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Impact of the Elimination of Canadian Refined Sugar Tariff on
Imports from Guatemala, Honduras, El Salvador and Nicaragua

A Study

For the

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Executive Summary

On September 28, 2000, Canada agreed to a request from four central American countries--El Salvador, Guatemala, Honduras, and Nicaragua (known as the CA-4 countries) to begin negotiations on a free trade agreement. Canada has embarked on public consultations to define the scope of the agreement. For the CA-4 countries, the Canadian refined sugar tariff appears to be a critical, if not mandatory, item with respect to any agreement in the negotiations.

Canada is heavily involved in the trade negotiations for the revision to the WTO Agreement on Agriculture and the regional agreement on the Free Trade Area of the Americas (FTAA). Canada has signed a free trade agreement with Costa Rica, reducing the tariffs on the imports of refined sugar, starting in 2003. Canadian overall trade and economic development policies are also important considerations in the free trade negotiations with the CA-4 countries.

Sugar is a major staple food providing a cheap source of energy, especially for low income countries. For many developing countries, sugar contributes a substantial part of the overall export earnings and, because it is labour-intensive, sugar represents a major source of employment. Compared to most other agricultural commodities, a significant part of global sugar production is traded internationally. Only a small part of the more than 40 million tonnes of global trade now occurs under the preferential trading relationships of the EU and the US.

Most countries, in both the developed and developing world, have highly regulated and supported sugar industries. At the production level, the OECD estimated that the Producer Subsidy Equivalent (PSE) for all OECD countries was 54 percent in 1998-2000. The international market for refined sugar is even more protected and distorted than the market for raw sugar. This support is generally maintained by high tariffs, and borne by sugar consumers. In contrast, Canada has one of the most open markets for sugar of any of the OECD countries. Canada imports about 90 percent of its sugar requirements. Most countries export raw sugar to Canada duty free under GPT or commonwealth tariff preferences. Refined sugar imports into Canada face a \$30.83/mt. tariff (approximately 6.5 percent ad valorem equivalent in 2000).

Market concerns

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The Canadian sugar refining industry is concerned that reducing the tariff for refined sugar could seriously impact their processing margins, refining capacity, profits and, perhaps, their viability. Sugar beet producers are concerned about lower returns on sales, and the continued operation of the only beet processing plant in Canada. The alternative sweetener industry (for example, the high fructose corn syrup (HFCS) producers) is concerned about lower prices and margins. On the other hand, the further processing sugar users (bakeries, soft drinks, and confectionary producers) believe that this refined sugar tariff elimination would represent a significant competitive element to facilitate growth in the domestic and export markets. Consumers want lower prices, and see the tariff on refined sugar as regressive to low income families. Governments are uncertain whether the potential losses to some of the market participants (refiners, beet growers, alternative sweetener producers) would be offset by the potential gains to sugar users. As part of the free trade negotiating process, Canada wants to be aware of the magnitude of the potential gains to the CA- 4 countries. Providing developing countries with better market access is generally the most efficient and effective form of economic assistance. In addition, there are issues concerning Canada's responsibility and obligations to its current sugar suppliers and its overall trade policy.

Study objectives

This study was contracted by the Canadian government in order to get a better understanding of the extent of the gains and losses, to the various market participants, from the refined sugar tariff reductions. By conducting the analysis in an open and transparent manner, all of the public and private sector participants can address the policy questions from the same basic information. The **primary** objective of the study was to estimate the economic impact on the various market participants (such as the sugar beet producers, refiners and processors, alternative sweetener producers, food processors, and consumers) in the Canadian sugar complex of eliminating the applied tariff on refined sugar from CA-4 countries. A **secondary** objective was to determine the effect on the sugar sector (raw and refined) of the CA-4 countries and Canada's major sugar trading partners (Australia, Brazil, US) from a unilateral refined sugar tariff elimination.

Canadian sugar market

While Canada imports about 90 percent of its raw sugar requirements, refined sugar imports only represented from 2-7 percent of Canada's total sugar imports during 1996-

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2000. Raw sugar is refined in four plants in Canada. Most refined sugar goes to industrial users (82-84 percent), while a much smaller amount goes to retail consumers (16-18 percent). Per capita sugar consumption in Canada has been very stable for many years. Domestic production comes from sugar beets, with about 41-45 thousand acres harvested each year, mainly in southern Alberta. Sugar beets are processed in a plant in Taber.

The MFN tariff for raw sugar for imports into Canada is \$25.57/mt (for a 98 degree of polarization). Most of the Canadian raw sugar imports are duty free, as the CA-4 countries, as well as major suppliers such as Cuba and Brazil already benefit from a zero duty under the GPT tariff preferences, or in the case of Australia, under the Commonwealth preference. In 2000, the primary import sources for Canada were Australia, Guatemala and Brazil, which provided about 80 percent of Canadian raw sugar imports. The refined sugar tariff is \$30.86/mt, with no preferential tariff. Imports of refined sugar were 88,669 mt. in 2000. This was higher than in recent years, but below the 1985-95 period import levels. Canada maintains an antidumping duty against most sugar imports from the US and the EU. This duty, applied in 1995, was reviewed and recommended to be maintained by the Canadian International Trade Tribunal in 2000.

CA-4 sugar market

Sugar production is an important source of employment and foreign exchange for the CA-4 countries. Sugar production doubled in these countries from 1980-1996, and their export prices are among the lowest in the world. Domestic sugar markets are highly regulated. Guatemala is the largest sugar producer of the CA-4 countries, and the third largest exporter in the western hemisphere, after Brazil and Cuba. Consumption is also rising rapidly in the CA-4 countries, limiting the growth in their exports (especially in El Salvador, Honduras and Nicaragua). These countries have high import tariffs, and hence there is little 'official' trade among them. The CA-4 countries' main export market is the US, and it accounts for 10.5 percent of the US global Tariff Rate Quota (TRQ). Total sugar exports from the CA-4 countries exceed total Canadian sugar imports. The current refining capacity in the CA-4 countries is limited, but it is continuing to grow, especially in Guatemala and Honduras. Most exports from the CA-4 countries are still in the form of raw sugar. Canada imported 3.2 thousand tonnes of refined sugar from Guatemala in 2000, less than 2 percent of Guatemala's total refined sugar exports.

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Study scenarios

The study examined two basic scenarios for the unilateral elimination by Canada of the specific tariffs for refined sugar from the CA-4 countries. The **first alternative** examined was an immediate elimination of the full tariff in 2003. The **second alternative** examined involved the potential for a more responsive and therefore vulnerable, sugar producing and refining capability in Canada.

There were several areas of the study where the information was considered to be weak, or the likely responses of the market participants were quite uncertain. The quantitative analysis design allowed sensitivity testing of various degrees of change of market parameters to be tested as part of the study.

Analytical framework and data

The analytical framework for the study involved the development of a quantitative representation of the Canada-Central America countries' sugar trade. This involved a detailed model specification for Canada, the CA-4 countries (El Salvador, Guatemala, Honduras, and Nicaragua), and the rest of the world.

For each country/region, two products are modelled - raw and refined sugar. The quantitative representation included the key economic factors affecting the demand, supply, price, and trade for each product. It was assumed that CA-4 country exporters and Canadian importers of refined sugar would respond to the elimination of the \$30.86/mt. refined sugar tariff, similar to a price change, and increase their exports and imports of refined sugar. At the same time, other market participants would also react and adjust to any price and quantity change, all of which would have an effect on the final market price and import quantities.

The key economic factors and their relationships were included in the construction and application of a trade modelling framework for CA-4 countries-Canada sugar, using VORSIM software. This VORSIM-built model is named SUGR for a SUGaR sector model.

The base period used for the analysis was 2000. The data for all of the foreign markets sugar production, consumption, trade and price were taken from the USDA sweetener situation. These data were supplemented with the USDA FAS attaches' reports. Canadian data from various Statistic Canada sources was used whenever possible. The allocation of the data between raw and refined sugar was made using FAO sugar

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statistics. The initial year for the ‘what if’ type questions was 2003. The analysis was assumed to be long-term, meaning that the impacts are those which would be found when all of the economic changes resulting from a policy change have worked through the system. These results did not include projected values for growth in population and income or other long term economic changes. No change was assumed in domestic or trade policies for sugar, which are under review in the US and the EU. Without any significant policy changes, there is limited change in international markets for sugar.

In developing the analytical framework for each of the countries/regions, the coefficients used for the economic relationships were taken from primarily USDA sources. These data were supplemented from other international quantitative studies which included sugar.

Key study results

The following elements are the key findings from the study of the unilateral elimination of the Canadian refined sugar tariff.

Limited change in Canadian refining capacity utilization and sugar beet production

In the basic scenario, and the alternative examined, there was only a small decrease (less than 1 percent) in the level of total Canadian raw sugar imports. Also, there was only a small decline in the production of sugar beets in Canada. Thus, in the scenarios examined, Canadian refining capacity utilization and beet sugar production decreased only by a very limited amount.

Small changes in prices

Little change was expected in the world price of raw sugar from the unilateral elimination of the Canadian refined sugar tariff. The estimated average price decline for the Canadian refined sugar from the unilateral elimination of the specific tariff on refined sugar imports from the CA-4 countries, for all scenarios was less than one percent. The price decline for the unit import price of refined sugar from the CA-4 countries was up to \$30/mt, causing the import market share for refined sugar of the CA-4 countries to increase significantly under both scenarios. Nevertheless, imports of refined sugar represented only about 9 percent of total Canadian consumption. Therefore, the lower

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CA-4 country prices only affected average Canadian prices for refined sugar to a very limited extent.

Modest growth in the imports of refined sugar

Canadian imports of refined sugar would be expected to grow only moderately, under most conditions, from the CA-4 countries, as the result of the elimination in the refined sugar tariffs. For both scenarios, the percentage increase for total imports of refined sugar was **14-30 percent** with about 60-70 percent of this increase accounted for by increased demand. This level would not exceed some of the previous levels of Canadian refined sugar imports. Even in the more responsive CA-4 scenario, however, the refined sugar imports did not constitute more than 9 percent of total Canadian refined sugar consumption. The expanded Canadian refined sugar demand from the industries using refined sugar and consumers, offset much of the loss of the market share for Canadian refiners to imports of refined sugar, minimizing the loss of production capacity from current levels. Thus, Canadian refiners would continue to produce the vast majority of refined sugar consumed in Canada.

Benefits to users

It was estimated that food manufacturers would benefit modestly from the reduction in market price from the elimination in the refined sugar tariff. The increased refined sugar imports would provide increased competition from additional sources of supply in the Canadian refined sugar market. It was estimated that Canadian consumers would obtain a small benefit from the reduction in the refined sugar tariffs. Retail sugar prices were expected to fall very slightly, as would the price for processed food products that contain sugar.

CA-4 countries benefit

It was estimated that the CA-4 countries would increase their refined sugar exports to Canada, as a result of the tariff reduction, albeit from a very small volume. It was estimated that these countries would increase their exports of refined sugar to Canada by 12,000-26,000 mt., or **290-609 percent**. Even in the latter case, this would still be less than the level of the CA-4 countries' total 2000 exports of refined sugar to all other countries (277,000 mt.). Other countries (mainly Australia and Brazil) would experience a small loss in market share of refined sugar exports to Canada, with their exports increasing very slightly under the more responsive CA-4 market.

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Small welfare changes

An estimate of the gains to Canadian consumers, less the losses to producers, processors and government (tariff revenue) showed a small total welfare loss for Canada of \$0.6-\$1.7 million in the basic and alternative scenarios, respectively. The CA-4 countries had welfare gains of \$0.9-\$2.3 million as gains to refiners and cane growers more than offset losses to CA-4 consumers. Domestic policies to prevent a rise in retail prices (and consumer losses) would be important to further increase the welfare gains for the CA-4 countries. Welfare changes for the rest of the world were generally very small since both scenarios assumed the most of the impacts were confined to Canadian-Central American raw and refined sugar trade.

Concluding observations

The quantitative framework developed for the study provided a reasonable approach to assess the impact of the elimination in the Canadian refined sugar tariff and to test the sensitivity of various assumptions to the overall outcome. The assumption about the Canadian supply response was found to be important in estimating the CA-4 country share and the total level of refined sugar imports, but did not negate the basic conclusions. Because the impacts to Canadian refiners were estimated to be minimal, Canadian refiners probably would not require a long adjustment period.

Capacity utilization of Canadian sugar refiners was marginally affected under the elimination of the tariff on refined sugar. Sugar beet production in Canada was also minimally affected. Refining margins for Canadian firms were reduced, but only by a very small fraction of the refined sugar tariff. Sugar users benefit from slightly lower prices and increased competition in the refined sugar market. Sugar consumption in Canada increased by from 1-1.5 percent.

In the context of a total welfare calculation, gains to Canadian sugar consumers were less than losses to sugar refiners. The CA-4 countries' welfare gains were reduced by a small rise in domestic sugar prices. To increase the positive welfare gains from the increased producer-refiners surplus, the CA-4 countries need to liberalize domestic sugar policies so as to restrict any retail price increase.

