by \$238.8 million, or 0.8%. The output value of U.S. sugar cane and sugar beets would decrease by \$18.2 million, or 0.8%. The effects of a global sugar FTA on other sectors are minor and negligible.

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Table 1- General Economic Statistics of the Selected Countries and Regions in 2001(billion U.S. dollars)

	USA	Australia	Brazil	Canada	China	EU	FSU	India	Indonesia	Japan	Mexico	SAfrica	SKorea	Thailand	ROW
Population (million)	277.5	19.4	172.3	31.2	1269.9	376.3	290.9	1032.1	213.3	126.8	100.9	43.4	47.6	62.8	2068.1
Capital Stock	22575.1	935.6	1444.9	1799.5	2737.6	22895.8	1431.4	1018.3	309.5	15068.2	1757.4	378.0	1266.7	382.3	10751.3
Investment	1990.6	77.2	105.3	144.6	408.8	1614.5	99.0	106.1	23.4	1059.7	121.8	15.8	109.9	23.1	842.3
GDP	10082.2	357.4	502.5	715.0	1159.0	7929.5	439.3	477.3	145.3	4177.6	617.8	113.3	427.6	114.7	4020.0
Imports	1300.9	72.9	74.0	243.1	281.2	2571.4	142.7	62.3	45.4	413.1	149.8	29.8	162.6	63.9	1531.6
Exports	907.5	73.9	69.4	271.3	388.4	2603.9	175.1	63.2	69.1	478.4	166.3	40.1	191.8	81.3	1565.0
Land	42.1	3.0	3.3	3.5	45.8	33.8	10.3	44.9	8.3	8.3	8.5	0.6	8.6	4.7	69.2
Unskilled Labor	3156.5	108.3	123.4	214.4	428.2	1690.2	135.4	152.1	33.9	1159.9	115.1	39.8	127.4	21.8	1099.3
Skilled Labor	2230.4	76.5	71.0	104.1	103.2	1160.5	45.1	47.5	9.5	706.5	50.4	18.1	54.1	8.3	520.1
Capital	3644.0	120.5	179.3	235.8	369.0	3035.7	144.9	192.1	77.4	1345.0	357.2	39.1	182.3	62.1	1628.4
Natural Resources	22.6	5.3	2.4	7.6	17.2	18.6	20.1	4.4	6.0	4.8	7.5	2.1	0.7	1.1	80.1
Sugar	30.1	1.9	4.8	0.3	0.4	19.7	9.6	6.1	2.1	10.8	4.8	0.8	0.8	1.3	36.6
Sugar Cane and Beets	2.3	0.5	3.2	0.0	1.2	3.9	2.3	7.6	0.8	1.3	1.4	0.2	0.0	0.4	9.8
Processed food	714.6	31.5	63.7	55.2	171.6	724.4	119.2	44.3	31.7	305.7	99.8	15.4	42.5	21.5	498.2
Primary Agriculture	197.7	22.3	33.7	24.1	280.7	230.2	146.3	130.5	21.0	71.9	33.1	8.5	27.3	13.2	458.1
Manufactures	4421.0	153.3	257.5	427.0	1705.8	4448.1	606.8	280.5	127.4	2182.6	403.4	88.3	423.1	117.7	2556.2
Services	12586.4	447.8	491.0	736.7	976.2	9176.9	598.3	398.3	106.7	4759.2	507.4	119.1	475.9	100.7	4091.9

Note: The endowments in the middle five rows present the distribution of total output to the five primary factors. The last six rows present industry output of the six sectors. FSU refers to the former Soviet Union.

