



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*



*International Food and Agribusiness Management Review*  
*Volume 13, Issue 4, 2010*

## **Trade Liberalizing Impacts of NAFTA in Sugar: Global Implications**

Ronald D. Knutson,<sup>ⓐ</sup> Patrick Westhoff,<sup>ᵇ</sup> and Pablo Sherwell<sup>ᶜ</sup>

<sup>ᵃ</sup>*Professor Emeritus, Agricultural and Food Policy Center, Department of Agricultural Economics,  
Texas A&M University, 450 Blocker Building, College Station, Texas, 77843-2124, U.S.A.*

<sup>ᵇ</sup>*Co-Director, Food and Agricultural Policy Research Institute, Department of Agricultural Economics,  
University of Missouri, 101 Park DeVille Drive, Suite E., Columbia, Missouri, 65203, U.S.A.*

<sup>ᶜ</sup>*Mexico Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, Av. Municipio Libre 377,  
piso 4 A: Col. Santa Cruz Atoyac, Del. Benito Juárez: México, DF 03310*

---

---

### **Abstract**

In 2008, the NAFTA provisions opened the U.S. market for sugar imports from Mexico. The FAPRI U.S. agriculture sector model and the Mexican agriculture sector model were utilized simultaneously to analyze the implications for agribusiness interests of free trade with Mexico in sugar. It was found that the dire predictions of U.S. producer interests would not materialize. The economic impacts were much less than had been predicted. It was found that even with free trade, U.S. and Mexican sugar prices do not move in lockstep.

**Keywords:** policy, NAFTA, sugar

---

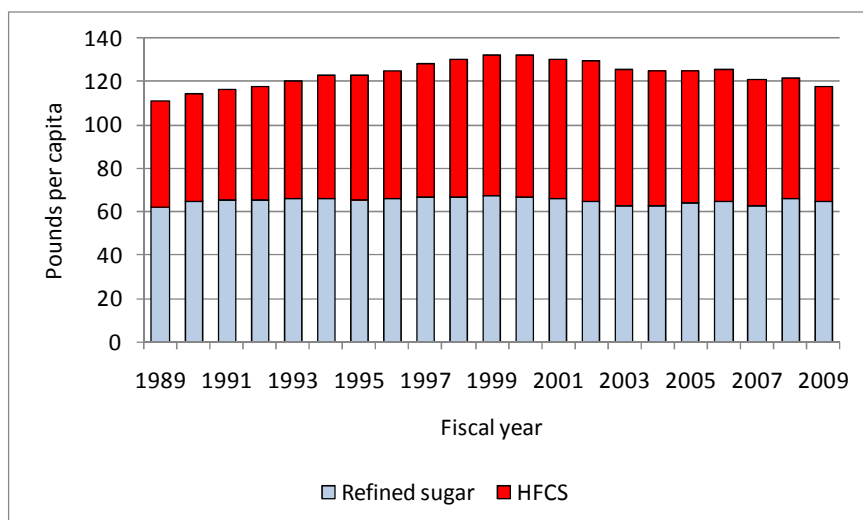
<sup>ⓐ</sup>Corresponding author: Tel: + 1 979.845.5913  
Email: [rknutson@tamu.edu](mailto:rknutson@tamu.edu)

Other contact information: P. Westhoff: [westhoffp@missouri.edu](mailto:westhoffp@missouri.edu)  
P. Sherwell: [psherwell@gmail.com](mailto:psherwell@gmail.com)

## Problem

While U.S. consumers traditionally have had a sweet tooth, some chinks may be developing in the armor. Consumption of sugar and high fructose corn syrup (HFCS) peaked at 132 pounds per capita in fiscal year (FY<sup>1</sup>) 1999 but then declined progressively to 117 pounds in FY 2009—an average of 1% per year over the decade (Figure 1). HFCS accounted for most of the decline, with per-capita consumption falling from 65 pounds in FY 1999 to less than 53 pounds in FY 2009.