Under the calculated scenarios, CA-4 countries gain a larger share of the total Canadian refined sugar import market from the elimination of the refined sugar tariff.

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The rest of the world exporters, conversely, lose very little market share. If the scenarios had assumed that price changes between Canada and Central American sugar trade would have been fully shared with the rest of the world, the results would have been about the same for Canada but some of the CA-4 impacts would have been smaller (because of larger impacts in the rest of the world). In absolute terms however, the changes are small, and represent a very small part of the total world sugar market.

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Preface

This study was contracted by Agriculture and Agri-Food Canada. It was responsible for setting the terms of reference and providing guidance to the contractor on the work to be performed. The consultants wish to thank in particular, Merritt Cluff, Eileen Krakar, and Brian Paddock for their support and direction for the study. The consultants appreciate the assistance of Paul Bell, Diane Mately and Debra Harper in providing data.

The consultants would also like to acknowledge the assistance provided by Dr. Stephen Haley, ERS, USDA. Dr Haley was an important information source on international sugar markets, policies, data sources and model equation representation, in developing the SUGR model.

The international sugar industry is a highly managed sector and offers many challenges in specifying the representation of the key economic factors. The impact of the Canadian tariff on refined sugar is an important issue to both Canadian sugar producers and refiners, and the users of refined sugar. Expanding refined sugar exports offer a significant opportunity for the growth and development of the CA-4 countries. It also adds to the political pressure for other developed and developing countries to liberalize their sugar sectors.

We hope that the results provided by the study will provide the industry and the government with the basic information for an effective exchange and debate on this trade policy issue.

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1 Introduction

1.1 Study Objectives

The **primary** objective of the study was to estimate the economic impact on the various market participants (such as the sugar beet producers, refiners and processors, alternative sweetener producers, food processors, consumers) in the Canadian sugar complex of eliminating the applied tariff on refined sugar from CA-4 countries (Guatemala, Honduras, El Salvador and Nicaragua). A **second** objective was to determine the effect on the sugar sector (raw and refined) of such tariff reductions on the CA-4 countries and Canada's major trading partners (Australia, Brazil, US).

By conducting the study and providing results in an open and transparent manner, it provided the public and private sector with similar information to engage in a policy debate on the proposed change in refined sugar tariffs.

1.2 Background Issues

Regional trade negotiations

At the Canada-Central America Summit in Guatemala on September 28, 2000, Canada agreed to a request by the leaders of the Central American countries of El Salvador, Guatemala, Honduras and Nicaragua to begin free trade negotiations. On January 9, 2001, International Trade Minister Pierre Pettigrew announced that the Government would embark on a broad and comprehensive consultation process to define the scope of this initiative involving the provinces and territories, the business community, non-governmental and citizen-based organizations and individual Canadians.

The CA-4 countries are likely to consider the refined sugar tariff to be an essential item in the regional trade negotiations with Canada. Because of the importance of sugar in their economy and their trade balance, in addition to a perceived comparative advantage, the CA-4 countries would likely want to include refined sugar tariffs as one of the central items in the negotiations. Canada, on the other hand, is concerned about the potential impact of the elimination of the tariff on refined sugar imported from CA-4 countries would have on its domestic sugar beet producers, the sugar refiners and processors, and the alternative sweetener industry. To prepare for the negotiations, Canada would need to assess these potential impacts for producers and refiners

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against the potential benefits from the tariff elimination that would be derived by the further processing food industry (such as bakery, soft drinks and confectionary processors), and consumers. Another consideration for Canada would be the impact on its current sugar trading partners. Canada must also consider these sector level impacts within a broader set of objectives for overall trade and economic development policy, as well the consequences for Canadian consumers and taxpayers.

Agriculture Trade Negotiations

Canada is actively participating in the WTO negotiations on revisions to the WTO Agreement on Agriculture. Its WTO position for agriculture (released on August 19, 1999) is consistent with, and complementary to, the negotiations in the Free Trade Area for the Americas (FTAA). Both of these sets of negotiations, in addition to NAFTA and the bilateral free trade agreements with Costa Rica and Chile, have implications for market access for sugar. In all cases, the resulting changes from the negotiations are likely to result, if anything, in lower protection for sugar. The major unknown is how quickly such a decline in support and protection will occur.

Sugar would appear to be under more pressure for change than other commodities in the revisions to the WTO Agreement on Agriculture. The revisions to the WTO Agreement will likely focus on increased market access, and reduced domestic support and export subsidies. The pressure for reduced support and protection for sugar is the consequence of its very high level of protection (bound tariffs average 80 percent), demands from sugar exporting institutions, and internal forces in the EU and US. For example, the Global Alliance for Sugar Trade Reform and Liberalization which is a group of sugar producing and exporting institutions in Australia, Brazil, Canada, Chile, Columbia, Costa Rica, E Salvador, Guatemala, Honduras, Nicaragua, Panama, India, South Africa and Thailand, was formed prior to the Seattle WTO Ministerial Meeting to press for the liberalization of the international sugar market. Sugar is important for a number of developing countries, who have been critical of the protectionist policies of many developed countries. Developing countries have been particularly critical of the tariff escalation for agricultural commodities (like sugar) by developed countries. Developing countries view it as an important market access issue, and it is widely believed to be one of the obstacles to establish processing industries for exports. At the same time, the African/Caribbean/ Pacific (ACP) sugar producers are concerned about the loss of their preferences into the EU market, and hence would be reluctant to see a general liberalization of the world sugar market. As Canada did not eliminate the tariff

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on refined sugar in the list of duty-free items from the least developed countries, there would not be a similar reluctance from these countries for a reduction in the Canadian refined sugar tariff.

1.3 Report Outline

The next section of the report provides a brief overview of the international and CA-4 sugar markets, and Canadian sugar trade policies. In section 3, there is a discussion of the expected impacts from a reduction in the refined sugar tariff. Section 4 contains a description of the analytical approach and data used in the evaluation of the reduction in refined sugar tariffs. Section 5 outlines the basic policy and several alternative scenarios used in the study. It also outlines those aspects of the analysis where there may be some debate over the economic relationships, or the market data and the type of sensitivity used in the analysis to address these concerns. Section 6 provides the results of the analysis on the economic impact information on the Canadian sugar trade and market participants and on Canada's current sugar trade partners, from a reduction in Canada's refined sugar tariff. The final section provides some concluding observations from the analysis.

2 Canadian and International Sugar Markets

Global sugar market

Sugar is a major staple food providing a cheap source of energy, especially for low income countries. For many developing countries, sugar contributes an important amount to overall export earnings and, because it is labour-intensive, it represents a major source of employment. Compared to most agricultural commodities, a significant part of global sugar production is traded internationally. Only a small part of the more than 40 million tonnes traded now occurs under the preferential trading relationships of the EU and the US.

Sugar is one of the most protected agricultural commodities in the industrialized countries. At the production level, the OECD estimates that the Producer Subsidy Equivalent for sugar in OECD countries was 54 percent, during the period 1998-2000 (OECD PSE/CSE database, 2001). The major developed countries—US, EU, and Japan—have highly protected sugar sectors, especially for refined sugar. The market for refined sugar is even more distorted than the raw sugar market, resulting in limited export opportunities. Most of the costs of these sugar support programs, generally maintained by very high import tariffs, are borne by consumers. Major Asian producers and consumers—China, India, and Pakistan—also have highly regulated sugar markets. Many developing countries also have high import tariffs and highly regulated domestic and export markets. Liberalization of the global market would require the US and the EU to make major domestic policy adjustments. This could arise from pressures due to budgets, unsustainable market distortions, or regional trade agreements such as the NAFTA or the ACP.

The high US and Japanese domestic prices for refined sugar have generated substantially increased competition from alternative sweeteners. In the US, high fructose corn syrup (HFCS) is now about as important as refined sugar in terms of total consumption. The alternative sweeteners are most competitive in the industrial uses, where they substitute most easily for liquid sugar. Non-caloric sweeteners account for a significant percentage of the total sweetener market, but tend to compete more on its non-caloric attributes, rather than sugar price.

The Uruguay round has had minimal effect on sugar trade. The International Sugar Organization reported that the weighted average tariff level for raw sugar remained

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relatively high, falling from 93 to 72 percent over the implementation period. For refined sugar, it fell from 109 to 88 percent. For developing countries that chose binding ceiling tariffs, the weighted average tariff level for raw sugar is 110 percent, and for refined sugar is 102 percent. Only limited additional access commitments were made as part of the Uruguay Round, amounting to less than 1 percent of world trade. Commitments to reduce export subsidies may have had the greatest impact on the world sugar market, as countries agreed to reduce subsidized export volumes by 1.3 million tonnes, or about 20 percent of subsidized tonnage in the mid-1990s.

Canadian sugar market

Canada imports about 90 percent of its raw sugar requirements (Table 1). Sugar is currently processed in four plants in Canada, which are owned by three firms. These firms are: Rogers Inc. (Vancouver, and in Taber, Alberta), Lantic (Montreal) and Redpath (Toronto). Most sugar refined in Canada goes to industrial users (82-84 percent), and a more limited amount goes to retail consumers (16-18 percent). Per capita sugar consumption in Canada has been very stable for a considerable number of years.

Canada exports a limited amount of refined sugar to the US, under its tariff rate quota. Recently, imports of refined sugar into Canada have been increasing, although these imports are below the level of the 1985-95 imports. Canadian sugar beet producers grow more than 40,000 acres each year, mainly in southern Alberta. These sugar beets are processed in the Rogers' Taber plant. Revenues generated in the Taber plant are shared with the beet growers using a predetermined formula. According to the company, the formula is set to mitigate the impact on Rogers of large increases or decreases in the world raw sugar prices.

Canadian industrial sugar users are manufacturing products which compete in a global marketplace. For some, sugar represents a sizable cost element. Sugar prices, thus, affect their competitiveness in the export market, which increasingly is diversified, beyond the US market, into Latin America, Asia and Europe. Competitiveness against imports of sugar containing products is also a concern to food processors. In many cases, food manufacturing firms are international companies, and their decisions on manufacturing locations are determined by relative costs of production. Sugar costs, may be one of those influential factors.

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Table 1. Sugar Supply and Exports: 2000/2001

Country	Production	Consumption	Exports	Imports
(thousand tonnes)				
El Salvador	505	245	325	
Guatemala	1645	455	1190	
Honduras	315	245	70	
Nicaragua	390	205	200	
(Total CA-4)	(2855)	(1150)	(1785)	
Costa Rica	375	245	130	
Canada	113	1245	15	1199

Source: ISO

The Canadian International Trade Tribunal, in its 1995 anti-dumping case, examined how prices are determined in the Canadian market. The Tribunal found that the domestic refiners calculate their list (selling) price for bulk refined sugar based on the Contract No. 11 raw sugar price on the New York Coffee, Sugar and Cocoa Exchange (NY No. 11). To this price, the refiners add an allowance for currency exchange, transportation and other costs to deliver the sugar to their refineries, plus a target margin which covers the costs of refining and other expenses, as well as an amount for profit. To the list price for bulk sugar, a product differential is added to calculate the specific price for the various refined sugar products and package configurations. The refined sugar is then generally sold at a discount from this list price. The amount of the discount varies with volume, trade level, type of product and other factors. Liquid sugar is generally the lowest priced market, in part, because it competes against the HFCS. The domestic refiners indicated that their raw sugar purchases were always fully hedged to protect against fluctuations in the world price of raw sugar. Sugar beet producers' compensation is based on a revenue sharing formula, which transfers much

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of the price risk from the processor to the producer.

Since Canada has one of the most open sugar markets among the industrialized countries, Canadian sugar consumers enjoy one of the lowest retail prices. The FAO (1996, p. 47) notes that “Few, if any countries have had a sugar policy as stable, consistent and simple as Canada’s”. The MFN tariff for raw sugar for imports into Canada is \$25/t. In 2000, the ad valorem equivalent of this tariff was approximately 10 percent, relative to its import unit value of \$256/t. Most of the Canadian raw sugar imports were duty free, as the CA-4 countries as well as major suppliers such as Cuba and Brazil already benefit from a zero duty as a result of the Canadian unilateral GPT tariff preferences. Australia, the major Commonwealth supplier, also benefits from a zero rate of duty. In 2000, the primary import sources for Canada were Australia, Guatemala and Brazil, which provided about 80 percent of Canadian raw sugar imports.