Table 2 - Sugar Exports in the selected countries and regions in 2001 (million U.S. dollars)

	USA	Australia	Brazil	Canada	China	EU	FSU	India	Indonesia	Japan	Mexico	SAfrica	SKorea	Thailand	ROW	Total
USA	0	4.1	3.3	98.7	11.3	29.3	2.8	0.5	5.8	63.2	53.6	1.7	12.3	2.5	61	350.2
Australia	44.1	0	0	97.6	54.8	0.4	0	0.4	17	136.1	0	0.3	95	0.1	290.5	736.1
Brazil	57.2	0.1	0	60.4	24.4	17.8	699.8	0	9.2	0.1	0	0.2	0.3	0	614	1483.5
Canada	134.7	1.6	0.1	0	0.3	8.2	0.2	0	0.3	7.6	3.7	0.6	0.4	0.5	5.1	163.3
China	0.5	0.6	0	0.7	0	0.4	0.1	0.1	4.6	2.9	0	0	2.2	0.4	16.2	28.8
EU	32	6.5	4.3	6.5	3.9	915.3	31.1	3.6	10.8	23.1	4.3	4.7	5	5.4	317	1373.4
FSU	1.9	0.1	0.1	0.3	0.3	11.6	18.1	0.3	0.2	1.1	0.1	0.2	0.5	0.1	8.6	43.5
India	2.7	0.2	0.1	0.5	14.2	31.4	0.4	0	8.4	0.5	0.1	0.1	5.5	0.1	169.4	233.7
Indonesia	1.2	0.8	0	0.2	1.3	2.2	0.2	1	0	3	0.1	0	2	0.1	5	17.1
Japan	1.6	0.2	0	0	1.1	1.2	0	0.2	0.8	0	0	0	4.5	0.4	2.6	12.6
Mexico	78.9	0	0	4.4	0.1	7.9	0.1	0	0	0.1	0	0	0	0	20	111.7
SAfrica	19.1	0.5	0	0.1	9.9	4.2	12.3	0	0.2	46.9	0	0	62.9	0	196.4	352.6
SKorea	1.7	0.6	0	0	0.3	0.1	0	0	1	1	0	0	0	0	6.5	11.2
Thailand	12.3	0.2	0	0.2	89.8	3.1	16.9	0.1	80	148.8	0.1	0	57.1	0	144.3	552.9
ROW	431.6	4.3	6.5	75.4	79.1	1039.1	719.4	3.8	17	33.1	2.7	68.3	106.7	2.8	568.1	3157.7
Total	819.4	20	14.6	345.1	290.7	2072.3	1501.5	10.2	155.2	467.4	64.7	76.1	354.2	12.4	2424.6	8628.4

Note: The values represent exports from the country in the row to the country in the column. The exports from EU to EU are not zero since it is an aggregated region.

Table 3 – Changes of Sugar Exports in the selected countries and regions in 2001 (million U.S. dollars)

