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Trade Creation and Diversion Effects of the North American Free Trade Agreement of U.S. Sugar Imports from Mexico

Stephen Devadoss, Jurgen Kropf, and Thomas Wahl

A world sugar model consisting of 21 countries was developed to determine the effects of NAFTA of U.S. and Mexican sugar markets and to quantify the trade creation and diversion effects on U.S. imports from Mexico. Mexican sugar production increases under NAFTA, causing Mexico to become a net exporter. NAFTA induces sugar imports from Mexico to displace U.S. production, to meet demand expansion, and also to divert U.S. imports from other foreign suppliers to Mexico. Effects of NAFTA on the U.S. sugar market are small because of the side agreements which limit Mexican exports and which include corn sweetener consumption when computing Mexico's production surplus.

Key words: NAFTA, sugar, trade creation, trade diversion

Introduction

One of the agricultural issues hotly debated during the negotiation and ratification of the North American Free Trade Agreement (NAFTA) was the effect of NAFTA on the U.S. sugar industry because sugar policies were one of the most sensitive and complicated agricultural policies negotiated under NAFTA.[1] There were conflicting predictions whether NAFTA would benefit or hurt the sugar industry in the United States. For example, Daniel Sumner, who at the time was assistant secretary of agriculture for economics at U.S. Department of Agriculture, elaborated "NAFTA promises positive gains" for the U.S. sugar industry because: (*a*) access to the Mexican market will improve; (*b*) U.S. production is more efficient than that of Mexico; and (*c*) higher income growth in Mexico resulting from NAFTA will stimulate consumption of sugar.

However, opponents of NAFTA suggested that the U.S. sugar industry is likely to lose. For example, Markwart, executive vice president of American Sugarbeet Growers Association, (p. 2) argued that NAFTA is "a blueprint for disaster for the U.S. sugar program and for the devastation of our domestic sugar industry." In support of his conclusion, Markwart reasons, (*a*) by creating a free trade zone, Mexico will become more cost competitive in sugar production because of the availability of better technology, new investments, and a lower wage structure; (*b*) NAFTA will cause an increase in sugar prices which will decrease the demand for sugar in Mexico and make more sugar available for export to the United

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[1]The effects of NAFTA on citrus and vegetables also received increased attention.

States; and (*c*) the establishment of a corn sweetener market and the substitution of high fructose corn syrup (HFCS) for sugar in Mexico will decrease Mexican sugar consumption and increase the amount of raw sugar available for export to the United States. Similar conclusions were also reached by Fleming (p. 22) who noted that the use of HFCS will cause Mexico to switch from net importing to exporting status, "thereby impairing the ability of the U.S. government to operate the sugar program . . . ."[2]

NAFTA became effective 1 January 1994. As NAFTA is being implemented, it is important, given the significance of the sugar industry, to predict the potential effects of sugar trade reforms on production, consumption, and prices and the resulting implications for U.S. sugar imports from Mexico and other countries. This article uses the theoretical analysis of economic integration to quantify the impacts of NAFTA on the U.S. and Mexican sugar markets. NAFTA sugar trade reforms present an ideal case for examining trade creation (TC) and trade diversion (TD) effects because U.S. imports from Mexico could displace domestic production, meet increases in demand (TC), and also replace imports from other foreign suppliers (TD). The objective of this study is accomplished by estimating a world sugar trade model consisting of 21 countries/regions. For each country, important components of supply and demand are estimated by incorporating *domestic and trade policies* and modeling sugar substitutes.

NAFTA Policy Provisions

The following NAFTA policy provisions include the side agreements negotiated in November 1993. The primary source of these policies is the USDA (1992). NAFTA sugar trade reforms have a 15-year transition period.

1. In the first six years, Mexico's sugar exports to the United States will be restricted to 7,528 metric tons (MT). However, if Mexico becomes a net exporter in any of these six years, it will be given access to the U.S. market for its net exportable surplus up to 25,000 MT.
2. After the first six years, Mexico can export up to a maximum of 250,000 MT of its net exportable surplus to the United States. Mexico will not have unlimited access to the U.S. market as in the original negotiation. Corn sweetener will be included on the consumption side in computing Mexico's production surplus.
3. In the first six years, the United States will reduce its second tier tariff on sugar imports from Mexico by 15%.
4. By year seven, Mexico will align its tariff and tariff-quota rates with those of the United States. In the remaining years, the U.S. and Mexican tariffs on bilateral trade will be phased out linearly.
5. If increased imports from Mexico affect the U.S. price support program, imports from other countries will be reduced.
6. The U.S. sugar reexport program will remain in place for exports to Mexico, but U.S. shipments will be subject to Mexico's most favored nation (MFN) tariff rate.
7. Canada and Mexico will preserve their tariffs on bilateral trade in sugar.

The policy parameters are incorporated in the simulation to analyze the effects of NAFTA, trade creation, and trade diversion.

[2]However, the side agreement negotiated in November 1993 includes corn sweetener on the consumption side in computing Mexico's production surplus. This side agreement should reduce Mexico's production surplus and, thus, the amount available for export to the United States.

Theoretical Analysis of Trade Creation and Diversion

Economic integration due to forming regional free trade zone induces trade creation and diversion, which will lead to resource reallocations. TC occurs as imports from a member country resulting from eliminating trade barriers displace domestic production and meet demand expansion, and TD occurs when goods imported from a member country replaces imports from nonmember countries (Wilford). Although TC and TD are studied under a static framework, the long-run effects of economic integration can arise from efficient reallocation of resources, specializations, structural changes, and economic growth. (Gernant; Wilford). However, studies have analyzed the effects of regional free trade over a period on the volume of trade creation and diversion only for a particular good (see, for example, Pelzman). Our study, along the line of Pelzman, examines the trade creation and diversion effects of NAFTA on the U.S. sugar market.