For refined sugar imports into Canada, a specific tariff of \$30.86/mt. applies. It has no preferential tariff for refined sugar. Nevertheless, the recently signed FTA with Costa Rica permits tariff free access for refined sugar under a tariff rate quota, starting in 2003 at 20,000mt., and rising to 40,000mt. in 2011. On an ad valorem equivalent basis, the Canadian tariff on refined sugar was 6.5 percent of the unit value import price \$475/mt. (2000). The effective tariff rate on refined sugar, however, was about 14 percent, using the implied refined-raw sugar price margin of \$219/mt. Canadian imports of refined sugar in 2000 were 88,669 mt., up significantly from 1999, but below the 1985-95 imports. Primary import sources for refined sugar have been Brazil, which has increased rapidly in recent years, and the US. Imports from the US for re-export to the US are rising. Canadian companies, importing US sugar, can avoid sugar antidumping duties under the Duty Deferral Program if they re-export the sugar as part of further processed products. Current refined sugar imports from CA-4 countries are relatively small in volume (3,200 mt. in 2000). Refined sugar imports, however, represent only a fraction (less than 8 percent) of Canada’s total sugar imports. Canada applied an antidumping duty against sugar imports from the US and the EU, in 1995. These antidumping and countervailing duties were maintained following a review by the Canadian International Trade Tribunal in 2000. The CITT concluded that there would be a threat of injury to the refining industry if these duties were removed.

CA-4 countries’ sugar market

Sugar production is an important source of employment and foreign exchange for the

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CA-4 countries. Production in these countries doubled from 1980-1996, and prices are among the lowest in the world. Consumption is also rising rapidly in the CA-4 countries, limiting the growth in exports. In general, these countries have high import tariffs, and hence there is little trade among them. Their main export market is the US, and CA-4 countries account for 10.5 percent of the US global Tariff Rate Quota (TRQ). The US market accounted for about one fifth of the CA-4 countries total sugar exports in 2000. Total sugar exports from the CA-4 countries are considerably larger than total Canadian sugar imports (Table 1). For the CA-4 countries and Costa Rica, tariff free access for refined sugar into Canada represents a sizable market opportunity of more than one million mt. Information on the current refining capacity in the CA-4 countries is incomplete. There may be some excess refining capacity, and it is continuing to grow in Guatemala and Honduras. Also, two privately owned mills in El Salvador expanded their capacity in order to increase exports of refined sugar. It is uncertain as to how quickly, and at what cost, refining capacity can be added in these countries. Nevertheless, most exports from the CA-4 countries are still in the form of raw sugar. Several factors may limit the export demand for refined sugar from CA-4 countries such as quality and other specialized user requirements, higher transportation and storage costs than for raw sugar, the need for continuous year-around deliveries, and the pricing strategies by Canadian refineries.

Guatemala is the largest sugar producer of the CA-4 countries, and the third largest exporter in the western hemisphere, after Brazil and Cuba. Growth in sugar cane production in Guatemala has slowed from an annual 12 percent rate in the 1960's and 1970's to around a 4 percent rate in the 1990's. Growth in sugar exports has also slowed from double digit levels in the 1960-89, to about an 8 percent annual rate in the 1990's. Guatemala has improved its port facilities for the export of both raw and refined sugar. In 2000, Guatemala shipped 205,000mt. of refined sugar, from three plants. Refined sugar represents about 18 percent of Guatemala's total exports of sugar. Canada imported 3.2 thousand tonnes of refined sugar from Guatemala in 2000, or less than 2 percent of Guatemala's total refined sugar exports. Thus, there is an opportunity for Guatemala to substantially increase refined sugar exports to Canada by simply diverting trade from other export markets. This action alone could more than double Canada's refined sugar imports.

3 Expected Economic Impacts of Tariff Reductions

To help interpret the empirical results, it is valuable to consider the theoretical expected

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results. The expected main impact for Canada from an immediate (in 2003) decline in the actual, and more importantly, in the effective tariffs for refined sugar imports from CA-4 countries would likely be a very modest domestic price decline for refined sugar. Thus, the expected consequence of the tariff reduction for refined sugar would be a modest, but positive benefit, for consumers and further food processors. The expected outcome would also be relatively small but negative for Canadian sugar beet producers, and alternative sweetener producers. A slightly more significant negative impact would likely occur for Canadian sugar refiners, as their processing margins would be squeezed considerably from reduced selling prices. As well, processing volumes for Canadian refiners may be reduced, but likely less than the increase in the refined sugar imports, due to the expansion in domestic demand for sugar.

The impact on Canadian sugar refiners would depend, largely, on the incentives for, and the ability of the CA-4 countries to expand their exports of refined sugar to Canada.

This expansion could be done, in the short term, through a diversion of their current refined sugar exports from other markets. A larger impact would come from their ability, in the longer term, to expand sugar production and refining capacity. This expansion in refining capacity would take time and a commitment to take advantage of the improved tariff free access to the Canadian market. Guatemala, the largest CA-4 exporter has been increasing its sugar production and has the potential to significantly increase the area devoted to sugar cane production. Other constraints on the increase in exports of refined sugar exports to Canada would be the higher transportation costs associated with refined sugar and whether the CA-4 refiners can compete with Canadian refiners to provide the quality and type of product, within a time-frame, that Canadian buyers are willing to purchase. The CA-4 countries are currently not equipped to provide the same quality and service offered by Canadian refiners.

The expected impact on other suppliers to the Canadian market (Australia, Brazil) would be the loss of their Canadian market share to the CA-4 countries. The impact on these sugar supplier countries would be expected to be minor, but would depend, in part, on their ability to divert exports of sugar to other markets, and on whether such changes in trade flows would result in a loss in export revenue.

As noted above, the reduced tariff on refined sugar is expected to be positive for the further processing sector, such as bakery, soft drinks, and confectionary processing, where sugar is a considerable input. The food and beverage sector is a large one in Canada, and it accounts for more than 80 percent of Canadian sugar consumption. A

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reduction in refined sugar costs would make these industries more competitive. A number of the food and beverage products are exported to, or compete against imports from, high-priced sugar markets, such as the US. Net exports of processed food products, containing sugar, would therefore be expected to increase. Part of the benefits is offset by the exemption for the countervailing duties on US sugar used in products for re-export to the US. The lower cost for refined sugar would also dampen the demand for the alternative sweeteners (e.g., HFCS) in Canada. Thus, the demand for refined sugar would be expected to increase from further food processors. The consumer retail demand for refined sugar, in contrast, is unlikely to expand very much as empirical estimates indicate that it is relatively insensitive to price. Nevertheless, consumers would benefit from the lower sugar prices, and the increased consumption and lower prices for processed food products, containing sugar.

Canadian sugar beet producers are concentrated in Southern Alberta. While the global price of raw sugar would likely be unchanged from the Canadian action on refined sugar tariffs, the expected reduction in processing margins for refiners could reduce their offer price to sugar beet producers. Sugar beet producers selling price is based on the processing plant's revenue. The outcome would be affected, in part, by various market factors such as the production alternatives for sugar beet producers, and the economies of scale from sugar beet processing at the Taber, Alberta plant. This market is partially protected from competition by transport costs.

4 Framework and Scope for Analysis

4.1 Direct Economic Impacts

The prime concern in the development of the analytical tool for the global sugar market is to illustrate the impact of a policy change on refined sugar tariffs in Canada. Modeling of the reduction in the Canadian refined sugar tariff for a single country or region (such as the CA-4) is complicated by the fact that trade flows must be taken into account between Canada's partner countries, and between those countries and the rest of the world (non-FTA). One commonly used approach for such an analysis is to construct a bilateral trade flow model which treats products from different sources as different products. This approach allows the examination of the impact from changes in tariffs that affect some, but not all, trading partners (a FTA) to be simulated. A standard methodology for this type of modeling approach is a so-called 'Armington' specification (named after its inventor). In this specification, it is assumed that after the total demand for imports for a country has been determined, relative price changes among the imports (caused for example, by a tariff change) determine the mix of imports by source. Thus, the model structure allows an endogenous selection of the volume and source of product, when relative prices change.

The selection of the Armington specification for the economic model was compelling in order to consider product differences in the international market for sugar among countries. First, it was incumbent in the context of changing the level of refined sugar tariffs from one source (i.e., the CA-4 countries), while maintaining tariffs on refined sugar imports from all other sources. In this case, they are assumed to be different products (i.e., with respect to price). Without this assumption, establishing the extent of trade diversion by the CA-4 countries from other countries to Canada becomes an arbitrary or predetermined estimate. The second rationale for the choice of the Armington specification is that Canadian refined sugar users implicitly treat domestic and imported refined sugar as different products (despite their chemical similarities), due to a series of inherent differences such as perceived quality considerations, extensive variety of product requirements, timing and mode of deliveries, and associated services provided. The Armington approach allows an examination as to the extent of how different, or how substitutable, are the refined sugar products originating from the various domestic and international sources. Hence, the assumptions as to the degree of the differences are explicit and testable within an economic framework. Also, variations in supply responsiveness can be examined.

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The Armington approach was applied to the Canada-CA-4 countries free trade area in the analytical model, SUGR (SUGaR sector model). The SUGR model divides the world into 3 regions, Canada, CA-4 countries, and the rest of the world. The data set used for the model is described below and is shown in appendix 1. In addition, the variable definitions and the set of equations for Canada for the SUGR model are attached in appendix 2.

The model logic is laid out as follows (see the listing of equations for Canada in the appendix 2 for a sample following this logic). Two products, raw and refined sugars are modelled. Countries/regions can produce raw (cane) sugar or beet sugar (measured in terms of refined beet sugar) or both. Refiners can process raw sugar (domestically grown as in CA-4 countries or imported as in Canada) into refined sugar. The demand for refined sugar in each country can be met by growing (and refining) beet sugar, refining raw (cane) sugar domestically grown or imported, or by importing refined sugar. Since products are differentiated by region, a separate price exists for each product. The relative movement of these prices in response to policy (tariff) change determines the source of both refined and raw sugar (domestically produced or imported). As prices and other model variables change, global balances are maintained for each product so that supply always equals demand even when sources of demand change. Thus, the model is always bound by real world accounting of trade, production and consumption. Given the global and national product accounting that is maintained, model behaviour is determined by assumptions about production, consumption and refining responses to price changes. In addition, choice of the source of consumption depends on the relative prices of raw and refined sugar from the alternative consumption sources.

Consumption prices are determined by a world price plus a tariff. In this study, the relevant tariff that is changed over time is the Canadian import duty on refined sugar. The tariff for refined sugar of C\$30.86/t is removed from refined sugar imports from the CA-4 countries with the implementation of FTA. Sugar consumers are expected to respond to the changes in prices from the various sources, including the Canadian tariff reduction as well as world price changes needed to re-balance the sugar markets. Supply of raw and beet sugar responds to the prices faced by producers.

Consumption of raw sugar (for processing) is determined by the prices paid for sugar from importers versus that grown domestically. For refiners, prices used are the relative

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prices of raw to refined sugar. If the price of raw sugar from one source goes up, refining of raw sugar from that source declines due to increased costs. If the price of refined sugar rises (declines), then refining increases (declines) due to increased (reduced) profits.

Relative prices of refined sugar from alternative sources determine the consumption source. For example, if the price of refined sugar from CA-4 countries declines in Canada because the duty is lowered, then more CA-4 country refined sugar is imported. The increased use of CA-4 country refined sugar is at the expense of imports from the rest of the world, and at the expense of Canadian refining of imported raw sugar, and possibly at the expense of the production of Canadian beet sugar. Sugar policies other than the Canadian duty on CA-4 sugar were assumed to remain unchanged over this period.

The degree of substitution in consumption from alternative sources is represented in terms of own and cross price responses calculated from an assumption about the substitutability of products from alternative sources (technically, an elasticity of substitution). The assumption about substitutability is important to model behaviour, as the import tariff is lowered. Substitutability embodies assumptions about products and their trading environment (a judgment). Low substitutability means, that from the consumers' (and processors) viewpoint, the products maintain some of their individuality, and switching between them is a slow and partial process, at best. In contrast, a high degree of substitutability as used in the basic and alternative scenario means that consumers (and processors) would quickly adjust their sourcing decisions in response to tariff changes. So, one key assumption in the model is the elasticity of substitution which represents this degree of practical substitutability and flexibility among product sources. For Canada, if one assumes that consumers are highly indifferent between imported and domestically sourced refined sugar, more CA-4 country imports are likely to occur as the tariff is reduced, even if the initial level of imports is low. Increased imports of refined sugar from CA-4 countries displace domestic refining (from raw sugar imports), imports of refined sugar from the rest of the world, and the production and refining of Canadian beet sugar. If one were to assume less flexibility and substitutability in the markets, all of these impacts would be smaller.

The KEY assumption differentiating the basic and alternative scenarios presented is one about the Canadian supply response. This response is embodied in assumptions about supply elasticities for Canadian beet sugar production and Canadian refining of

raw cane sugar. The basic scenario assumes a modest supply response from refiners and beet growers as product prices change. The alternative scenario assumes a much higher supply elasticity or responsiveness to price changes; this means that a price decline caused by a tariff reduction would bring about a greater contraction in sugar refining and beet production. Supply growth assumptions also matter but they were not varied in the scenarios presented – they would matter in a dynamic version of the model. So the bottom line on the modeling approach is that CA-4 countries' refined sugar import penetration in Canada under a proposed FTA could increase, but the amount depends upon one's assumptions about the supply response of Canadian producers in the short and long term. The assumption of more flexible markets in both scenarios (high elasticities of substitution) means more competitive sugar markets where industrial and home sugar consumers are impacted more by relatively small price changes. An assumption of less flexible markets with less substitutability would mean smaller impacts from the FTA and those presented in this report.