	USA	Australia	Brazil	Canada	China	EU	FSU	India	Indonesia	Japan	Mexico	SAfrica	SKorea	Thailand	ROW	Total
Scenario 1: Import tariffs and export subsidies are completely eliminated																
USA	0	0.9	3.6	1.9	3.8	-22.1	2.9	2.3	-0.4	-61.4	26	21.1	49.3	3.1	89.8	120.5
Australia	61.0	0	0	-2.6	14.2	-0.1	0	0.9	12.3	497.5	0	0.9	-18.5	0.1	123.5	689.5
Brazil	129.2	0	0	1.3	6.6	361.1	246.1	0	6.7	0.6	0.1	5.6	-0.1	0	262.3	1019.6
Canada	-49.3	0.1	0.1	0	0.4	-7.4	-0.1	0.2	0.2	-7.6	-0.6	-0.2	0.1	1.4	1.4	-61.2
China	1.6	0.1	0	0.4	0	3.7	0	0.3	3.9	10.2	0	0	5.6	1.2	4.6	31.6
EU	-27.1	-5.7	-3.3	-5.4	-3.4	-832.9	-28.4	-2.3	-8.6	-20.4	-3.6	2.1	-3.4	-3.1	-235.9	-1181.1
FSU	2	0.1	0	0	-0.1	-10.2	-8.2	1.0	0	-1.1	0	0.4	0	0	1.7	-14.4
India	3.9	0.1	0.1	0.2	-0.6	-1.5	-0.1	0	6	3.7	0	1.9	-1.2	0.4	168.8	181.3
Indonesia	5.4	0.1	0	0.1	-0.3	-0.9	-0.1	4.3	0	-2.4	-0.1	0.5	-0.2	0.2	1.2	8.0
Japan	9.6	0.5	0	0.1	2	-0.3	0.1	0.9	1.8	0	0.1	0	12.7	1.3	30.1	58.9
Mexico	-41.2	0.1	0	0.5	0	14.8	-0.1	0.1	0	-0.1	0	0	0	0	16.0	-9.9
SAfrica	6.6	1.4	0.1	0	2.9	-2.2	-2.2	0.2	0.1	-25.1	0	0	-12.0	0	94.8	64.3
SKorea	-0.3	1.0	0	0.1	0.1	-0.1	0	0.2	1.0	1.5	0	0	0	0.1	2.3	5.9
Thailand	8.0	0	0	0	3.6	4.4	7.5	0.1	38.4	386.6	0.2	0.7	-16.1	0	98.5	532.0
ROW	489.1	0.6	3.4	2.7	18	3969.6	248.9	5.0	1.7	1.4	-0.3	-18.3	-19.1	3.4	340.2	5046.4
Total	598.6	-0.9	3.9	-1.0	47.2	3476.0	466.3	13.0	63.2	783.6	21.8	14.6	-2.7	8.1	999.5	6491.3
Scenario 2: Import tariffs and export subsidies are cut by 33%																
USA	0	0.3	0.9	0.4	1.0	-4.9	0.7	0.4	-0.2	-23.6	7.3	1.9	7.8	0.7	19.4	12.0
Australia	14.0	0	0	-0.6	4.0	0	0	0.1	3.2	58.7	0	0.2	-3.2	0	36.7	113.4
Brazil	24.7	0	0	0.6	1.9	20.1	69.4	0	1.7	0.1	0	0.3	0	0	78.6	197.4
Canada	-14.3	0.1	0	0	0.1	-3.0	0	0.1	0.1	-4.8	-0.1	-0.1	0	0.2	0.4	-21.4
China	0.2	0.1	0	0.1	0	0.4	0	0	1	1.3	0	0	1.1	0.2	1.5	5.8
EU	-12.8	-2.8	-1.4	-2.5	-1.8	-365.2	-15.4	-0.7	-3.8	-8.0	-1.7	0.7	-1.2	-1.0	-97.1	-514.6
FSU	0.5	0.1	0	0	0	-3.9	-2.8	0.2	0	-0.4	0	0.1	0	0	0.6	-5.8
India	0.9	0.1	0	0.1	-0.2	5.8	0	0	1.5	0.2	0	0.2	-0.3	0.1	40.9	49.1
Indonesia	0.8	0.1	0	0	-0.1	0.1	-0.1	0.7	0	-0.2	0	0.1	0	0	0.4	1.8
Japan	1.1	0.1	0	0	0.3	0.1	0.1	0.1	0.3	0	0	0	2.1	0.2	2.5	6.9
Mexico	-14.5	0	0	0.2	0	4.0	0	0	0	-0.1	0	0	0	0	4.1	-6.4
SAfrica	2.3	0.3	0	0	0.7	0	-0.6	0.1	0	3.0	0	0	-2.2	0	26.8	30.3
SKorea	-0.1	0.3	0	0	0	0	0	0	0.2	0.3	0	0	0	0	0.6	1.5
Thailand	2.6	0	0	0	2.6	1.4	2.2	0	11.9	55.3	0	0.1	-2.9	0	28.8	102.0
ROW	119.9	0.3	1.0	1.0	5.0	689.1	69.1	1.3	0.6	6.4	-0.1	-1.8	-3.0	0.8	93.4	983.3
Total	125.3	-1.4	0.5	-0.7	13.6	343.9	122.4	2.1	16.5	88.4	5.5	1.6	-1.6	1.4	237.7	955.1

Note: EU refers to the European Union 15, and FSU refers to the former Soviet Union

Table 4 – Changes in GDP, Welfare (EV), Sugar Production, and Sugar Prices across the Countries and Regions