In figure 1, panel A depicts the U.S. domestic market with supply (S_{US}) and demand (D_{US}).[3] Panel B depicts the international market facing the United States. Considering the United States as a large importer of sugar,[4] a positively sloped excess supply for the rest of the world (ES_{ROW}) is drawn.[5] A positively sloped Mexican excess supply of sugar (ES_{MEX}) is drawn above the ES_{ROW} indicating that Mexico is a relatively less-efficient and higher-cost sugar producer than the other exporting countries. A negatively sloped U.S. excess demand curve (ED_{US}), which is the difference between domestic demand and supply, is also drawn.

The U.S. implements a tariff-rate quota system to restrict sugar imports. In this theoretical discussion, we consider, for expositional convenience, an import tariff to illustrate the TC and TD concepts. Suppose the United States imposes an import tariff equal to $\$t$ per ton of sugar imports. In response to this tariff, the excess demand will shift down to ED'_{US} because the tariff adds additional cost to sugar imports, and thus, importers demand less of the imported sugar. With the tariff level of $\$t$, imports are restricted to the amount ab in panel A or $a'b'$ in panel B. The domestic market price in the United States is the world price plus the tariff $(P_w + t)$. This higher domestic price helps to maintain the domestic price support to producers. The tariff revenue accruing from this import tariff policy is the shaded rectangular area in panel A. From panel B, since ES_{MEX} intersects the vertical axis at P_w,[6] all the U.S. imports come from the rest of the world (ROW) and none from Mexico because Mexico is a relatively high-cost supplier of sugar compared to other exporting countries.[7]

Next, TC and TD of U.S. sugar imports from ROW to Mexico are discussed in figure 2. NAFTA will phase out the tariff on Mexican sugar exports to the United States. The free trade agreement between the United States and Mexico, coupled with U.S. restrictions on imports from other countries, will give Mexico preferential access to the U.S. market with lower trade barriers during the transition period and, eventually, free access after the

[3]The following analysis abstracts from transportation costs for expositional convenience.

[4]Houck presents a model for analyzing trade preference using a small importing country assumption.

[5]The rest of the world does not include Mexico. For ease of theoretical exposition, other exporting and importing countries are aggregated as the rest of the world (ROW) and the ensuing analysis is carried out in a three-country (the United States, Mexico, and ROW) framework. However in the empirical section, a detailed country-level disaggregation is presented and analysis is conducted in a 21-country framework including all major exporters and importers.

[6]It should be noted that at *Pw* Mexico neither exports to the United States nor imports from ROW. However, Mexico would be a net exporter of sugar at free-trade world price, which is consistent with the sugar market conditions because Mexico was an exporter in the 1960s, 1970s, and some years in the 1980s.

[7]We thank an anonymous reviewer for helpful comments on figures 1, 2, and 3 in an earlier version of this article.

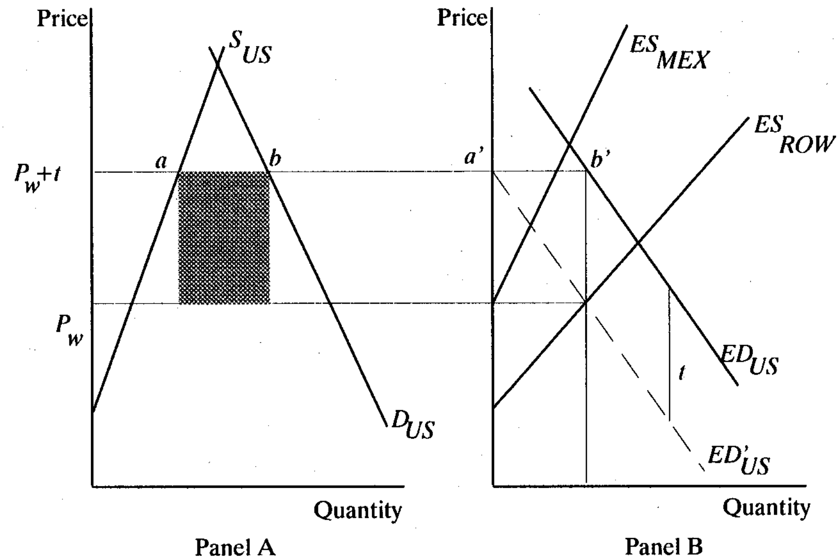

Figure 1. Graphical illustration of sugar trade

transition period. To ease the theoretical expositions, the following analysis is conducted by assuming that Mexico has free access to the U.S. market. Thus, as in figure 2 which depicts the U.S. domestic market, the total sugar supply in the United States is its domestic supply (S_{US}) plus the export supply from Mexico (ES_{MEX}). Since the United States is a large importing country, free entry of Mexico's sugar, in lieu of ROW's sugar, will depress the world price because it will shift the U.S. import demand curve downward and to the left. This results in the new world price $P_w' < P_w$ and also $P_w' + t < P_w + t$. The price decline from P_w to P_w' causes U.S. production to decrease. If imports from Mexico are equal to decreases in U.S. production (not depicted in fig. 2), the displacement of U.S. production by imports from Mexico is called trade creation. Furthermore, as prices decrease, demand in the United States increases, which will lead to an increase in total imports (that is, imports from ROW and Mexico).

If imports from Mexico are greater than the decrease in U.S. production, as depicted in figure 2, then both TC and TD will occur. At $P_w' + t$ in figure 2, the quantity of domestic supply is equal to *cd*, imports from Mexico are equal to *df*, and imports from ROW are equal to *fh*. The displacement of U.S. production by imports from Mexico is trade creation, which is equal to *de*. In addition, imports from ROW at $P_w' + t$ (equal to *fh*) are less than the pre-NAFTA imports of *ab*, and trade diversion equal to $ab - fh$ (or equally $ef - gh$) will occur. Because of the free access of Mexico's sugar exports to the United States, $ef - gh$ amount of sugar that could be imported from ROW is diverted to Mexico. If Mexican exports to the United States are relatively high, then TD will occur because one of the NAFTA provisions specifically states that if increased imports from Mexico affect the U.S. price support program, imports from other countries will be reduced. Furthermore, expansion in demand at $P_w' + t$ is met by imports equal to *gh*, which is also TC. In sum, TC is equal to $de + gh$ and TD is equal to $ef - gh$. U.S. producers will lose and consumers will gain to the extent domestic price declines from $P_w + t$ to $P_w' + t$.