The model does not explicitly include micro level responses, such as the possibility of Canadian sugar refinery plant closings. The high supply response scenario might result in enough refined sugar imports from CA-4 countries to make such a plant closure more likely, especially if margins are highly sensitive to capacity levels. Since the model assumes competitive markets for sugar because of trade in raw and refined sugar, producers and processors cannot restrict production or refining to raise prices. In Canada, however, with only 1 or 2 major refining firms in each region and in the CA-4 countries with highly regulated markets, this competitive assumption may be questionable. Existing firms may have some flexibility in how much they have to respond to competitive pressures. For example, the assumption of more substitutability of sugar from various sources (higher elasticities of substitution and therefore own and cross price elasticities of demand for refined sugar from various sources) is consistent with a more competitive market situation where the impact of the proposed duty reduction on prices and Canadian production is greater.

4.2 Data Sources

Because of the time limitations for this study, the model was constructed from available data and parameters. The demand and supply elasticity estimates were obtained from *A 1989 Global Database for the Static World Policy Simulation (SWOPSIM) Modeling Framework*, published by USDA's Economic Research Service in 1992. In addition, the formulae for calculating own and cross price elasticities of demand from elasticities of

substitution are explained in *Modeling Bilateral Trade Flows with the Static World Policy Simulation (SWOPSIM) Modeling Framework*, published by the Economic Research Service in 1986. Elasticity estimates were also reviewed in other international models, which contained a sugar sector for developed and developing countries (e.g., Food and Agriculture Policy Research Institute model, USDA Forecasting model, OECD Aglink model, and IIASA Linked National Models).

Several key aspects of the market were uncertain, such as the extent of the substitutability of sugar from various sources, and the possible rate of expansion of processing capacity in the CA-4 countries, or contraction in Canada. To compensate, the economic impacts were calculated under alternative assumptions. In this respect, the simulation model is very transparent, so that it is apparent how to evaluate or modify simulation scenarios.

The basic data used for the analytical model (sugar supply, consumption, exports, imports, stocks and prices) were obtained from Statistics Canada, for Canada, and the USDA (world supply-utilization) for all other countries and international markets. FAO data were used to allocate data between the raw and refined products, where such data were not readily available. The year 2000 was selected as the base year for the model, as this was the latest annual data available. Considerable time was devoted to developing a consistent international data set, which is fundamental for the model structure used in the study.

The modelling and the analytical work of USDA sugar experts made an important contribution to the construction of the SUGR model.

5 Alternative Scenarios

5.1 Two Scenarios

The study examined two scenarios for the reduction in the specific tariffs for refined sugar from the CA-4 countries. The **basic scenario** examined in the study was an immediate reduction in the Canadian refined sugar tariffs, as of 2003. This allowed a quantitative assessment of an immediate change in the Canadian and CA-4 countries' sugar market of the expected effects outlined in section 3.

The **alternative** scenario examined was one with a more responsive supply response

for Canadian sugar producers and refiners.

5.2 Sensitivity Tests

There were several areas of the study where the information was weak, or the likely responses of the market participants were quite uncertain. The quantitative analysis designed allowed sensitivity testing of various degrees of change of those market parameters which were deemed to be critical assumptions to the results. Three of these changes were specifically tested as part of the study to illustrate how important the economic assumptions were to the policy impacts. While the general impact of the sensitivity testing is discussed, the scenario results are not presented.

Greater response from the rest of the world

The basic and alternative scenarios assume that the Canadian tariff reduction in the context of a free trade area causes most of the impact in the partner regions, i.e. Canada and the CA-4 countries. However the CA-4 countries (primarily Guatemala) could divert some of their exports of refined sugar, currently being exported to other countries, to Canada. The rest of the world could also respond to price changes resulting from the Canadian removal of the tariff on refined sugar imports from the CA-4 countries; this would mitigate the impact on the CA-4 countries. This assumption was tested in the analytical framework by assuming that there would be a much higher level of price response from the rest of the world (the price transmission elasticity between world prices and rest of the world prices was raised from the 0.2 level used for this report to 1.0). This assumption resulted in little change for Canada but the rest of the world shared more of the impact at the expense of the CA-4 countries.

Canadian Supply and Refining Capacity Response

The KEY assumption used in the study is about the Canadian production and refining capacity response. The basic scenario assumed a modest response meaning that the removal of the tariff would not decrease Canadian beet sugar production and Canadian refining of raw cane sugar very much. The alternative scenario assumed a 10-fold increase in supply response for these two sectors meaning that a tariff reduction would cause a greater contraction of beet sugar production and sugar refining.

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An important question was the ability of the CA-4 countries to increase their refining capacity. The CA-4 countries were assumed to have a high supply response for the both the production and refining of cane sugar; an assumption which seems to be widely held. A relatively low cost approach, already used by processors in these countries, is to add refining capacity to an existing sugar cane processing mill. Had these supply elasticities been increased more, the CA-4 supply increases would have been even larger.

Phasing of the reduction

A dynamic representation of the model was also developed and applied for the project.¹ Using this dynamic model, tariff reductions were made in eight equal steps over the period from 2003-2010. This allowed an assessment of a gradual versus an immediate implementation of the refined sugar tariff elimination by Canada from the CA-4 countries, by simulating the results over the period 2003-2010. Projections of population and income were also made as part of the dynamic model alternative scenarios. The results from the dynamic model showed very little difference on the overall impact at the end of the period between a scenario with a gradual elimination of the tariff by 2010 or one with an immediate elimination in 2003. Moreover, since the results were relatively modest, either method of implementation would not substantially affect participants. Since, the dynamic aspect of the model did not materially affect the results, it was decided to use the static model. This static model structure is simpler and the reporting of the results of the policy changes is clearer. Finally, the impact of a gradual reduction in the tariff over time basically follows a linear path.

¹The dynamic model (SUGS) structure, data and various scenario results for the global sugar market are available from the authors. This model also runs on the VORSIM software.

6 Impact of Tariff Reduction

6.1 Basic Scenario

Using the basic analytical approach of an Armington-type model outlined in section 4, the refined sugar tariff of \$30.86/mt. on the imports from the CA-4 countries was assumed to be unilaterally eliminated by Canada. A summary of some of the market impacts for the basic scenario is presented in Table 2. More comprehensive statistics for the basic scenario, (and the alternative scenario) are shown in Appendix 3. The results reflect the Canadian refined sugar tariff reduction, compared to the base with the tariff in place.

An elimination in the refined sugar tariff would result in a small reduction (0.4 percent) in the total level of raw sugar imports into Canada. This reduced level of Canadian imports reflects not only the decline in the import demand for raw sugar for refining in Canada, but the switch in the CA-4 countries from exporting raw sugar to exporting refined sugar. Reduced refining margins in Canada would occur, while the opposite effect would take place in the CA-4 countries. Little change occurred in domestic sugar beet production (a decline of 0.5% - which would only affect the Taber processing plant). Canadian Sugar beet supply is influenced by the refined sugar price (under a formula with producers), but it is not very responsive to changes in the refined sugar price, as sugar beets represent a good option for irrigated land. Thus, total Canadian shipments of refined sugar, and the level of capacity utilization by the Canadian sugar refiners using imported raw sugar would decline marginally (0.4 percent).

A modest increase in refined sugar imports into Canada is expected, as a result of the refined sugar tariff elimination. The CA-4 countries are expected to increase their exports of refined sugar into Canada by 12,500 mt (290 percent). A small increase in refined sugar imports is foreseen from the rest of the world. As a result, total imports of refined sugar would be expected to increase modestly (12.4 percent) into Canada, as a result of the refined sugar tariff elimination.

Table 2: Impact of the Elimination of the Refined Sugar Tariff (Basic Scenario).

Refined sugar tariff

Raw Sugar Imports (Canada)	Base (1000mt)	Impact (1000mt)	Impact (% change)
CA-4 countries	96	-3.5	-3.6%
Rest of World	986	-0.7	-0.1%
Total	1082	-4.2	-0.4%

Refined Sugar Imports (Canada)	Base (1000mt)	Impact (1000mt)	Impact (% change)
CA-4 countries	4	12.5	290%
Rest of World	84	0	0.1%
Total	89	12.5	12.4%

Canadian Shipments Impact	Base	Impact	
	(1000mt.)	(1000mt)	(% change)
Refined sugar			
Domestic source	110	-0.5	-0.4%
Total	1082	-4.2	-0.4%

Unit Import Price from CA-4 (Incl. tariff)	2000 (C\$/mt)	Impact (C\$/mt)	Impact (% change)
Raw sugar	228	0	0%
Refined sugar	475	-21.5	-4.4%

Source: study estimates

World prices for raw sugar are not expected to change as a result of the Canadian refined sugar tariff elimination, as its impact on the world market is minimal. Canadian raw sugar prices are based directly on world prices. The unit import value for refined sugar from the CA-4 countries is expected to fall by about 70 percent extent of the tariff reduction, or about \$22/mt... Nevertheless, the average Canadian domestic price for refined sugar would fall very slightly, because the CA-4 countries' volume represents only a very small share of the total refined sugar market in Canada. Given the structure of the international and Canadian sugar markets, it is expected that other countries

exporting to Canada would not drop their refined sugar price to the level of the CA-4 countries in order to maintain market share. Thus, margins for refined sugar for Canadian refiners would decrease very slightly. The drop in the CA-4 countries' import price for refined sugar is consistent with an inelastic import demand for CA-4 countries' refined sugar, as their quality is viewed as lower than the domestic product and they have a limited ability to provide the type of product, for just-in-time delivery, with all of the services that Canadian sugar users demand. Moreover, the underlying final domestic Canadian sugar demand is inelastic. At the same time, the CA-4 countries' export supply is quite elastic, as they can supply additional quantities of refined sugar to Canada by diverting expanding supply.

6.2 Increased Canadian Supply Responsiveness

In this scenario, as in the basic scenario, the elimination of the refined sugar tariff would result in a modest decrease in total Canadian raw sugar imports (0.4 percent). Because of the increased Canadian supply response, it was estimated that there would be a larger percentage increase in raw sugar imports from CA-4 countries than in the basic scenario. This reduction in Canadian raw sugar imports reflects the same factors as described in the base scenario—changes in refining margins and the switch from exporting raw to refined sugar in the CA-4 countries. The small decline in domestic beet production (0.8 percent) was double the basic scenario as was the small decline in Canadian refining. Overall, Canadian shipments of refined sugar declined by 0.7 percent.

With the increased Canadian supply response, trade patterns changes were stronger than in the basic scenario. The projected total refined sugar imports of 115,100 mt. would not be a record level for Canada. Essentially, the increased demand for refined sugar in Canada (18.0 mt.) due to reduced sugar prices, is met by increased imports of refined sugar from CA-4 countries (26.1 mt.) and a decrease (8.4 mt.) in Canadian sugar refining. As sugar consumption in Canada would increase by 1.4 percent, the total shipments of refined sugar, and the refining capacity utilization in Canada would be expected to decline slightly (less than 1 percent) from the base period.

Table 3: Impact of the Elimination of the Refined Sugar Tariff (Stronger Canadian Supply Response).

Refined sugar tariff

Raw Sugar Imports (Canada)	Base (1000mt)	Impact (1000mt)	Impact (% change)
CA-4 countries	96	-6.4	-6.6%
Rest of World	986	-1.2	-0.1%
Total	1082	-4.1	-0.4%

Refined Sugar Imports (Canada)	Base (1000mt)	Impact (1000mt)	Impact (% change)
CA-4 countries	4	26.1	609%
Rest of World	85	0.8	0.9%
Total	87	26.5	30%

Canadian Shipments Refined sugar	Base (1000mt.)	Impact (1000mt)	Impact (% change)
domestic sources	110	-0.8	-0.8%
total	1082	-7.6	-0.7%

Unit Import Price from CA-4 (Incl. tariff)	Base (C\$/mt)	Impact (C\$/mt)	Impact (% change)
Raw sugar	228	0.1	0%
Refined sugar	475	-30.2	-6.4%

Source: study estimates.

In this environment of a greater Canadian supply response, the unit import price (including the tariff) for refined sugar from the CA-4 countries declined substantially (\$30.2/mt.), almost the full magnitude of the tariff reduction. Overall, refined sugar prices declined only slightly (0.1 percent) in Canada but CA-4 raw sugar prices increase more than in the basic scenario. As in the basic scenario, it is expected that the structure of the refined sugar market would deter other countries from lowering their refined sugar prices to maintain import market share.

6.3 Welfare Estimation

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In order to provide an overall evaluation of the impact from the tariff elimination for all of the market participants in Canada, the CA-4 countries, and the rest of the world, estimates of the producer and consumer surplus and other welfare components were calculated for each of the scenarios. Since the Armington model distinguishes between types of sugar by source, this distinction was taken into account in the use of prices for the consumer surplus (savings) calculations. A summary of the results is shown in Table 4. Detailed results for the two scenarios are shown in Appendix 3.