Countries	GDP (million US\$)	GDP (%)	Welfare (million US\$)	Per Capita Welfare (%)	Sugar Production (%)	World Prices (%)	Import Prices (%)	Domestic Prices (%)
Scenario 1: Import tariffs and export subsidies are completely eliminated								
USA	-1983.0	-0.02	-53.2	0.00	-2.8	0.6	-21.9	-0.8
Australia	636.2	0.18	122.5	0.04	48.3	4.0	0.7	0.3
Brazil	1215.2	0.24	215.6	0.05	25.0	4.4	-8.6	0.6
Canada	-106.5	-0.01	4.6	0.00	-26.2	0.2	-0.3	-0.1
China	-124.6	-0.01	-47.0	0.00	-6.2	1.3	-14.8	-0.4
EU	-4443.5	-0.06	1385.6	0.02	-39.5	-0.2	-50.4	-3.8
FSU	-444.5	-0.10	73.1	0.02	-8.1	0.6	-23.1	-4.5
India	263.2	0.06	24.5	0.01	2.7	4.8	-28.9	0.3
Indonesia	-81.6	-0.06	-16.1	-0.01	-2.9	3.0	-13.4	-0.5
Japan	-1904.7	-0.05	884.3	0.02	-14.5	2.3	-73.9	-18.3
Mexico	-82.8	-0.01	-1.5	0.00	-1.1	0.1	-11.5	-0.1
South Africa	15.4	0.01	15.1	0.02	5.1	2.3	-12.1	0.1
South Korea	-25.7	-0.01	2.0	0.00	0.6	0.3	-7.0	-3.2
Thailand	242.0	0.21	111.1	0.11	36.9	7.1	-17.3	4.5
ROW	1994.0	0.05	730.0	0.02	11.3	2.3	-13.7	0.1
Total	-2847.9		3503.8					
Scenario 2: Import tariffs and export subsidies are cut by 33%								
USA	-399.0	0.00	14.7	0.00	-0.8	0.2	-6.7	-0.2
Australia	102.6	0.03	19.6	0.01	8.0	2.1	1.2	0.0
Brazil	232.7	0.05	41.1	0.01	4.9	1.9	-2.2	0.1
Canada	-30.7	0.00	-1.0	0.00	-9.2	0.1	-0.1	0.0
China	-27.4	0.00	-7.1	0.00	-3.3	0.3	-4.9	-0.1
EU	-333.5	0.00	735.9	0.01	-9.5	-0.2	-14.4	-0.7
FSU	-106.4	-0.02	36.7	0.01	-2.5	0.2	-7.6	-1.4
India	74.4	0.02	8.2	0.00	0.7	2.3	-8.4	0.1
Indonesia	-21.7	-0.01	-2.5	0.00	-0.9	0.8	-4.4	-0.1
Japan	-189.7	0.00	337.3	0.01	-3.7	0.6	-23.3	-4.5
Mexico	-21	0.00	-0.3	0.00	-0.4	0.2	-3.6	0.0
South Africa	16.1	0.01	6.9	0.01	3.5	0.5	-1.9	0.1
South Korea	-4.1	0.00	2.0	0.00	0.2	0.2	-1.6	-0.7
Thailand	44.9	0.04	19.4	0.02	7.3	3.1	-4.7	0.9
ROW	320	0.01	146.9	0.00	1.9	0.9	-4.3	0.0
Total			1343.2					

Note: EU refers to the European Union 15, and FSU refers to the former Soviet Union

Table 5 - Effects of a Global Sugar FTA on U.S. production across the Sectors

Sectors	Output Value in Base Year (billion US\$)	Output Value after FTA is implemented (billion US\$)	Change in Output Value (million US\$)	Change (%)
Scenario 1: Import tariffs and export subsidies are completely eliminated				
Sugar	30.1	29.2	-853.5	-2.8
Sugar Cane and Sugar Beets	2.3	2.2	-64.9	-2.8
Processed Food	714.6	714.5	-68.9	0.0
Primary Agriculture	197.7	197.8	137.3	0.1
Manufactures	4421.0	4421.7	731.0	0.0
Services	12586.4	12586.3	-83.0	0.0
Scenario 2: Import tariffs and export subsidies are cut by 33%				
Sugar	30.1	29.8	-238.8	-0.8
Sugar Cane and Sugar Beets	2.3	2.3	-18.2	-0.8
Processed Food	714.6	714.6	-11.1	0.0
Primary Agriculture	197.7	197.7	25.1	0.0
Manufactures	4421.0	4421.1	176.5	0.0
Services	12586.4	12586.4	0	0.0