Markwart argues that NAFTA provides Mexico with access to improved technology, lower-priced inputs, and new investments and will allow Mexico to substitute HFCS for

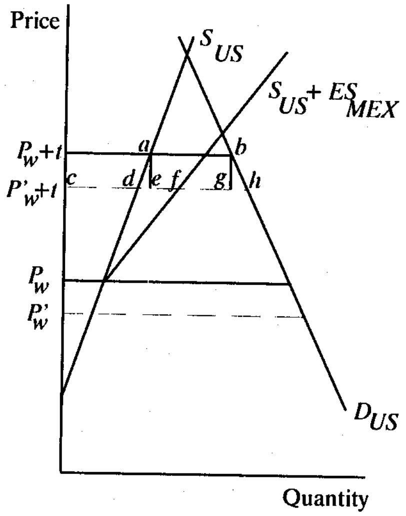

Figure 2. Trade creation and diversion
Note: $de + gh$ = amount of trade creation
$ef - gh$ = amount of trade diversion

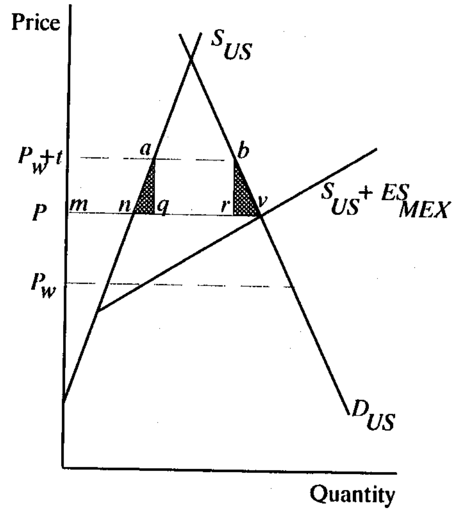

Figure 3. Trade creation and diversion
Note: $nq + rv$ = amount of trade creation
qr = amount of trade diversion

sugar, which will cause Mexico to become a permanent net exporter of sugar to the United States and lead to a significant decrease in U.S. sugar production. If such an increase in Mexico's exports to the United States occurs, Mexico's excess supply in figure 2 will shift further down, and P'_w and $P'_w + t$ will continue to decline. During this process both TC and TD will occur.

Continued increase in Mexico's exports will cause ES_{MEX} to shift down towards a point such as v in figure 3, where $S_{US} + ES_{MEX}$ intersects D_{US}, at which there would be no imports from ROW and price declines will end. At v, imports from ROW are completely replaced by imports from Mexico and TD from ROW to Mexico is said to be complete. As a consequence of complete TD, ROW is totally shut out and Mexico's exports to the United States are equal to nv. Thus, the total sugar supply in the United States is equal to mn from the domestic market and nv from Mexico. Because of the price decline, the new domestic price P in figure 3 is less than the price $P'_w + t$ in figure 2. Consequently, domestic production falls from point a to n on the U.S. supply curve and demand increases from point b to v on the demand curve. The total TD equals $ab\,(= qr)$ and TC equals $nq + rv$. The two shaded triangles in figure 3 measure social gains as a result of these TD and TC processes. The area naq represents an increase in production or technical efficiency as resources are moved from less efficient sugar production to other more productive uses. The area rbv measures the gain in consumer surplus as U.S. consumers are able to consume more at a lower price.

World Sugar Trade Model

This section describes the structure of a nonspatial equilibrium world sugar trade model and provides detailed information about data, country coverage, and model estimation. The basic elements of such a model in a partial equilibrium framework are illustrated graphically in figure 4. The U.S. excess demand curve (ED_{US}) is the difference between domestic demand (D_{US}) and supply (S_{US}) and represents the quantity of imports at various price levels demanded from the world market. Exporters' supply and demand schedules are given in the lower panel. The curve *EST* is the combined excess supply of all the exporters, which is the difference between the supply and demand of all the exporters. The excess demand curve (*EDO*) of all other importers is the difference between their total demand and total supply. Exporters' export supply (*EST*) and importers' import demand (*EDO*) are represented in the top panel under the title "Foreign Trade." The excess supply curve (*ESN*) facing the U.S. is the difference between the export supply (*EST*) of all exporters and the import demand (*EDO*) of all other importers. A trade equilibrium is achieved by equating excess demand of the United States to the net excess supply of all other countries, which also equates the excess demands and supplies generated from all the countries. This graphical analysis is illustrated using a free trade framework for ease of exposition. However, the world sugar market is hardly a free trade market. The theoretical and empirical model presented below incorporates the important features of domestic and trade policies of major exporters and importers.

Theoretical Model

The algebraic formulations of the necessary components of the world sugar trade model are described here.

Exporters. The domestic demand for sugar in the *i*th ($i = 1, \ldots, n$) exporting country is specified as:

$$SUD_i = D_i(SP_i, Y_i, ZP_i, X_{1i}). \tag{1}$$

Domestic demand for sugar (SUD_i) is determined by own price (SP_i), income (Y_i), substitute price (ZP_i) such as HFCS price, and a vector of country-specific demand shifters (X_{1i}) that explain food use. Thus, the theoretical specification for demand is based on consumer theory.