Table 4: Estimated Welfare Gains and Losses (\$ million).

Scenario	Canada	CA-4 Countries	Rest of the World
Basic scenario			
producer income	-0.12	0.96	-.08
refiner income	-1.26	-0.01	-.01
tariff revenue	-0.13		
producer rent		0.36	
consumer savings	0.93	-0.38	0.13
total welfare change	-0.59	0.93	0.04
Higher supply response			
producer income	-0.19	2.14	-0.09
refiner income	-1.9	-.01	0.03
tariff revenue	-0.13		
producer rent		0.92	
consumer savings	0.55	-0.8	0
total welfare change	-1.66	2.25	-0.07

Source: study estimates

With the basic scenario, there was a small welfare loss for Canada and a small welfare gain for the Central American countries. Canadian consumers gained from lower sugar prices but Canadian refiners and growers suffered small income losses. Including the loss of tariff revenue, Canada lost about \$0.6 million. Central American growers increased incomes and refiners obtained a rent by selling tariff-free into the Canadian

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market. Central American producers lost a small amount by having to pay slightly higher sugar prices. Because the rest of the world was set to respond only slightly to the Canadian Central American free trade agreement, its welfare changes were very small.

Welfare effects were over twice as large for the alternative scenario where a larger Canadian supply response was assumed. However, estimates of the overall consumer and producer surplus for the CA-4 countries show relatively small impacts in both scenarios. The welfare losses for Canada range from \$0.6 to \$1.7 million while the welfare gains for the Central American countries range from \$0.9 to \$2.3 million. To further increase the welfare gains from the increased producer surplus, the CA-4 countries need to liberalize domestic sugar policy so as to restrict any retail price increase. For the rest of the world, welfare changes are small for both scenarios.

The modeling exercise suggests that even under the most favorable circumstances, the changes from the Canadian removal of the refined sugar tariff on imports from Central America are likely to be modest. Of course if the Canadian sugar industry believes that other exporters to the Canadian market will match the price reduction to Central American countries, then if Canadian prices are lowered to meet this expectation, declines in Canadian sugar production and refining could be greater.

7.0 Concluding Observations

The quantitative framework developed for the study provided one approach to assess the impact of the elimination of the Canadian refined sugar tariff. In addition, it allowed tests of the sensitivity of various assumptions and market responses to the overall outcome of the market impacts. In particular, it showed that the assumption on the substitutability of raw and refined sugar among countries was important in estimating the CA-4 country share and the total level of refined sugar imports. A greater supply response to price changes in the sugar sector in Canada did result in greater increases in the level of refining in the CA-4 countries, and exports of refined sugar to Canada. The timing of the implementation of the reduction showed little difference in the impact over the long medium term. With little impact, the Canadian refiners do not require a long adjustment period. The expectation that the structure of the market would deter Canadian refiners and other country exporters from reducing refined sugar prices was also a factor in limiting changes in the Canadian refined sugar market.

For both of the scenarios examined, capacity utilization of Canadian sugar refiners is only marginally reduced, even in the conditions of a very elastic Canadian supply response, under the elimination of the tariff on refined sugar. Canadian sugar beet production is marginally impacted by the elimination of the refined sugar tariff as are the refining margins in Canada.

Canadian sugar users, both food processors and retail consumers benefit from slightly lower domestic prices and increased competition in the refined sugar market. Consumption would be expected to increase by 0.6 to 1.4 percent as a result of the refined sugar tariff elimination. In the context of a total welfare calculation, gains to Canadian consumers were less than losses to producers in the two scenarios.

CA-4 countries gain a larger share of the Canadian refined sugar imports from the removal of the refined sugar tariff. The rest of the world exporters see little change in their market share. The changes calculated in the study are small and represent a tiny part of the total world sugar market. It appears that there would have to be greater price declines in the Canadian refined sugar market before Canadian importers would be willing to replace Canadian refined sugar with imported CA-4 countries' sugar. Thus, the benefits to the CA-4 countries would be modest in both scenarios.

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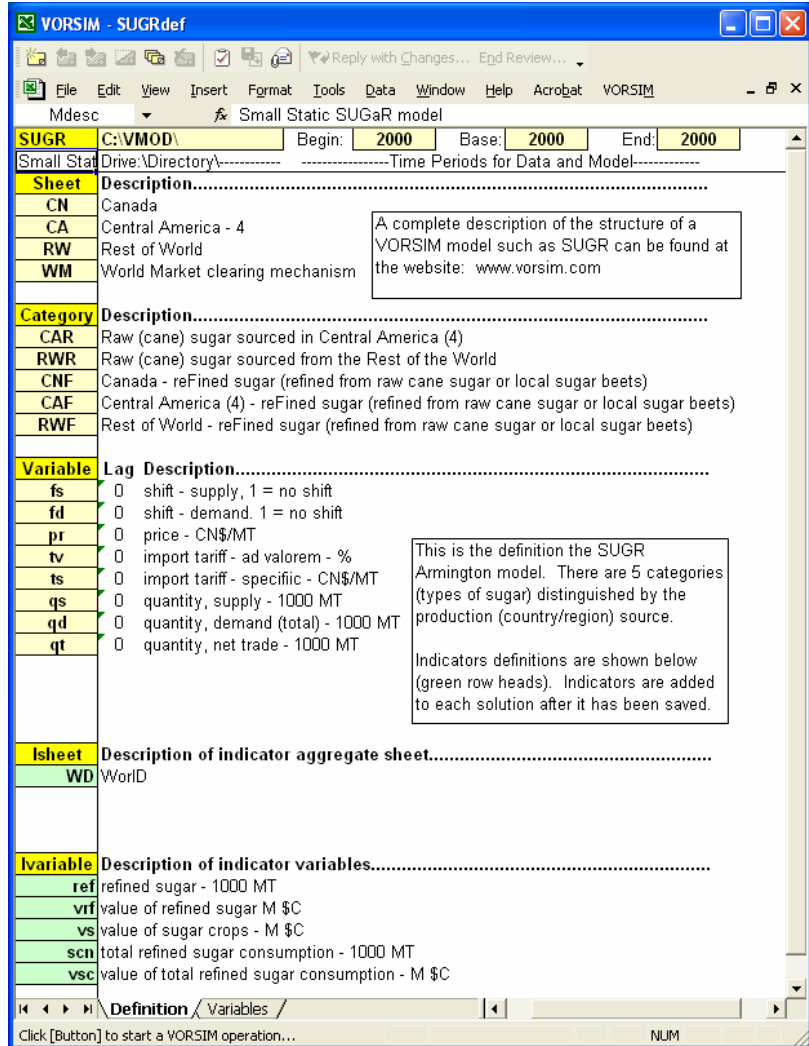
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Appendix 1: Model Specification and Definitions

The calculations in this report were done with a small static Armington bilateral trade flow model SUGR that was created with the VORSIM spreadsheet modeling system. The definitions of the regions, products, variables, and indicators in the model are shown in the SUGR model definition sheet to the right. World raw and refined sugar data was aggregated to three countries/regions – Canada, Central America (4 countries), and the rest of the world). For the Armington demand specification, 5 categories of sugar were defined in SUGR according to the source of the sugar. Equations are written for prices, supply, demand, and trade. While the model itself is an Excel workbook, it is created from sets of Excel workbooks including the definition workbook shown



and on the next page, the equation workbooks shown on subsequent pages, and a data workbook. Indicators are added to model solution workbooks after they have been created and saved; indicators are simply post-solution calculations done with solution value. The VORSIM model building framework provides a structure for the SUGR model as it is built. A model construction begins with the definition workbook. Then the equation workbook is constructed, equations are built, and a model is assembled.

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When equation parameters are change, the equations can be re-written automatically and the model is re-assembled with the click of a button. VORSIM automatically puts the control buttons for all operations into the workbook where the operations are carried out. Details on VORSIM model building and model structures can be found on the website: www.vorsim.com.

The master variable list for the SUGR model is shown to the right. Variable names are concatenations of the codes listed in the model definition sheet above. Following the definition sheet for example, the variable CNTsCAF is the Canadian tariff on Central American refined sugar. Spreadsheets put data in particular cells. This sheet specifies the location of each variable and piece of data in the model workbook and serves as a reference point for many model building operations. Note the buttons at the top of the sheet which initiate various model-building operations. These buttons are put in place and linked to VORSIM programs as a model is built. Each VORSIM-built model has, in effect, its own set of custom built controls put in place in each component workbook. Normal spreadsheet tasks can be done in model workbooks along with VORSIM operations. The Canada (CN) sheet of the

SUGR	CN	CA	RW	WM
fsCAR		CAfsCAR		
fsRWR			RWfsRWR	
fsCNF	CNfsCNF			
fsRWF			RWfsRWF	
fdCAR	CNfdCAR	CAfdCAR	RWfdCAR	
fdRWR	CNfdRWR	CAfdRWR	RWfdRWR	
fdCNF	CNfdCNF	CAfdCNF	RWfdCNF	
fdCAF	CNfdCAF	CAfdCAF	RWfdCAF	
fdRWF	CNfdRWF	CAfdRWF	RWfdRWF	
prCAR	CNprCAR	CAprCAR	RWprCAR	WMprCAR
prRWR	CNprRWR	CAprRWR	RWprRWR	WMprRWR
prCNF	CNprCNF	CAprCNF	RWprCNF	WMprCNF
prCAF	CNprCAF	CAprCAF	RWprCAF	WMprCAF
prRWF	CNprRWF	CAprRWF	RWprRWF	WMprRWF
tvCAR	CNtvCAR		RWtvCAR	
tvRWR	CNtvRWR	CAtvRWR		
tvCNF		CAtvCNF	RWtvCNF	
tvCAF	CNtvCAF		RWtvCAF	
tvRWF	CNtvRWF	CAtvRWF		
tsCAR	CNtsCAR		RWtsCAR	
tsRWR	CNtsRWR	CAtsRWR		
tsCNF		CAtsCNF	RWtsCNF	
tsCAF	CNtsCAF		RWtsCAF	
tsRWF	CNtsRWF	CAtsRWF		
qsCAR		CAqsCAR		
qsRWR			RWqsRWR	
qsCNF	CNqsCNF			
qsRWF			RWqsRWF	
qdCAR	CNqdCAR	CAqdCAR	RWqdCAR	
qdRWR	CNqdRWR	CAqdRWR	RWqdRWR	
qdCNF	CNqdCNF	CAqdCNF	RWqdCNF	
qdCAF	CNqdCAF	CAqdCAF	RWqdCAF	
qdRWF	CNqdRWF	CAqdRWF	RWqdRWF	
qtCAR	CNqtCAR	CAqtCAR	RWqtCAR	WMqtCAR
qtRWR	CNqtRWR	CAqtRWR	RWqtRWR	WMqtRWR
qtCNF	CNqtCNF	CAqtCNF	RWqtCNF	WMqtCNF
qtCAF	CNqtCAF	CAqtCAF	RWqtCAF	WMqtCAF
qtRWF	CNqtRWF	CAqtRWF	RWqtRWF	WMqtRWF

Refined sugar tariff

SUGR equation workbook is shown below. The top of the sheet contains matrices of parameters which define the equations. The set of equations for Canada appear at the bottom of the sheet in groups. The first group consists of price equations relating the world price for a type of sugar to the Canadian price, including any tariffs in place.

The screenshot displays the VORSIM - SUGReq software interface. The main window contains several matrices and text boxes explaining their functions:

- CN - Equation Parameter Matrices and Equations:** This section includes matrices for domestic price (CN), supply (qs), and Armington demand (qd). Each matrix has columns for different sugar types (CAR, RWR, CHF, CAF, RWF) and rows for various parameters like price, quantity, and shift terms. Text boxes explain that these matrices produce CN price equations, the supply equation for Canadian beet sugar, and the Armington demand equations for raw and refined sugar in Canada.
- Net trade for each type of sugar:** A matrix showing trade flows for each sugar type.
- Equations:** A list of mathematical equations defining the relationships between variables, such as $0 + CNsCAR + (WMprCAR^M) * (1 + CNvCAR/100)$.

The interface also shows a menu bar (File, Edit, View, Insert, Format, Tools, Data, Window, Help, Acrobat, VORSIM), a toolbar, and a status bar at the bottom with the text "Click [Button] to start a VORSIM operation..." and "NUM".

Next follows the Canadian supply equation for beet sugar. Then the Armington demand equations are shown where “own” and “cross price” elasticities of demand are

Refined sugar tariff

calculated from an overall demand elasticity and an Armington elasticity of substitution. These parameters are all shown in the equation matrices at the top of the sheet. If the model is re-specified with a different parameter (e.g. supply elasticity or elasticity of substitution), the number is changed in the matrix and the [Write CN equations] button is clicked to re-write the equations at the bottom of the sheet with the new parameter.

World prices that clear world markets for each type of sugar are translated into domestic prices with the price equations. These prices feed into the sugar crop supply equations (sugar beets for Canada) and the Armington demand equations for raw and refined sugar. The Armington specification assumes an overall demand elasticity for each raw and refined sugar. A formula translates this demand elasticity and an elasticity of substitution into a set of own and cross price elasticities for each type of sugar (raw and refined) by source (domestic or imported from another region).