The changes occurring on the demand side could be dwarfed by those on the supply side. Traditionally, the U.S. sugar industry has been highly protected by policies that restrict imports. Over the last decade, these policies have resulted in an average price of sugar in the U.S. market that was approximately double the world market price (Figure 2). Because of the North American Free Trade Agreement (NAFTA), there are no longer any restrictions on the amount of sugar the United States can import from Mexico. If this results in a sharp increase in U.S. sugar imports, it could transform U.S. sweetener markets.



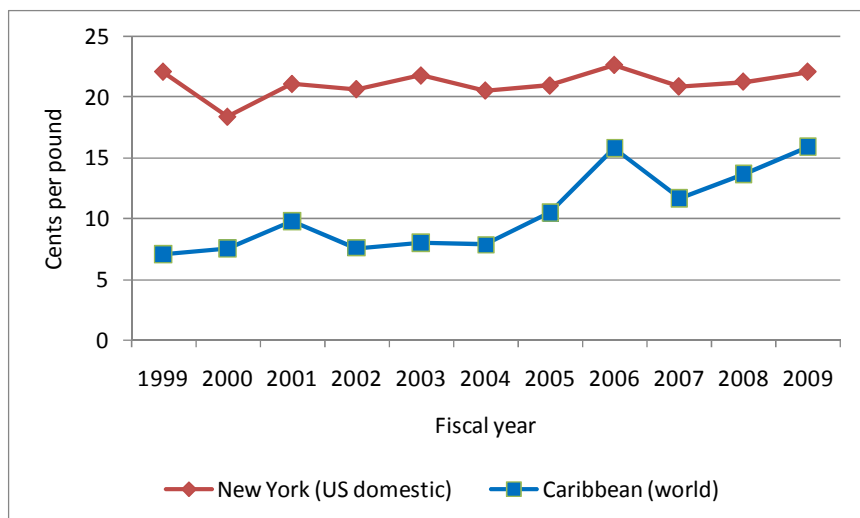
**Figure 1.** U.S. per-capita consumption of refined sugar and high-fructose corn syrup (HFCS).

**Source:** Author calculations based on USDA Economic Research Service data from “Sugar and Sweetener Yearbook Tables,” available at <http://www.ers.usda.gov/Briefing/Sugar/data.htm#yearbook>.

Many expected the NAFTA liberalization of North American sugar markets to result in a surge of exports of Mexican sugar into the United States. Early indications appeared to confirm this view: in the first full year after the final barriers to U.S.-Mexican sugar trade were removed in 2008, Mexican exports of sugar to the United States exploded, more than doubling from the previous record set just one year earlier.<sup>2</sup>

<sup>1</sup> Sugar data are reported here on a fiscal year (FY) basis, where the fiscal year begins on October 1 of the previous calendar year. FY 2009, for example, extended from October 2008 until September 2009.

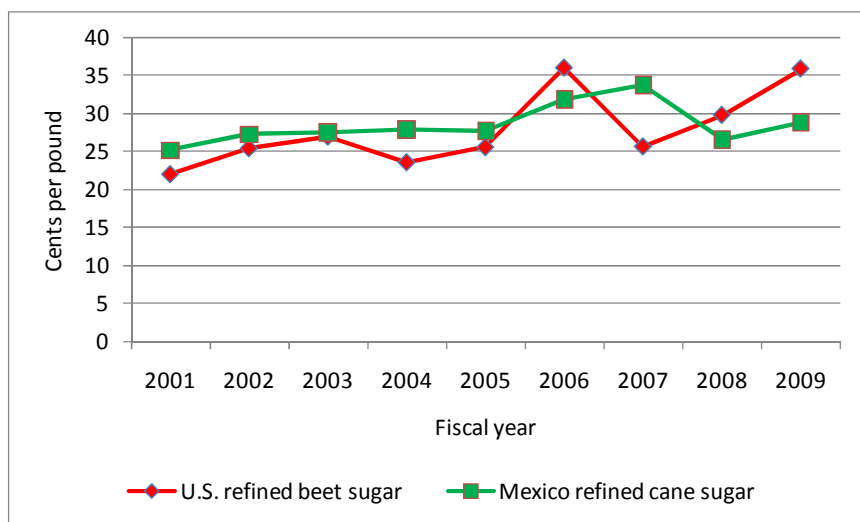
<sup>2</sup> USDA’s January 2010 *World Agricultural Supply and Demand Estimates* reports U.S. imports of Mexican sugar reached 1.4 million short tons in FY 2009, up from 0.7 million tons in FY 2008.