The domestic stock demand for sugar in the *i*th exporting country is specified as:

$$SUSD_i = SD_i(SP_i, SUPD_i, GP_i, X_{2i}). \tag{2}$$

The behavioral relationship of stock demand ($SUSD_i$) reflects speculative and transactive motives of inventory demand. The stock demand is determined by own price (SP_i), current production ($SUPD_i$), government stock policies (GP_i), and a vector of shift variables (X_{2i}).

Domestic supply is determined by estimating acreage functions. The acreage function in the *i*th exporting country is specified as:

$$SUAC_i = AC_i(SP_i, LSP_i, GSP_i, CP_i, X_{3i}). \tag{3}$$

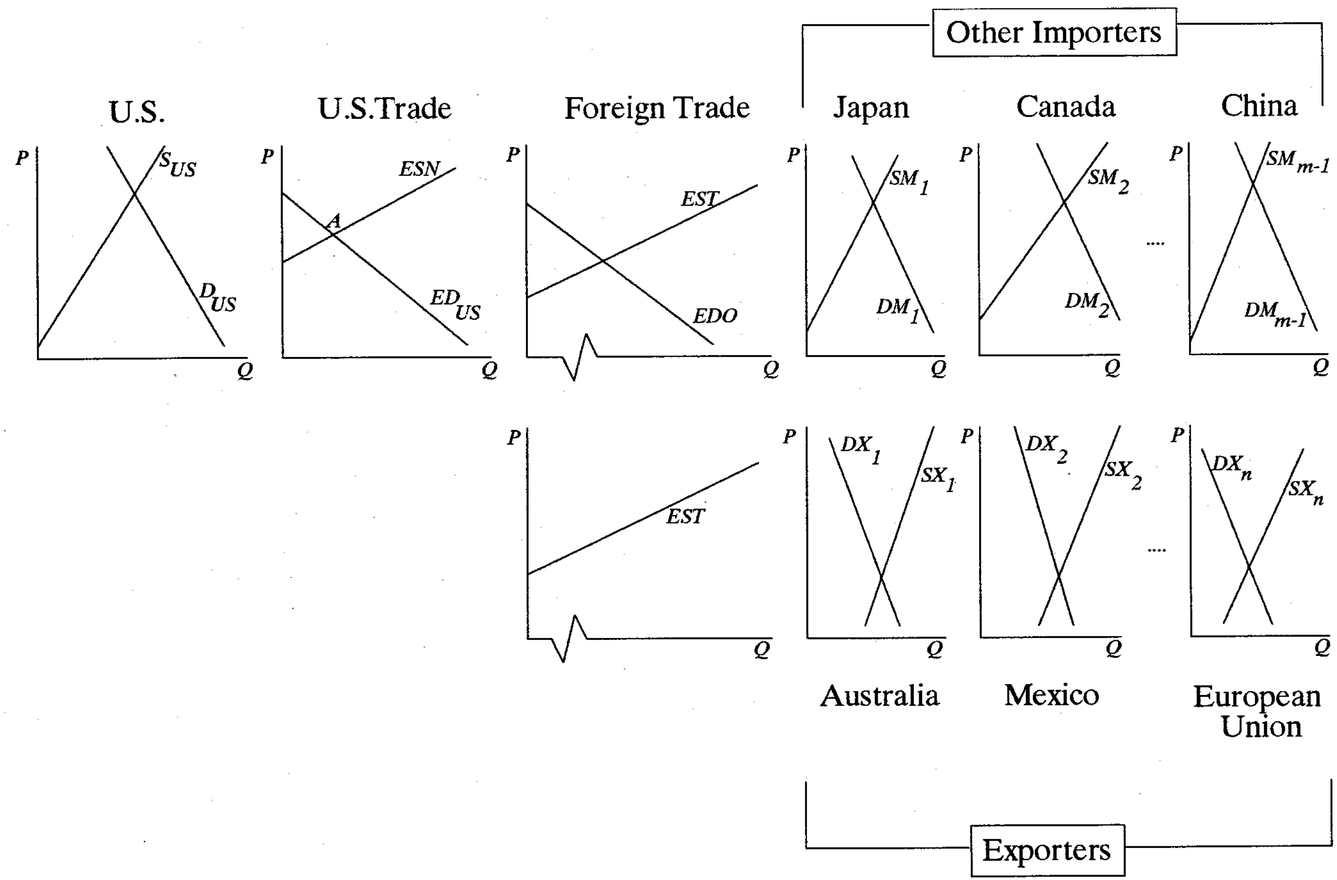

Figure 4. Illustration of a nonspatial equilibrium world sugar model

The acreage ($SUAC_i$) is determined by current price (SP_i), lagged price (LSP_i), government price supports (GSP_i), competing crop prices (CP_i), and a vector of country-specific supply shifters (X_{3i}).

Sugar supply in the ith exporting country ($SUSY_i$) is yield ($SUYD_i$) times acreage times extraction rate (ER_i) plus beginning stocks ($SUSD_{i,t-1}$). Thus,

$$SUSY_i = SUAC_i\ SUYD_i\ ER_i + SUSD_{i,t-1}. \tag{4}$$

The excess supply of sugar by the ith exporting country is the sum of domestic supply minus domestic demand. Thus, the export supply ($SUES_i$) is given as:

$$SUES_i = SUSY_i - SUD_i - SUSD_i. \tag{5}$$

If an exporting country pursues border intervention policies such as export subsidies to increase its exports, then an export supply function is explicitly estimated. The total export supply of all the exporters ($SUEST$) is the sum of each country's export supply:

$$SUEST = \sum_{i=1}^{n} SUES_i. \tag{6}$$

This function is comparable to the EST curve in figure 4.