The refined sugar price for Canada (CNprCNF) enters the Canadian demand equations for raw sugar imported from Central America and the rest of the world in such a way that if the refined sugar price rises, demand for raw sugar for refining decreases. On the other hand, the prices in Canada for imported raw sugar (CNprCAR, CNprRWR) serve to discourage processing demand if they rise and encourage the use of alternative import sources. The Armington raw sugar demand equations serve as the supply equations for sugar processing (raw cane sugar); a refining supply elasticity responding to the refined sugar price drives the demand for raw cane sugar along with the costs (prices) of imported raw sugar. The Armington refined sugar demand equations, on the other hand, allocate sugar demand between the possible sources of supply; for Canada this is domestic processing of refined cane sugar (the variable CNqdCNF includes the processing of imported cane sugar), domestic production and processing of beet sugar (also included in the variable CNqdCNF), imports of refined sugar from Central American countries, and imports of refined sugar from the rest of the world. The demand specification insures that if demand for Canadian refined sugar increases, it increases proportionally for both cane and sugar beet refining. However the share of sugar beet refining can be changed by making the supply elasticity in the sugar beet production equation different from the refining supply elasticity.

The final set of equations calculates the net trade values for Canada for each type of sugar. For CA and RW sugars this is import demand while for CN sugars this is an equation which calculates net Canadian exports. Note that in SUGR there is no raw sugar type for Canada because Canada does not produce cane sugar. These net trade

Refined sugar tariff

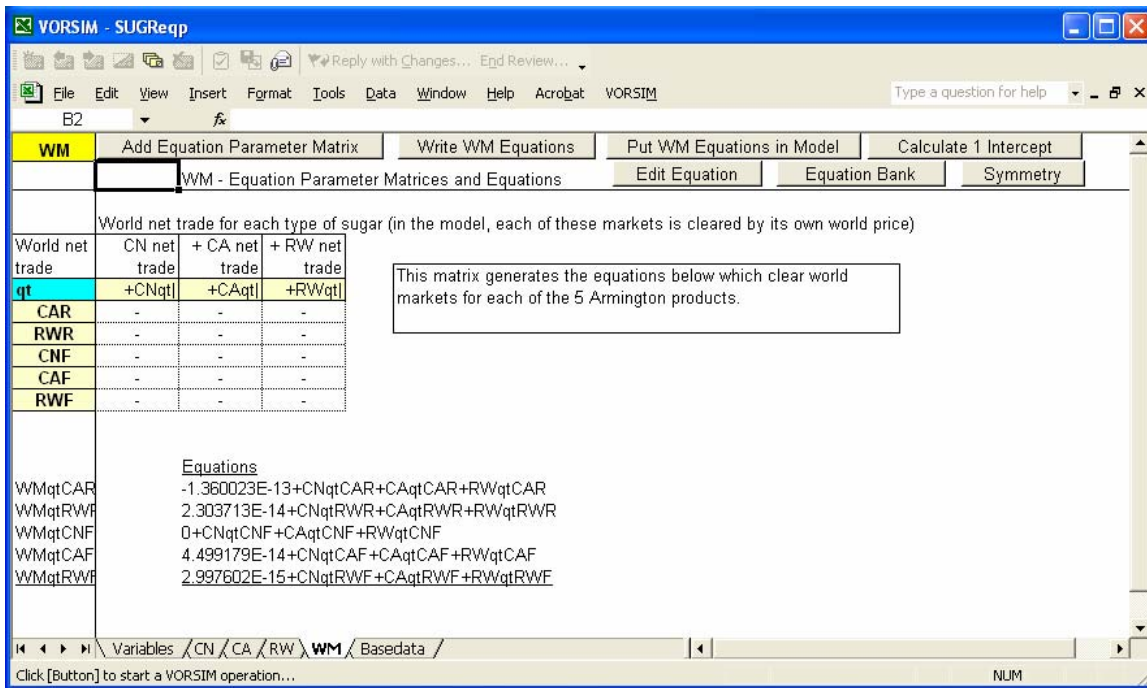
values along with those produced by the CA (Central America – 4) and RW (rest of the world) regions are summed to world net trade totals in WM (world market clearing mechanism) sheet.

The equation sheet for the Central American region is shown above. It contains similar types of equations and balances. The equation sheet for the rest of the world shown below completes the set of equations for SUGR model.

Refined sugar tariff

report.

The world market clearing mechanism sheet for the SUGR model is shown below. These equations calculate net world trade balances that result from trade equations in countries/regions. The trade balance equations in this sheet and the trade equations in the country/region sheets impose two key conditions on world markets. First, world net trade is balanced insuring that exports equal imports for all types of sugar. Second, the country region equations insure that supply equals demand in each country/region for all types of sugar.



In the model itself, when a tariff or another exogenous variable is changed, world trade will be out of balance. New world prices will be calculated and feed into country/region equations, creating new world trade balances. This process iterates to a solution with a new set world prices (giving new prices and quantities in country/region equations) and zero net world trade for each type of sugar. The data sheet for the equation workbook is shown below. This data is used to calculate the intercepts of the equations when they are written. The data here is drawn from the SUGR model data workbook where it was

Refined sugar tariff

originally entered. In the case of a static model such as SUGR, this is all of data for the model.

Update Basedata sheet for Model

SUGR	CN	CA	RW	WM
fsCAR		1.0		
fsRWR			1.0	
fsCNF	1.0			
fsRWF			1.0	
fdCAR	1.0	1.0	1.0	
fdRWR	1.0	1.0	1.0	
fdCNF	1.0	1.0	1.0	
fdCAF	1.0	1.0	1.0	
fdRWF	1.0	1.0	1.0	
prCAR	228.0	228.0	228.0	228.0
prRWR	228.0	228.0	228.0	228.0
prCNF	444.0	888.0	444.0	444.0
prCAF	474.9	444.0	444.0	444.0
prRWF	474.9	888.0	444.0	444.0
tvCAR	0.00		0.00	
tvRWR	0.00	0.00		
tvCNF		100.00	0.00	
tvCAF	0.00		0.00	
tvRWF	0.00	100.00		
tsCAR	0.00		0.00	
tsRWR	0.00	0.00		
tsCNF		0.00	0.00	
tsCAF	30.86		0.00	
tsRWF	30.86	0.00		
qsCAR		2781.0		
qsRWR			98329.4	
qsCNF	110.0			
qsRWF			27950.3	
qdCAR	96.5	1425.8	1259.1	
qdRWR	985.4	0.7	97342.9	
qdCNF	1175.9	0.2	15.8	
qdCAF	4.3	1145.8	276.6	
qdRWF	84.5	0.4	126467.6	
qtCAR	-96.5	1355.2	-1259.1	0
qtRWR	-985.4	-0.7	986.5	0
qtCNF	16.0	-0.2	-15.8	0
qtCAF	-4.3	280.7	-276.6	0
qtRWF	-84.5	-0.4	84.7	0

This is the base data from the model data workbook that is used to initialize the SUGR equations. Gray cells indicate that formulas have been used to calculate the data in the data workbook. This is done to provide a globally balanced data set for the model.

Finally, the SUGR model sheet itself is shown below. Yellow cells contain equations while the green and red cells contain world prices (changed for a solution) and world trade balance equations (zero when world trade is balanced), respectively.

Refined sugar tariff

This is the actual SUGR model spreadsheet. Yellows cells contain model equations that generate the observed numbers. White cells contain exogenous data that can be changed to generate alternative solutions. Green cells contain world prices for the five Armington sugar products while the red cells contain world trade balance equations for each type of sugar. When the model solves, the world prices change to drive world trade for each product to zero. Changes in world prices feed through to country/region prices and to country region supply and demand equations. These equations generate world net trade. When an exogenous variable is changed, the Excel solver drives the world prices to an equilibrium where world trade is again balanced.

SUGR	CH	CA	RW	WM
fsCAR		1.0		
fsRWR			1.0	
fsCHF	1.0			
fsCAF				
fsRWF			1.0	
fdCAR	1.0	1.0	1.0	
fdRWR	1.0	1.0	1.0	
fdCHF	1.0	1.0	1.0	
fdCAF	1.0	1.0	1.0	
fdRWF	1.0	1.0	1.0	
prCAR	228.0	228.0	228.0	228.0
prRWR	228.0	228.0	228.0	228.0
prCHF	444.0	888.0	444.0	444.0
prCAF	474.9	444.0	444.0	444.0
prRWF	474.9	888.0	444.0	444.0
tvCAR	0.00			0.00
tvRWR	0.00	0.00		
tvCHF		100.00		0.00
tvCAF	0.00			0.00
tvRWF	0.00	100.00		
tsCAR	0.00			0.00
tsRWR	0.00	0.00		
tsCHF		0.00		0.00
tsCAF	30.86			0.00
tsRWF	30.86	0.00		
qsCAR		2781.0		
qsRWR			98329.4	
qsCHF	110.0			
qsCAF				
qsRWF			27950.3	
qdCAR	96.5	1425.8		1259.1
qdRWR	985.4	0.7		97342.9
qdCHF	1175.9	0.2		15.8
qdCAF	4.3	1145.8		276.6
qdRWF	84.5	0.4		126467.6
qtCAR	-96.5	1355.2		-1259.1
qtRWR	-985.4	-0.7		986.5
qtCHF	16.0	-0.2		-15.8
qtCAF	-4.3	280.7		-276.6
qtRWF	-84.5	-0.4		84.7

Green Cells - variables changed by the Solver to solve model (drive values in red cells to zero)
 \$E\$13:\$E\$17

Red cells - equation values driven to zero
 \$E\$38
 \$E\$39
 \$E\$40
 \$E\$41
 \$E\$42