**Figure 2.** U.S. and world raw sugar prices.

**Source:** USDA Economic Research Service, “Sugar and Sweetener Yearbook Tables,” Tables 3 and 4, available at <http://www.ers.usda.gov/Briefing/Sugar/data.htm#yearbook>.

The story, however, is not so simple. Mexico also has a Tariff Rate Quota (TRQ) designed to keep the price of sugar in Mexico above the level that prevails in world markets. In fact, domestic sugar prices in Mexico are sometimes above those in the United States (Figure 3). However, in FY 2009 there were strong incentives for Mexico to export to the United States as the Mexican refined sugar price fell 7.1 cents per pound below the U.S. price. Mexico increased its exports to the United States in FY 2009 by sharply drawing down sugar stocks built up in previous years. When weather problems reduced the size of the FY 2010 sugar crop in Mexico, tight supplies in the Mexican sugar market caused a dramatic price spike that at least temporarily drove Mexican sugar prices above those in U.S. markets. What will happen next in North American sugar and sweetener markets remains uncertain, and different plausible scenarios have very different implications.



**Figure 3.** U.S. and Mexican refined sugar prices.

**Source:** USDA Economic Research Service, “Sugar and Sweetener Yearbook Tables,” Tables 5 and 55, available at <http://www.ers.usda.gov/Briefing/Sugar/data.htm#yearbook>.

Sugar markets also have a number of other features that deviate from free trade ideals. Price supports, TRQs, and state traders are prevalent globally. As a result, the residual world market for sugar has been thin, with relatively small volumes being freely traded outside preferential arrangements. Both the residual market and the TRQ international markets have been dominated by developing countries, often as state refiners and as state traders.

An additional factor influencing the U.S. caloric sweetener supply and demand situation is competition from biofuels. Brazil is the world's largest exporter of sugar, but the country uses most of its sugarcane to produce ethanol, not sugar. While Brazil led the world in the development of ethanol, U.S. ethanol production has surpassed that of Brazil (AFDC). Increased corn demand for ethanol was one of the factors that resulted in a rise in the price of HFCS, a primary U.S. soft drink sweetener.<sup>3</sup> Brazil and the United States also produce biodiesel from soybean oil. Land utilized for sugar production in both Brazil and the United States has had to compete with that utilized to produce corn and soybeans, creating yet another linkage between sweetener and biofuel markets.

## **Objectives**

This paper identifies and weighs the factors affecting the contemporary and future Mexican and U.S. sugar industry. The analysis takes place in a NAFTA open-market environment where sugar competes with HFCS produced from corn and where ethanol production has important direct and indirect effects. The specific objectives of the paper include:

1. To evaluate how the changed configuration of demand for sugar and HFCS impacts the U.S. and Mexican agriculture and agribusiness sectors.
2. To evaluate the impacts of NAFTA sugar provisions on the Mexican and U.S. sugar supplies.
3. To explore the implications of this change in sugar policy for the market for sweeteners, for consumer demand, and for agribusiness firms that utilize sweeteners.

## **Literature Review**

While there have been a number of previous studies of sugar and sweetener policy issues, the interactive impacts of freer trade policies and consumer demand changes have received little empirical analysis. In 1987, Lieu, Schmitz, and Knutson completed an economic welfare analysis of the gainers and losers for the U.S. sugar prices support and production control program with a finding that while the U.S. producers experienced large welfare gains, U.S. consumers were much bigger losers as were producers in other countries. Subsequently, Kennedy and Schmitz used a welfare approach to analyze the U.S. production response options to increased imports of sugar. While the NAFTA opening of the U.S. sugar market and the anticipated drop in U.S.

---

<sup>3</sup> Corn prices also rose from 2005-2008 because of higher energy prices, which increased the cost of fertilizer and fuel, strong global food demand growth, and the weather-induced reductions in grain supplies in major exporting countries, and a range of other factors. Corn prices have since retreated but remain above pre-2007 levels (Westhoff). HFCS prices rose with corn prices but have remained high even as corn prices have declined from their peak levels.

sugar prices is mentioned as a justification for the study, most of the attention in this research is given to the impacts of U.S. production control policy options.