Importers. The $m(j = 1, \ldots, m)$ importing countries include the United States. The notations used for describing the supply and demand functions of the exporting countries can also be used for the importing countries with two modifications. First, the subscript i is changed to j to denote the importing country. Second, the m number of importing countries is divided into $m-1$ other importers and the United States as shown in figure 4. The subscript j denotes the $m-1$ countries and u represents the United States. With these modifications the sugar excess demand by the jth importing country ($SUED_j$) and the United States ($SUED_u$) is given by:

$$SUED_j = SUD_j + SUSD_j - SUSY_j, \text{ and} \tag{7}$$

$$SUED_u = SUD_u + SUSD_u - SUSY_u. \tag{8}$$

As with the exporting countries, if an importing country pursues border intervention policies such as quotas and tariffs, then an import demand function is explicitly estimated.

The sum of excess demands of the other $m-1$ importers is

$$SUEDO = \sum_{j=1}^{m-1} SUED_i. \tag{9}$$

This function is comparable to the EDO curve in figure 4.

The net excess demand ($SUESN$) facing the United States is the difference between the excess supply of exporters minus excess demand of the other importers:

$$SUESN = SUEST - SUEDO. \tag{10}$$

This function is comparable to the *ESN* curve in figure 4.

The world market equilibrium for sugar is determined by equating the excess demand of the United States to the net excess supply of all other countries. Thus,

$$SUHED_u = SUESN. \tag{11}$$

This world market equilibrium corresponds to point *A* in figure 4.

Price linkage equations are specified to account for the transportation costs, exchange rate differences between countries, and trade policies. The price linkage equations for the importing and exporting countries and the United States are

$$SP_i = SP_i(WSP\, e_i, Z_i) \qquad i = 1, \ldots, n, \tag{12}$$

$$SP_j = SP_j(WSP\, e_j, Z_j) \qquad j = 1, \ldots, m-1, \tag{13}$$

$$SP_u = SP_u(WSP, Z_u), \tag{14}$$

where *WSP* is the world sugar price, e_i is the exchange rate between country *i* and the currency (dollar) used to represent the world price. The vectors Z_i represent transportation costs and trade policies such as import tariffs, quotas, and export subsidies.

Because of the growing importance of HFCS in the caloric sweetener industry, the HFCS market is also explicitly modeled.

Empirical Model

The model consists of 21 countries/regions. The exporting countries/regions included in the model are Australia, Brazil, Cuba, the European Union, India, South Africa, Thailand, other Central America, and other South America. The importing countries/regions are the United States, Canada, Japan, Mexico, Indonesia, China, the former Soviet Union, Eastern Europe, other Western Europe, other Asia, other Africa, and ROW. The high disaggregation allows the market structure of most of the countries/regions participating in the world sugar market to be adequately captured.

This large-scale model allows incorporating the influence of domestic and trade policies on production, consumption, stocks, and trade. Furthermore, incorporating government intervention policies allows accurate capturing of the effects of trade liberalization. The model includes the dynamic behavior of the sugar market, which captures the adjustments in the endogenous variables over time in response to policy changes. The influence of macroeconomic variables (exchange rates, interest rates, inflation rates, and GNP) and time lags in production are also explicitly modeled.

Data for production, consumption, exports, imports, and ending stocks are obtained from the Economic Research Service and the Foreign Agricultural Service of the U. S. Department of Agriculture.[8] Data for area harvested, yield, and extraction rates are obtained from the

[8]We acknowledge Ron Lord of the Economic Research Service of the U.S. Department of Agriculture for providing some of the data and sources for additional variables.

Food and Agricultural Organization of the United Nations (FAO). Macroeconomic data such as income, population, and exchange and inflation rates are obtained from the International Monetary Fund (IMF). The estimation period includes the years 1970 to 1992.

For each country, functional relationships for supply and demand components and price linkage equations are estimated. The estimation of the supply side consists of sugarcane or sugarbeet area planted and a total sugar production equation which is the product of the area planted, the extraction rate, and the yield. For some countries, the supply side also includes the estimation of sugar imports. The estimation of the demand components consists of sugar consumption and ending stocks. For some countries, sugar exports are also estimated. The price linkage equation links the domestic price to the world price. As specified in the theoretical model, for each country net excess demand or excess supply is derived and the world market equilibrium is established by equating the net import demand of all the importers and net export supply of all the exporters.

Since the model incorporates considerable details such as country-level disaggregation, HFCS sector, domestic and trade policies, macroeconomic factors, and unique characteristics of beet and cane production, a rigorous analysis can be conducted to accurately estimate the effects of NAFTA trade liberalizations.

The model includes a total of 82 endogenous equations and 21 market-clearing equations, which determine 103 endogenous variables and use 205 exogenous variables. Both linear and nonlinear techniques are used in estimating the endogenous equations. The values of R^2 for various equations and the simulation results indicate that the model is suitable for policy analysis. Because of the space limitations, the complete empirical model could not be included in the text. However, readers interested in the modeling approach, estimated equations, structural coefficients, elasticities, and simulation analysis are referred to Kropf.

We report the estimated supply and demand elasticities for various countries in table 1, which represent behavioral relationships in the model, and compare the elasticity estimates with those from past literature. The estimated own-price supply elasticity for sugarbeet in the United States is 0.215 and cross-price (wheat price) elasticity is –0.077. The own-price beet supply elasticity is comparable with the estimates reported by Lopez at 0.246 and Vroomen at 0.280 (also, see Messina and Seale). Haley, Vivien, and Sigua estimated beet supply elasticities for various regions of the United States, ranging from 0.02 to 1.51. Sudaryanto's estimate for an earlier period is 0.70. The estimated own-price elasticity for cane in the United States is 0.054, cross-price (cotton price) elasticity is –0.05 and input price elasticity is –0.046. The own-price cane elasticity is very inelastic because of the ratooning practices for sugarcane, which limits the acreage adjustment to price changes. This inelastic estimate is comparable with the elasticity reported by Lopez at 0.103, Vroomen at 0.135, Leong at 0.16, and Sudaryanto at 0.17. Haley, Vivien, and Sigua estimated cane supply elasticity for four states (Florida, Hawaii, Louisiana, and Texas), which range from 0.04 to 0.62. Wong, Sturgiss, and Borrell estimated an aggregate U.S. sugar supply elasticity at 0.221. The estimated own-price consumption elasticity is –0.042 and income elasticity is 0.254. The own-price elasticity estimate is very similar to the ones reported by Wong, Sturgiss, and Borrell at –0.048, Vroomen at –0.114, and Lopez at –0.141. The income elasticity estimate is comparable to that of Wong, Sturgiss, and Borrel's 0.287.