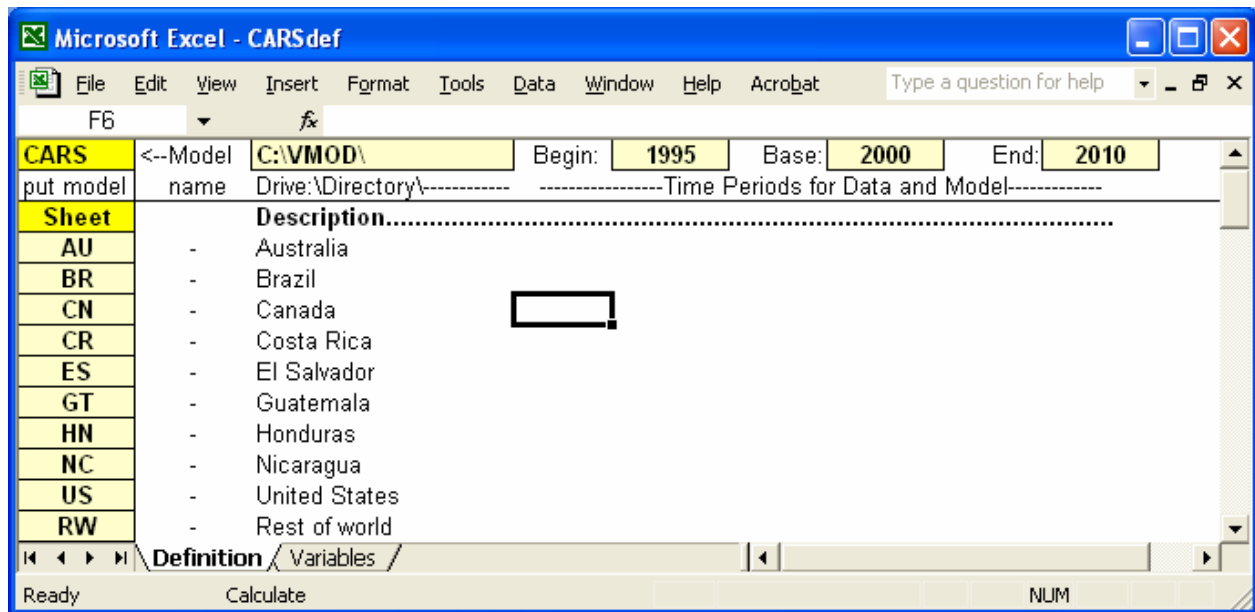
Appendix 2: Model Data and Sources

Refined sugar tariff

Model Manager - Sugar datam														
File Edit View Insert Format Tools Data Window Help Acrobat VORSIM														
Type a question for help														
V2														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Sugar Data (quantities - 1000 metric tons, prices C\$/metric ton) for 2000														
3	Raw	AU	BR	CH	CR	ES	GT	HII	HC	US	RW	Raw.Exp.	M.Exp.	
4	AU	1082.9	0.0	530.7	0.0	0.0	0.0	0.0	0.0	94.3	2410.1	3035.1	625.0	
5	BR	0.0	11868.0	172.9	0.0	0.0	0.0	0.0	0.0	168.0	4741.1	5082.0	340.9	
6	CH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
7	CR	0.0	0.0	37.4	223.7	0.4	0.0	0.0	0.0	44.0	66.5	148.3	81.8	
8	ES	0.0	0.0	1.0	0.0	267.9	1.5	0.6	0.5	65.7	91.4	160.7	69.3	
9	GT	0.0	0.0	93.5	0.0	0.5	670.5	1.4	0.5	233.2	646.7	975.8	329.1	
10	HII	0.0	0.0	1.0	0.0	0.4	1.5	260.8	0.5	8.8	57.5	69.8	12.2	
11	HC	0.0	0.0	1.0	0.0	0.2	1.5	0.6	216.5	70.6	85.2	159.1	73.9	
12	US	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3792.7	7.7	7.9	0.2	
13	RW	2.6	0.0	244.5	2.9	0.0	0.5	0.2	0.0	793.8	72044.3			
14	Own.Proc	1082.9	11868.0	0.0	223.7	267.9	670.5	260.8	216.5	3792.7	72044.3	TOTAL sugar supply and utilization is from USDA.		
15	RAW/TOT	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.48	0.75	FAO data was used to break sugar exports and imports into 'raw' and 'refined' and USDA production data was used to break down TOTAL US utilization tables (bold italic numbers) into 'Raw' and 'Refined' production and stocks (green numbers).		
16	RAW	Raw sugar = cane sugar											FAS attache reports on trade flows were used to create the trade matrices (red numbers) for 'raw' and 'refined' sugar. The rows of the matrices represent exporters; the columns represent importers. Diagonals of the matrices represent refining or consumption of domestic sugar as opposed to imported sugar. The data set is consistent globally.	
17	E.Stk.-1	517.6	710.0	32.9	80.0	21.9	95.6	98.5	110.4	1118.7	23752.2			
18	Prod.	4181.0	17000.0	0.0	370.0	430.6	1630.4	304.7	363.6	3662.3	71707.5			
19	Imports	2.8	0.0	1082.0	2.9	1.5	5.0	2.8	1.5	1478.4	8106.3			
20	Exports	3035.1	5082.0	0.0	148.3	160.7	975.8	69.8	159.1	7.9	1044.4			
21	Refined	1085.7	11868.0	1082.0	226.6	269.4	675.5	263.6	218.0	5271.1	80150.6			
22	E.Stocks	580.6	760.0	32.9	78.0	23.9	79.7	72.6	98.5	980.3	22371.0			
23	TOTAL	3032.3	5082.0	-1082.0	145.4	159.2	970.8	67.0	157.6	-1470.5	-7061.9			
24	E.Stk.-1	578.0	710.0	39.0	80.0	22.0	96.0	99.0	111.0	2073.0	31779.0			
25	Prod.	4181.0	17000.0	170.0	370.0	431.0	1632.0	305.0	364.0	7770.0	95670.0			
26	Imports	6.0	0.0	1170.7	3.0	3.0	70.0	4.0	3.0	1540.0	11175.8			
27	Exports	3129.0	7700.0	16.0	160.0	196.0	1190.0	75.0	194.0	113.0	1141.8			
28	Cons.	995.0	9250.0	1264.0	215.0	236.0	468.0	260.0	185.0	9386.0	107492.0			
29	E.Stocks	581.0	760.0	39.7	78.0	24.0	80.0	73.0	99.0	1764.0	29937.0			
30	REFINED	Refined sugar = refined beet sugar (except Ref.Raw which is refined cane sugar)												
31	E.Stk.-1	0.4	0.0	6.1	0.0	0.1	0.4	0.5	0.6	894.3	8026.8			
32	Prod.	0.0	0.0	110.0	0.0	0.4	1.6	0.3	0.4	4047.8	23902.5			
33	Imports	3.2	0.0	88.7	0.1	1.5	5.0	1.2	1.5	61.6	3069.5			
34	Ref.Raw	1085.7	11868.0	1082.0	226.6	269.4	675.5	263.6	218.0	5271.1	80150.6			
35	Exports	93.9	2618.0	16.0	11.7	35.3	214.2	5.3	34.9	105.1	97.4			
36	Cons.	995.0	9250.0	1264.0	215.0	236.0	468.0	260.0	185.0	9386.0	107492.0			
37	E.Stocks	0.4	0.0	6.8	0.0	0.1	0.3	0.4	0.5	783.7	7560.0			
38	net trade	90.7	2680.0	-22.7	11.6	33.8	202.2	4.1	33.4	43.5	-2622.1			
39	Refined	AU	BR	CH	CR	ES	GT	HII	HC	US	RW	Ref.Exp.	M.Exp.	
40	AU	991.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.9	93.9	0.0	
41	BR	0.0	9250.0	21.8	0.0	0.0	0.0	0.0	0.0	0.0	2596.2	2618.0	21.8	
42	CH	0.0	0.0	1175.3	0.0	0.0	0.0	0.0	0.0	10.0	5.8	16.0	10.2	
43	CR	0.0	0.0	0.0	214.9	0.0	0.0	0.0	0.0	0.0	11.7	11.7	0.0	
44	ES	0.0	0.0	0.5	0.0	234.5	1.5	0.4	0.5	0.0	32.4	35.3	2.9	
45	GT	0.0	0.0	3.2	0.0	0.5	463.0	0.4	0.5	0.0	209.6	214.2	4.6	
46	HII	0.0	0.0	0.1	0.0	0.5	1.5	258.8	0.5	0.0	2.7	5.3	2.6	
47	HC	0.0	0.0	0.5	0.0	0.5	1.5	0.4	183.5	0.0	32.0	34.9	2.9	
48	US	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	9324.4	84.6	105.1	20.5	
49	RW	3.2	0.0	42.2	0.1	0.0	0.5	0.0	0.0	51.6	104422.5	Sum Raw	Sum Ref.	
50	Own.Cons	991.8	9250.0	1175.3	214.9	234.5	463.0	258.8	183.5	9324.4	104422.5	0.0	-0.7	
Quantity and price data - 2000														
Click [Button] to start a VORSIM operation...														
NUM														

Refined sugar tariff

The basic balance data which is behind the SUGR model is shown above. The data began with USDA supply and utilization data which was modified (using FAO information) to derive matrices of production, consumption, stocks and bilateral trade for raw and refined sugar. USDA attaché reports were also used to create bilateral trade flow information for Central American countries. Finally, to the extent possible, data directly from Canadian sources was used whenever it was available. The country/region definitions for the above matrix are shown below.



In order to simplify the data and modeling exercise, this data was condensed to two versions shown below. Both versions consisted of three countries/regions; Canada, Central America – 4 (Guatemala, Honduras, El Salvador and Nicaragua). The version on the left is for the dynamic model SUGS which includes sugar stocks while the version on the right (green background) is for the model SUGR used for this report.

The basic data below was entered into the SUGR data workbook (not shown but equivalent to the Basedata sheet shown above). All quantities of sugar are measured in terms of thousand metric tons of refined sugar equivalent. Base domestic prices are world prices plus any documented tariffs in place. All prices are measured as Canadian dollars per metric ton.

Refined sugar tariff

Model Manager - Sugar datam

File Edit View Insert Format Tools Data Window Help Acrobat VORSIM Type a question for help

V2 fx

The figures below are the data above rearranged for the three region dynamic SUGS model. Definition of model codes are all contained in the model definition sheet.

	Importer		
Raw	CN	CA	RW
CN	0.0	0.0	0.0
CA	96.5	1425.8	1259.1
RW	985.4	0.7	97342.9
E.Stk.-1	32.9	326.5	26178.5
Prod.	0.0	2729.3	96920.8
Imports	1082.0	0.7	1259.0
Exports	0.0	1355.6	986.1
Refined	1082.0	1426.4	98602.0
E.Stocks	32.9	274.7	24769.9

Quantities are in 1000 metric tons, prices are in C\$/metric ton.

Small static data set (without stocks - raw stock changes were added to production data) for the static SUGR model.

	Importer		
Raw	CN	CA	RW
CN	0.0	0.0	0.0
CA	96.5	1425.8	1259.1
RW	985.5	0.7	97342.9
Prod.	0.0	2781.0	98329.4
Imports	1082.0	0.7	1259.1
Exports	0.0	1355.6	986.2
Refined	1082.0	1426.5	98602.0

	Importer		
Refined	CN	CA	RW
CN	1175.3	0.2	15.8
CA	4.3	1145.8	276.6
RW	84.5	0.4	127045.6
E.Stk.-1	6.1	1.5	8921.5
Prod.	110.0	0.0	27950.3
Imports	88.8	0.6	292.4
Ref.Raw	1082.0	1426.4	98602.0
Exports	16.0	280.9	84.9
Cons.	1264.0	1146.3	127338.0
E.Stocks	6.8	1.3	8344.1

	Importer		
Refined	CN	CA	RW
CN	1175.3	0.2	15.8
CA	4.3	1145.8	276.6
RW	84.5	0.4	127045.6
Prod.	110.0	0.0	27950.3
Imports	88.8	0.6	292.4
Ref.Raw	1082.0	1426.5	98602.0
Exports	16.0	280.9	84.9
Cons.	1264.8	1146.2	126759.8

This is the data set used for the static SUGR model. It was derived from more detailed data and aggregated to the 3 region level. Since SUGR is a static model, stock changes (relatively small) that existed in the original data had to be accounted for. This was done by added them to production data.

		Raw	Refined
Assumed	AU	232.37	443.89
import	BR	324.29	365.93
prices for	CN	256.09	443.89
each	CR	229.88	443.89
country	ES	229.88	443.89
are	GT	229.88	443.89
shown to	HI	229.88	443.89
the right.	HC	229.88	443.89
	US	228.26	487.69
	RW	228.26	443.89

Quantity and price data - 2000

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Appendix 3: Detailed Results of Model Scenarios

The two solutions presented in this report are shown below in summary form. The top of each output sheet contains the base and solution values for variables along with differences and percentage differences between solution and base values.

The next section contains the values of elasticities that were used to generate the solutions. They are followed by a section containing the welfare calculations for the solution. The final part of the sheet contains a plot of the welfare components and total welfare changes for Canada, Central America, and the rest of the world.

The two solutions shown are labeled “casl” and “cash”. Both solutions were generated by the SUGR model assuming a fairly competitive international markets (high Armington elasticities of substitution for raw and refined sugar demand in all countries/regions = 30) and a low price transmission elasticity for the rest of the world. This latter assumption simply means that the expected trade and other changes would take place in Canada and Central American countries that form the free trade arrangement. Both solutions are generated by the Canadian removal of the refined sugar tariff on imports from the four Central American countries involved in the proposed free trade agreement. Both solutions assume Armington demand elasticities of -1 in all regions and cane, cane processing, and beet sugar supply elasticities of 1 in the rest of the world. In addition, both solutions assume a high (15) cane sugar supply elasticity and a high refining elasticity (12) in Central America. The differences between the two solutions are:

Solution casl – Canadian supply elasticities for beet sugar supply = 1.25 and the Canadian refining supply elasticity = 1. Canadian supply elasticities are assumed to be moderate or normal, in line with those in the rest of the world.

Solution cash – Canadian supply elasticities for beet sugar supply = 15 and the Canadian refining supply elasticity = 12. These high elasticities are at the level set for the Central American countries and reflect the idea that small margin changes in beet and cane processing, driven by a tariff reduction on imports from Central America, could cause major reductions in the quantity of Canadian sugar beet production and refined sugar processing.

Refined sugar tariff

Model Manager - cas1

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A2

SUGR Base solution Name: base Alternative solution: cas1 Difference Percent Difference
 CN removal of CA refined sugar tariff - RW t.e. = 2 - normal CN supply elasticities

Prices	CN	CA	RW	CN	CA	RW	CN	CA	RW	CN	CA	RW
prCAR	228.0	228.0	228.0	228.0	228.0	228.0	0.04	0.04	0.00	0.02	0.02	0.00
prRWR	228.0	228.0	228.0	227.8	227.8	228.0	-0.23	-0.23	0.00	-0.10	-0.10	0.00
prCNF	444.0	888.0	444.0	443.6	887.2	444.0	-0.40	-0.80	0.00	-0.09	-0.09	0.00
prCAF	474.9	444.0	444.0	453.3	444.3	444.0	-21.53	0.33	0.00	-4.53	0.08	0.00
prRWF	474.9	888.0	444.0	474.4	887.0	444.0	-0.50	-1.01	0.00	-0.11	-0.11	0.00

Supply	CN	CA	RW	CN	CA	RW	CN	CA	RW	CN	CA	RW
qsCAR	2781.4			2789.3			7.9			0.3		
qsRWR		98329.4			98329.1				-0.3			0.0
qsCNF	110.0			109.6			-0.5			-0.4		
qsCAF			27950.3			27950.4			0.1			0.0
qsRWF												0.0

Demand	CN	CA	RW	CN	CA	RW	CN	CA	RW	CN	CA	RW
qdCAR	96.4	1426.0	1259.1	90.0	1450.2	1258.9	-6.37	24.21	-0.21	-6.61	1.70	-0.02
qdRWR	985.8	0.7	97342.9	984.6	0.8	97343.6	-1.21	0.06	0.63	-0.12	8.83	0.00
qdCNF	1176.2	0.2	15.8	1167.7	0.2	15.8	-8.43	0.01	0.00	-0.72	4.98	0.00
qdCAF	4.3	1145.8	276.6	30.4	1143.9	276.6	26.14	-1.85	-0.03	608.76	-0.16	-0.01
qdRWF	84.3	0.4	126467.6	84.7	0.4	126467.7	0.36	0.03	0.12	0.42	6.23	0.00

Totals	CN	CA	RW	CN	CA	RW	CN	CA	RW	CN	CA	RW
Refined	1082.1	1426.7	98602.0	1074.6	1450.9	98602.5	-7.59	24.27	0.48	-0.70	1.70	0.00
Consumer	1264.8	1146.4	126760.0	1282.8	1144.6	126760.1	18.07	-1.81	0.10	1.43	-0.16	0.00

Summary of key information for the welfare calculations. The full set of elasticities and generating equations are given on the CA, CA, and RW sheets.
 CN tariff on ref. sugar from CA 30.86% change in crop producer surplus

Tariff rev.	CN	CA	RW	qsCAR	qsRWR	qsCNF	qsCAF	qsRWF
0.1	12.00	12.00	1.00	2.1		-0.2		0.0

Change in consumer surplus

	CN	CA	RW
CN	-3.04	-29.99	-30.00
CA	-29.90	-1.02	-29.94
RW	-28.06	-29.99	-1.07

Arm. Own-price elast.