Of greater interest to this analysis is a 2008 study by Castillo, Bucaram, and Schmitz, which studied price relationships in the U.S. sugar market. They concluded that the consequence of increases in U.S. corn prices could be to put sugar at a price advantage over HFCS, thus increasing the demand for sugar and reducing the price depressing effects of increased imports from Mexico. Neither of these studies gave attention to limitations on the sugarcane production potential of Mexico, the impacts of open market policies on Mexico, or the policy options available to Mexico, which are a central focus of this analysis.

## **Procedures**

Over the past two years, a Mexican baseline and policy analysis model has been developed as a counterpart to the U.S. model maintained by the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri (Meyers et al.). Both models are being utilized to evaluate for U.S. and Mexican policymakers, the impacts of policy changes. Utilizing models simultaneously makes it possible to evaluate effects of free trade in sugar on the U.S. and Mexican producer, agribusiness, and consumer sectors.

The U.S. and Mexican models are directly linked to ensure a consistent set of estimate results for North American markets. This linkage makes it possible to analyze the impacts of economic and policy changes on the agriculture and agribusiness sectors in both countries. Utilizing these models, the impacts of liberalization of sugar trade under NAFTA are analyzed over the next decade, 2010-2019. This analysis simultaneously considers the effects of NAFTA, ethanol, HFCS, and farm policies on the agriculture subsectors related to sweeteners, corn, and ethanol for both countries.

## **Demand and Supply Conditions for Sweeteners**

### *Changes in U.S. Demand for Sweeteners*

U.S. demand for sugar and HFCS has been influenced primarily by the combination of changes in consumer tastes and preferences and changing price relationships. In the past two decades, U.S. sugar consumption has been relatively stable (Haley and Dohlman, Haley, and Jerardo). The big change in U.S. caloric sweetener use is attributable to the 19% drop in per-capita HFCS consumption from FY 1999 to FY 2009. The major user of HFCS is the beverage industry (ERS, Sugar and Sweetener Background). Table 1 suggests that there has been a marked shift in demand from caloric soft drinks, primarily sweetened with HFCS, to bottled water. Part of this shift may represent a change in consumer preferences (Farah and Busby). HFCS has encountered adverse publicity from studies linking HFCS consumption with obesity and other health concerns, as reported widely (e.g., Science Daily) and even dramatized on a recent television sitcom.<sup>4</sup>

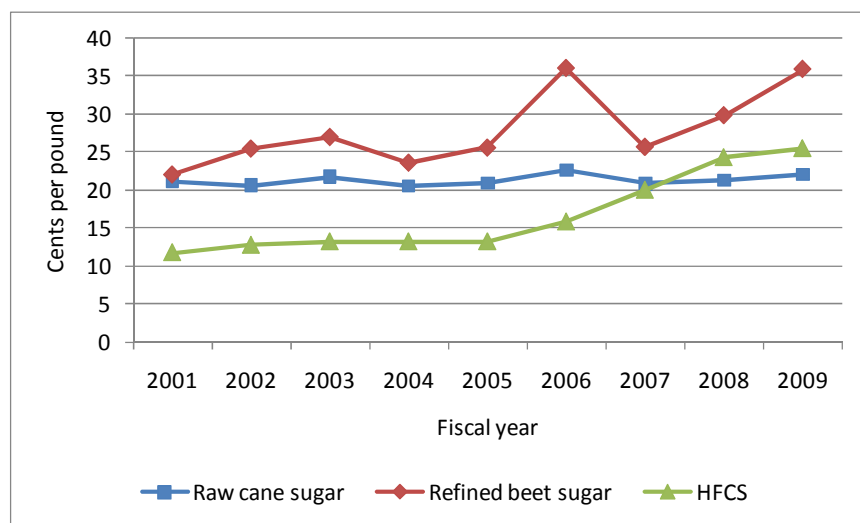
---

<sup>4</sup> Corn prices also rose from 2005-2008 because of higher energy prices, which increased the cost of fertilizer and fuel, strong global food demand growth, and the weather-induced reductions in grain supplies in major exporting countries, and a range of other factors. Corn prices have since retreated but remain above pre-2007 levels (Westhoff). HFCS prices rose with corn prices but have remained high even as corn prices have declined from their peak levels.