Empirical Results

In this section, details about baseline and NAFTA projections and impacts, particularly as they relate to trade creation and diversion, are presented. To examine the effects of NAFTA,

Table 1. Estimated Supply and Demand Elasticities from the World Sugar Trade Model

	Supply Elasticities			Demand Elasticities		
				Consumption		Stocks
Country/Region	Own Price	Cross Price[a]	Input Price	Own Price	Income	Own Price
United States				–0.042	0.254	–0.157
Beet area	0.215	– 0.077				
Cane area	0.054	– 0.050	– 0.046			
European Union					0.304	– 0.005
Quota A	0.228					
Quota B	0.223					
C–Sugar	0.215					
Australia	0.066	– 0.184		– 0.041	0.044	– 0.230
Brazil	0.085	– 0.619		– 0.012	0.812	– 0.302
Canada	0.140	– 0.196		– 0.066	– 0.195	– 0.283
Indonesia	0.320		– 0.196	– 0.085	1.247	– 0.120
India	0.978		– 0.061	– 0.020	0.117	– 0.220
Japan	0.336			– 0.002		
Mexico	0.891			– 0.019	0.246	– 0.022
South Africa	0.047		– 0.002	– 0.013	0.425	
Thailand	0.138		– 0.007	– 0.023	0.009	– 0.041
Eastern Europe	0.025			– 0.020		
Western Europe	0.712		– 0.012	– 0.021		– 0.101
Asia	0.144			– 0.121	0.414	– 0.072
Africa	0.017			– 0.015		
Central America	0.008			– 0.016		
South America	0.018		– 0.061	– 0.478		

[a]The cross prices include wheat for U.S. beet, cotton for U.S. cane, wheat for Australia and Canada, and ethanol for Brazil.

a baseline scenario is run to project the endogenous variables over the period of 1994 to 2007 by using the forecast values of the exogenous variables. The forecast values of the exogenous variables are derived from various sources: GDP, GDP deflator, exchange rates, commodity production, and prices are obtained from the Food and Agricultural Policy Research Institute (FAPRI). Population forecasts are obtained from the USDA (1993). Crude oil prices and coffee prices come from a World Bank report. The baseline values of the endogenous variables serve as a benchmark to measure the effects of the trade liberalization.[9]

NAFTA will have general effects on the economies of the United States, Mexico, and Canada, which will also have impacts on the sugar markets. Some of these impacts include changes in income, technology, input prices, and the availability of HFCS in Mexico. The

[9]This baseline scenario includes the Uruguay Round (UR) policy parameters. Since these UR provisions will be followed by the GATT member countries, inclusion of the UR parameters in the baseline will help to isolate the effects of NAFTA.

policy provisions negotiated under NAFTA along with the assumptions of these variables are incorporated into the world sugar trade model, and the NAFTA scenario is run for the period of 1994 to 2007. The NAFTA analysis predicts the effects on U.S. cane and beet area, sugar production, consumption, stocks, imports, and HFCS production and consumption; on Mexico's sugar production, consumption, stocks, and trade; and on major exporters' and importers' supply and demand components (some of these results are reported in table 2). In the interest of brevity, however, we focus our discussion on the trade creation and diversion effects of NAFTA by supplementing the discussion with the results of supply and demand changes in the United States and Mexico. The theoretical model explained earlier presents the trade creation and diversion effects in a static framework. However, the empirical model is capable of analyzing these effects in a dynamic framework, and thus, the results presented below examine these effects over the NAFTA transition period.

NAFTA's most significant effect on the sugar market is the increase in Mexican sugar production by an average of about 11.4% per year over the baseline productions. This increase is caused by Mexico's opportunity to import improved U.S. technology, lower-priced inputs such as fertilizer, and the increased availability of U.S. capital to modernize Mexican production facilities. The increase in sugar production ranges between 1.6 and 8.4% during the first six years of NAFTA and reaches between 12.3 and 20.7% after the year 2000 when Mexican sugar production becomes more efficient. The effect on sugar consumption in Mexico is relatively small although the total caloric sweetener consumption increases significantly. This result occurs because with the increased availability of HFCS from the U.S. market HFCS is substituted for sugar.

Since sugar production increases surpass consumption increases, the world sugar price experiences very slight decreases, an average of 0.2 cents per pound below baseline values. Consequences of these production and consumption changes are that Mexico increases its total sugar exports and switches from net importer to net exporter status in 1995 even if HFCS is included in the demand side in the calculation of the net exportable surplus.

Mexico increases its total sugar exports by an average of 138,000 MT per year over the baseline export levels. After becoming a net sugar exporter, Mexico can export its surplus to the United States up to the amount allowed under NAFTA which invokes the possibility of trade creation and diversion. From 1995 to 1996, Mexico will export about 20,000 MT per year to the United States which is below the NAFTA limit of 25,000 MT. In these initial years, the effects of NAFTA on the Mexican sugar production are small and do not lead a production increase strong enough to fill the allowed export quota to the United States. Beginning in 1997, NAFTA impacts on Mexico's sugar production will be more effective and Mexico will be able to export 25,000 MT per year, the maximum allowed for the first six years of NAFTA. A similar development occurs during the second part of the transition period when the export quota for Mexico is raised to 250,000 MT. From the year 2000 to 2004, Mexico's sugar production will increase slowly, but Mexico will not be able to fill the quota. By 2005, Mexico's sugar production should be large enough to fill the quota, which will result in exports to the United States by 250,000 MT, the maximum allowed per year for the second part of the transition period.