	CN	CA	RW
qdCNF	0.1	0.0	0.0
qdCAF	0.5	-0.8	0.0
qdRWF	0.0	0.0	0.0

Arm. Elast. of Substitution

	CN	CA	RW
qsCAR	15.00		
qsRWR		15.00	
qsCNF			1.00
qsCAF			1.00
qsRWF			1.00

WELFARE CHANGES

Million C\$	Canada		Central America		Rest of World	
	Components	Total	Components	Total	Components	Total
Cane grower income			2.14		-0.10	
Cane refiner income	-1.90		-0.01		0.03	
Govt. tariff revenue	-0.13					
Beet growing, refining income	-0.19				0.01	
Rent to CA refiners			0.92			
Consumer savings	0.55		-0.80		0.00	
TOTAL WELFARE CHANGE		-1.66		2.25		-0.07

The full set of elasticities as well as equations generating these results are shown on the sheets CN, CA, RW.

Estimated Annual Welfare Changes from Canadian Removal of Tariff on Refined Sugar Imports from Central

Legend: ■ TOTAL WELFARE CHANGE, ■ Consumer savings, ■ Rent to CA refiners, ■ Beet growing, refining income, ■ Govt. tariff revenue, ■ Cane refiner income, ■ Cane grower income

NUM

Mechanically the second solution cash was obtained by changing the Canadian supply elasticities to higher values, re-writing the model equations, re-assembling the model,

Refined sugar tariff

simulating the tariff removal, and saving the results. Indicators are added to the saved results and they are called into a report writer which compares results with the base situation (no tariff change) and which generates the welfare calculations.

Components of the welfare calculations: Cane and beet sugar growers' income is the change in producer surplus for these sectors. Canada loses tariff revenue when removing the tariff on refined sugar imports from Central America but the Central American countries gain a rent from being able to sell refined sugar into the Canadian market without a tariff. This occurs because a tariff is still charged on refined sugar imports from the rest of the world. Consumer savings is the change in consumer surplus for refined sugar. Because the SUGR Armington model contains three types of refined sugar by origin (CN, CA and RW), separate consumer surplus calculations are made for each type of sugar and the results are aggregated.

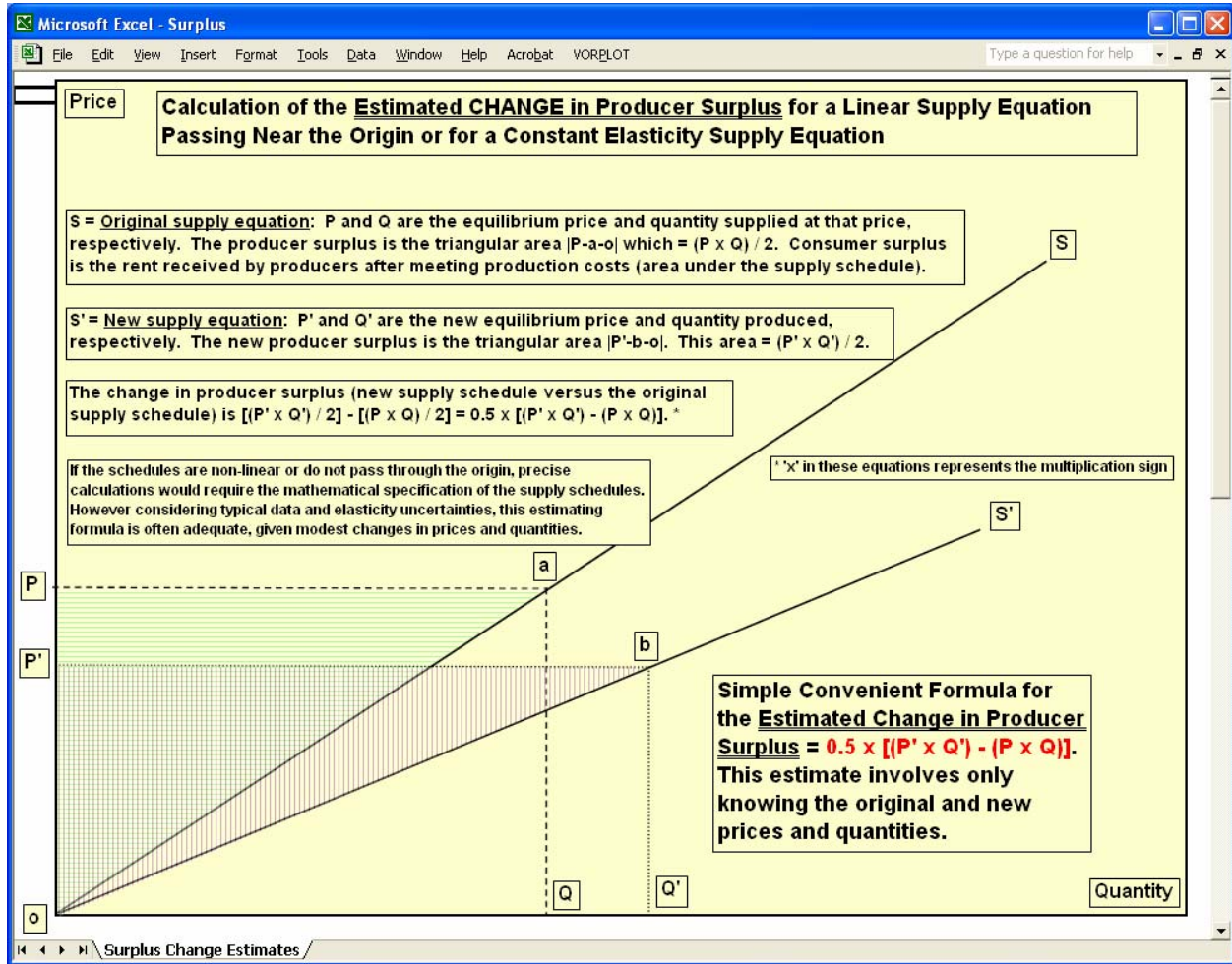
The SUGR model does have the facility to specify that producers select a weighted average of prices from various sources. If, for example, this is done for Canada and heavy weights are given to the tariff free price of refined sugar imported from Central America, the cutbacks in supply are more dramatic for Canada than those shown in the scenarios in this paper. However, the logic of the Armington model would be undercut by this procedure, invalidated welfare calculations among other problems.

There is one situation in which larger impacts might be obtained. If one were to assume that the existing Canadian tariff allowed a non-competitive situation to exist among Canadian sugar beet producers and sugar cane processors, then such a situation might be effectively modeled by adding the price equivalent associated with non-competitive pricing to the tariff when the model was initialized. Then the reduction in the tariff plus the non-competitive pricing component would have a greater impact all around including a greater impact on economic welfare. Unfortunately while there is some discussion of the competitiveness of Canadian producers and processors, there is no available measure associated with a non-competitive situation.

Finally, the figure below explains the methodology behind the producer and consumer calculations shown in the solution sheets. These calculations allow for shifts in supply and demand schedules as well as changes in prices and quantities. The formulas used are approximations and are only accurate for linear supply schedules that pass through the origin and linear demand schedules. However they are reasonable approximations for constant elasticity supply and demand schedules which are very convenient for a

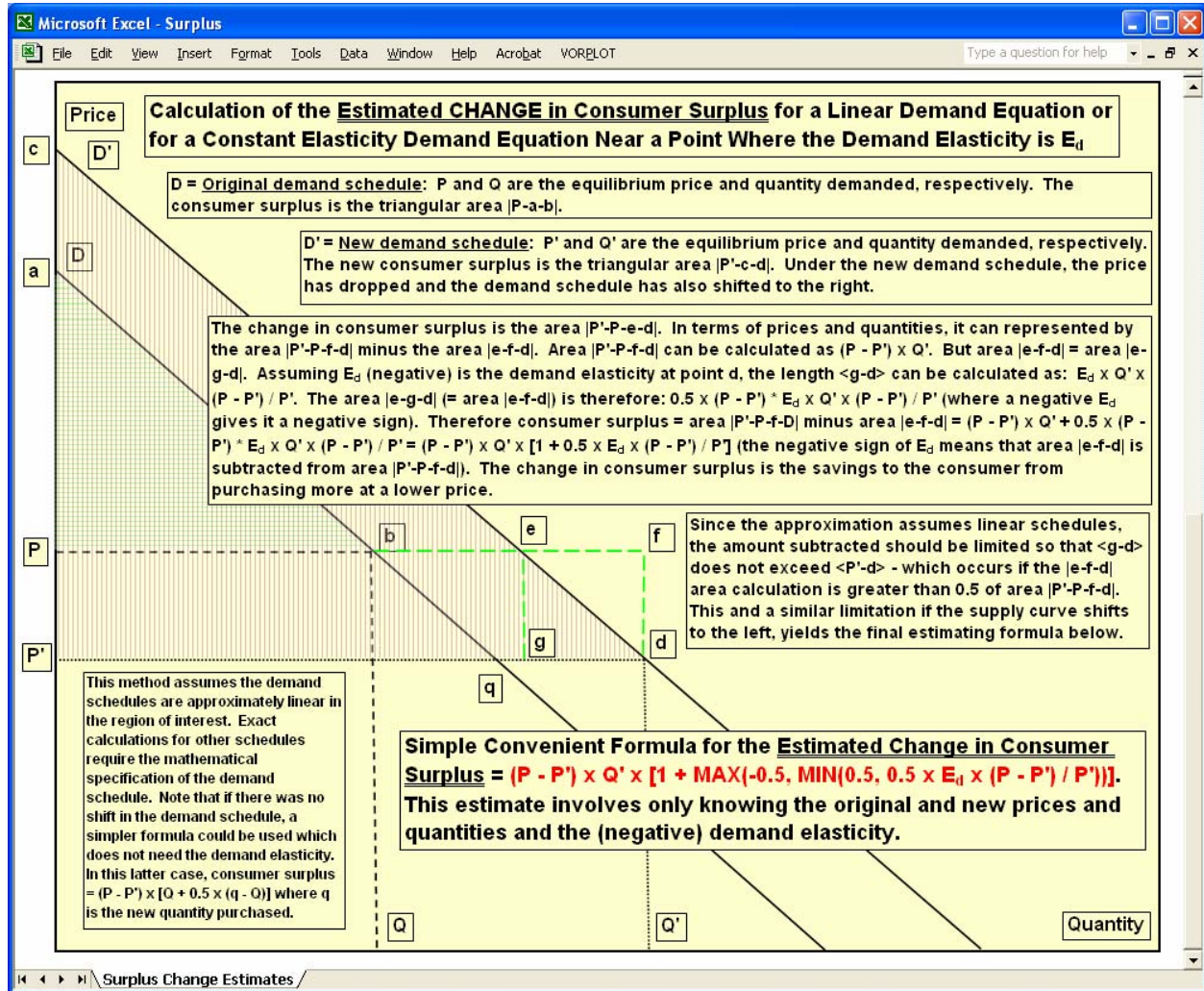
Refined sugar tariff

modeling format.



If one wants an exact producer or consumer surplus calculation with anything other than the linear schedules shown here, the actual mathematical specification for the equation would have to be used. However for most purposes, these approximations are adequate. They have the advantage that they require only base and alternative prices and quantities and in the case of consumer surplus, the elasticity of demand.

Refined sugar tariff



The consumer surplus calculations are more complicated since they account for possible shifts in the demand schedule (i.e. cross price effects, etc.). If the demand schedule does not shift, the simpler formula in the lower left part of the diagram can be used. It does not require knowledge of the demand elasticity at the base or alternative quantity or price.