**Table 1.** U.S. carbonated soft drink and bottled water consumption per capita by calendar year, 1989-2007.

Calendar year	Carbonated soft drinks			
	Bottled water	Diet soft drinks	Other soft drinks	Total soft drinks
<i>Gallons</i>				
1989	8.1	13.4	33.0	46.4
1990	8.8	14.0	33.1	47.1
1991	8.9	14.1	33.1	47.3
1992	9.2	13.9	33.4	47.3
1993	9.9	13.6	34.3	47.9
1994	10.8	13.8	35.6	49.4
1995	11.6	13.8	36.8	50.6
1996	12.4	13.8	37.8	51.6
1997	13.4	13.6	39.1	52.7
1998	14.4	13.9	39.9	53.8
1999	15.8	13.8	39.7	53.5
2000	16.7	13.8	39.4	53.2
2001	18.2	13.9	39.0	52.9
2002	20.1	14.4	38.5	52.8
2003	21.6	15.1	37.5	52.6
2004	23.2	15.4	37.0	52.5
2005	25.5	15.3	36.3	51.7
2006	27.7	15.2	35.4	50.6
2007	29.1	14.9	33.9	48.8

Source: ERS/USDA, Beverage Consumption per capita data set, beverage.xls/.



**Figure 4.** U.S. Sweetener Prices.

Source: ERS, “Sugar and Sweetener Yearbook Tables,” Tables 4, 5, and 9. The HFCS price reported is the spot price for HFCS-42 in Midwest markets.

Relative prices of sugar and HFCS may have also played an important role in the recent decline in HFCS consumption. For many years, HFCS sold at a large discount to sugar, providing a strong incentive for its use in soft drinks and other suitable products. That relationship changed

dramatically over the last few years. The HFCS price increased by 94% between FY 2005 and FY 2009 and actually exceeded the price for raw cane sugar in FY 2008 and FY 2009 (Figure 4).

### *Changes in Mexican Demand*

The sugar and HFCS demand patterns in Mexico are quite different than in the United States. While over the period, 2001-2009, total Mexican and U.S. demand for sugar and HFCS were reasonably comparable, Mexican sugar use per capita<sup>5</sup> was two-thirds higher than that of the United States (Table 2). Prior to NAFTA's full implementation, domestic HFCS production in Mexico was hindered by high Mexican corn prices. HFCS imports were long restricted, and a tax was imposed on the use of HFCS in soft drinks.

**Table 2.** Mexico sugar and HFCS consumption per capita.

<b>Fiscal year</b>	<b>Sugar</b>	<b>HFCS</b>	<b>Sugar and HFCS</b>
<i>Pounds</i>			
2001	99.5	13.1	108.6
2002	105.8	5.7	111.5
2003	105.7	2.8	108.5
2004	112.0	2.8	114.9
2005	108.6	7.4	116.0
2006	112.6	13.7	126.3
2007	107.5	14.2	121.7
2008	106.3	15.7	122.0
2009	102.3	13.0	115.3

**Source:** Sherwell, Knutson, and Westoff.

In spite of these factors inhibiting the industry, Mexican HFCS consumption increased from 2.8 pounds per capita in FY 2003 to 14.2 pounds in FY 2007. Most of the growth, however, was for uses other than carbonated soft drinks, which continued to be sweetened with sugar. With full NAFTA implementation, Mexican HFCS producers now have free access to U.S. corn, and the tax on the use of HFCS in soft drinks was repealed. With the playing field leveled, an important question is whether the Mexican soft drink industry will evolve to rely as heavily on HFCS as its U.S. counterpart.

At least two factors will play a role in determining future use of HFCS by the soft drink industry. First, it is often asserted that Mexican consumers have a strong taste preference for sugar rather than HFCS, so soft drink producers may be reluctant to take a step that could alienate consumers. Second, as noted by Castillo, Bucaram, and Schmitz, the relative prices of sugar and HFCS in the Mexican market will also clearly play an important role.