NAFTA has a small influence on the U.S. sugarcane and sugarbeet areas which decrease by an average of about 0.02 and 0.7% per year, respectively, compared to the baseline areas. The decline in cane and beet area causes a decrease in total domestic sugar production of about 1% per year below the baseline estimates. This decrease in production arises from trade creation, that is, Mexico's imports displace U.S. production. This trade creation is

Table 2. Baseline Projections and NAFTA Impacts on the U.S. and Mexico Sugar Markets

Variables	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
United States														
Sugarcane (base) area (1,000) acres	841.60	836.76	832.80	830.03	828.80	828.04	826.57	828.55	829.05	830.47	832.22	833.36	835.46	837.92
NAFTA impacts (%)	0.00	−0.00	−0.02	−0.03	−0.03	−0.02	−0.03	−0.02	−0.02	−0.02	−0.02	−0.01	−0.01	−0.01
Sugarbeet (base) area (1,000) acres	1383.15	1392.30	1364.47	1338.30	1332.31	1321.66	1297.22	1270.26	1238.80	1206.18	1176.62	1144.47	1110.28	1077.75
NAFTA impacts (%)	−0.04	−0.24	−0.61	−0.86	−0.85	−0.89	−0.98	−0.94	−0.89	−0.87	−0.84	−0.77	−0.74	−0.72
Sugar (base) production (1,000 MT)	6670.66	6679.55	6616.69	6561.29	6564.20	6519.13	6435.24	6330.40	6226.14	6176.56	6128.79	6108.65	6048.86	6013.35
NAFTA impacts (%)	−0.02	−0.13	−0.19	−0.27	−0.40	−0.34	−0.54	−0.52	−0.48	−1.27	−2.07	−2.36	−2.35	−2.68
Sugar (base) demand (1,000 MT)	9662.64	9632.19	9660.16	9857.69	9936.63	10038.84	10082.39	10277.42	10436.49	10538.21	10572.01	10680.12	10808.11	10911.98
NAFTA impacts (%)	0.05	0.17	0.03	0.05	0.63	1.12	1.47	1.13	0.99	1.02	0.84	0.97	1.25	1.28
Imports (base) from ROW (1,000 MT)	1661.31	1702.23	1907.45	2113.92	2079.06	2185.42	2322.73	2581.42	2788.88	2844.45	2847.26	2955.36	3127.66	3224.16
NAFTA impacts (%)	−0.06	0.32	−0.30	−0.22	2.92	4.96	4.45	0.46	−0.34	−0.85	−0.84	−0.19	0.79	1.49
NAFTA imports from Mexico (1,000 MT)	7.50	19.70	20.49	25.00	25.00	25.00	56.91	109.81	119.78	204.17	236.21	250.00	250.00	250.00
US sugar price (cents/lb.)	21.86	20.14	18.14	20.33	20.51	20.60	20.43	20.42	20.32	20.82	20.24	20.40	19.86	20.64
NAFTA impacts (cents/lb.)	−0.06	−0.27	−0.39	−0.16	−0.09	−0.28	−0.14	−0.12	−0.10	−0.15	−0.08	−0.07	−0.15	−0.05
Mexico														
Sugar (base) production (1,000 MT)	3744.33	3750.87	3756.69	3762.51	3768.07	3773.35	3778.83	3784.31	3789.82	3803.77	3816.63	3818.21	3816.68	3828.68
NAFTA impacts (%)	1.64	3.17	4.34	5.12	6.97	7.30	8.35	12.25	16.19	17.15	17.62	18.10	20.72	20.67
Sugar (base) consumption (1,000 MT)	3865.43	3898.31	3945.79	3979.16	4022.70	4075.58	4135.68	4148.97	4167.25	4214.52	4218.06	4234.64	4238.04	4260.72
NAFTA impacts (%)	0.02	0.54	0.64	0.67	0.93	1.13	1.85	1.45	0.91	1.33	1.14	0.50	0.53	0.11
NAFTA exports to US (1,000 MT)	7.50	19.70	20.49	25.00	25.00	25.00	56.91	109.81	119.78	204.17	236.21	250.00	250.00	250.00
Net exports under NAFTA (1,000 MT)	−5.91	19.70	20.49	27.58	38.68	79.01	56.91	109.81	119.78	204.17	236.21	311.06	371.04	344.51
Word sugar price (cents/lb.)	15.06	13.18	10.62	13.43	13.66	13.77	13.56	13.54	13.42	14.05	13.31	13.51	12.82	13.82
NAFTA impacts (cents/lb.)	−0.08	−0.35	−0.50	−0.20	−0.12	−0.35	−0.18	−0.15	−0.13	−0.19	−0.11	−0.09	−0.19	−0.06

caused by a decline in the price which arises because the United States as a large country can depress the world price by shifting its imports from other quota holders to Mexico. The decrease in U.S. production and trade creation are smaller in the initial years (an average of about 10,220 MT in 1994–97) but larger towards the end (an average of about 143,600 MT in 2004–07) of the NAFTA transition period because Mexican exports to the United States are lower in the beginning than in the end of the trade liberalization period.

The U.S. sugar demand is projected to increase slightly, as a result of price declines and income increases. This increase in sugar demand is about 0.8% per year higher than the baseline demand levels. The increase in demand is met by imports from Mexico and ROW. The portion of imports from Mexico that is used to meet demand expansion is also trade creation, which increases from an average of about 5,940 MT in 1994–97 to 98,670 MT in 2004 – 07.[10] The total trade creation from production contraction and demand expansion, which averages about 115,940 MT per year, is plotted in figure 5.