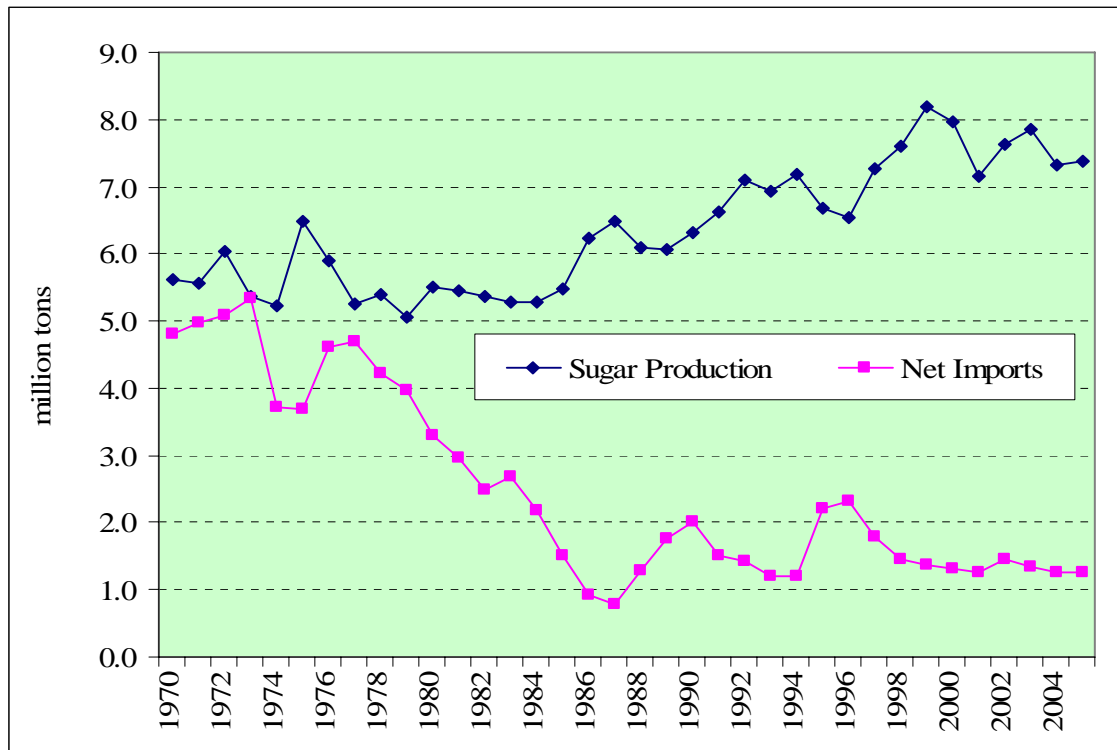


Figure 1 – U.S. Sugar Production and Net Imports in 1970 – 2005

Appendix A – 6 Sectors Aggregated based on the GTAP Version-6 Database

Sectors	Comprising 57 Original Sectors
Sugar	Sugar
Sugar cane and sugar beet	Sugar cane, sugar beet.
Processed food	Meat: cattle,sheep,goats,horse; Meat products nec; Vegetable oils and fats; Dairy products; Processed rice; Food products nec; Beverages and tobacco products.
Primary agriculture	Paddy rice; Wheat; Cereal grains nec; Vegetables, fruit, nuts; Oil seeds; Plant-based fibers; Crops nec; Cattle,sheep,goats,horses; Animal products nec; Raw milk; Wool, silk-worm cocoons.
Manufacturing goods	Forestry; Fishing; Coal; Oil; Gas; Minerals nec; Textiles; Wearing apparel; Leather products; Wood products; Paper products, publishing; Petroleum, coal products; Chemical,rubber,plastic prods; Mineral products nec; Ferrous metals; Metals nec; Metal products; Motor vehicles and parts; Transport equipment nec; Electronic equipment; Machinery and equipment nec; Manufactures nec.
Services	Electricity; Gas manufacture, distribution; Water; Construction; Trade; Transport nec; Sea transport; Air transport; Communication; Financial services nec; Insurance; Business services nec; Recreation and other services; PubAdmin/Defence/Health/Educat; Dwellings.