Next, the trade diversion of U.S. imports from ROW to Mexico is examined. Between 1994 and 1996, Mexico's exports to the United States increase by an average of about 15,897 MT per year, which is below the allowed quota limit. But in 1997, Mexico is able to export 25,000 MT, the maximum amount for the first six years of NAFTA. In 1996 and 1997, since the U. S. imports are partly supplied by Mexico, the United States reduces its imports from other quota holders by 5,690 MT in 1996 and 4,750 MT in 1997. These decreases in exports to the United States by other exporters are the consequences of the trade diversion from other exporters to Mexico resulting from the NAFTA trade preference provided by the United States to Mexico (fig. 5).

In 1998 and 1999 Mexico continues to export to the United States the allowable limit of 25,000 MT. However, in these years the U.S domestic demand is strong enough to warrant additional import increases from other exporters. Consequently, the United States increases its imports from other exporters by about 60,810 MT in 1998 and 108,480 MT in 1999 above the baseline levels. In these two years, trade diversion from other exporters to Mexico does not occur, but trade creation resulting from the demand expansion and production decline does.

After the sixth year of the transition period, that is, beginning year 2000, the Mexican export quota is increased to 250,000 MT. Responding to this higher quota and coupled with increased production efficiency resulting from NAFTA, Mexico is able to increase its exports modestly in the years 2000 to 2007. From 2000 to 2004, Mexico's net exports increase from 56,910 MT to 236,210 MT, which are below the NAFTA provision's allowable limit. By 2005, Mexico will export 250,000 MT to the United States, the maximum amount for the second part of the transition period. As the United States gets some of its imports from Mexico in these years, the need to import from other exporters decreases. Consequently, other U.S. quota holders' exports to the United States decrease in these later years. In particular, other countries' exports to the United States are reduced by 9,460 MT in 2002; 24,100 MT in 2003; 23,880 MT in 2004; and 5,500 MT in 2005. These reductions in imports from other countries are diverted to Mexico which increases its market share of the U.S. sugar market under NAFTA. The trade diversion effects in these later years are more pronounced than those in 1996 and 1997 because Mexico's export quota is higher in the second part of the transition period.

[10]Imports from other foreign suppliers used to fulfill the U.S. demand can also be included in computing trade creation. However, to isolate the effects of Mexican imports, we report only the portion of imports from Mexico as part of the trade creation arising from the demand expansion.

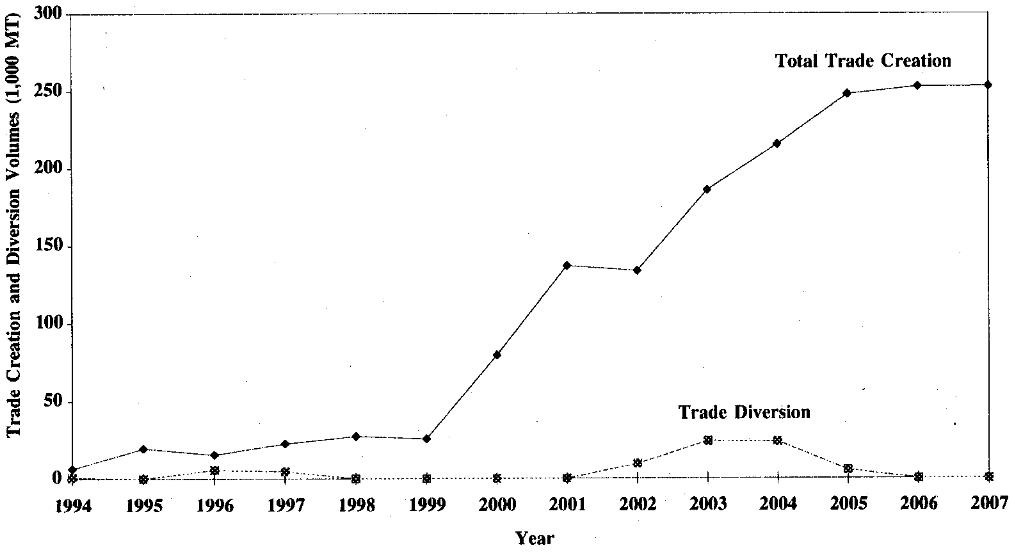

Figure 5. Trade creation and diversion of U.S. imports from Mexico

In years 2006 and 2007, trade diversion does not occur because U.S. demand increases in these years, and Mexico cannot increase its exports under NAFTA beyond the allowable limit of 250,000 MT. Consequently, the United States has to increase its imports from other exporters to meet its domestic demand in these two years. Because of the expansion in demand, trade creation of 110,250 MT in 2006 and 91,920 MT in 2007 occurs. It should be noted that Mexico's exports to the United States do not fully eliminate U.S. imports from other exporting countries, implying that trade diversion is not complete.

Conclusions

NAFTA increases Mexican sugar production as a result of the availability of improved U.S. technology, new investments, and lower-priced inputs. Higher production allows Mexico to increase its total exports and to become a net exporter beginning in 1995.

Because of NAFTA's preferential treatment, Mexico will export sugar to the United States, which results in trade creation and diversion of U.S. imports from other foreign suppliers to Mexico. However, the volume of trade creation and diversion are relatively small. Consequently, the effects of NAFTA on the U.S. sugar market are also relatively small because of the side agreement provisions which limit the amount of Mexico's exports particularly in the second half of the transition period and includes HFCS as a demand component in computing Mexico's net exportable surplus. If this side agreement had not been negotiated, the effects of NAFTA on the U.S. sugar market would have been more pronounced. Finally, the potential gainers from NAFTA sugar trade reforms are Mexican producers, the U.S. HFCS industry, and U.S. sugar consumers. The losers are other U.S. foreign suppliers. U.S. producers are also affected because of production declines; however, these declines are very small.

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