Another important dimension of demand for Mexican sugar is the export market. Prior to 2008, Mexican exports of sugar to the United States were limited by a TRQ. In 2008, NAFTA provisions removed all restrictions on Mexican sugar exports to the United States. Due to high

<sup>5</sup> In contrast with the United States where most consumption is refined sugar, most sugar consumed in Mexico is "standard" sugar, with about 96 degrees of polarization, while refined sugar has 99 degrees. Mexico exports both standard and refined sugar.



stocks and low sugar prices relative to U.S. prices, Mexican sugar refiners took advantage of this policy change by sharply increasing exports (Table 3). Mexico's exports to the United States increased from 118,000 tons in FY 2007 to 694,000 tons in FY 2008 and 1.402 million tons in FY 2009. This increase in export demand drew down stocks and caused Mexican sugar prices to rise sharply in 2009. Coupled with a weather-reduced sugar crop in 2009, Mexico was forced to increase its TRQ and import more sugar to address the serious shortage in the domestic market.

**Table 3.** U.S. and Mexican sugar production, exports, and imports.

Fiscal year	United States			Mexico		
	Sugar production	Sugar imports	Sugar exports	Sugar production	Sugar imports	Sugar exports
<i>1000 Short tons</i>						
2005	7,877	2,100	259	5,813	132	276
2006	7,399	3,443	203	5,813	629	247
2007	8,446	2,080	422	5,846	130	487
2008	8,152	2,620	203	6,081	694	237
2009	7,484	3,082	137	5,470	1,402	607

#### *Changes in U.S. Sugar Supplies*

U.S. sugar production fell in FY 2006, partially because of the damage caused by Hurricane Katrina, which occurred in August 2005. Recovery of the Louisiana sugar cane industry and record sugar beet yields in the Plains resulted in a sharp recovery in production in FY 2007. U.S. cane sugar production was fairly steady from FY 2007 to FY 2009, at about 3.4 million short tons each year, and preliminary estimates suggest the FY 2010 crop will be about the same.

In contrast, beet sugar production has been quite variable in recent years. Strong returns to competing crops, rising sugar beet production costs, and other factors led to a 23% reduction in the area planted to sugar beets between FY 2007 and FY 2009. This contributed to a significant reduction in U.S. sugar production in FY 2009, but domestic market prices were somewhat restrained by the surge in imports from Mexico.

In FY 2010, there has been some recovery in U.S. beet sugar production, but reduced sugar imports from Mexico have led to a very tight market and a sharp increase in U.S. sugar prices. World sugar prices have set record highs this year, not so much because of developments in North America, but because of a very poor crop in India and a Brazilian crop that also fell short of expectations. For the first time in decades, world sugar prices have actually risen above the levels at which the U.S. government supports the domestic market price, making it difficult to relieve the pressure on the domestic market by opening the U.S. market to third-country imports.

#### *Changes in Mexican Sugar Supplies*

The Mexican sugarcane crop was adversely affected by poor weather conditions in both FY 2009 and FY 2010. Large carry-in stocks from FY 2008, however, meant that total sugar supplies in Mexico in FY 2009 were adequate to allow the country to export record amounts of sugar to the United States. Without the buffer provided by large stocks, the poor FY 2010 crop led to

incredibly sharp increases in domestic sugar prices in Mexico. For example, the price of standard sugar in Mexico rose from 17 cents per pound in February 2009 to almost 45 cents per pound in September 2009 (ERS Sugar and Sweetener Yearbook, Table 54). As a result, Mexican sugar was no longer very attractive to U.S. buyers, although sugar that was under contract continued to be delivered.

## **U.S. and Mexican Baseline**

The U.S. and Mexican baselines were developed using FAPRI's U.S. baseline model (FAPRI), which has a 25-year history of development and enhancement. Following its development, FAPRI's 2010 baseline was peer reviewed by USDA, Congressional Budget Office, and industry analysts with adjustments considered to be justified. The Mexican baseline model (Sherwell, Westhoff, and Knutson), was first developed and utilized in 2008. The Mexican model was substantially modified in 2009 to better reflect domestic and trade policies. Special attention was given to improving and updating the sugar model. It was peer reviewed by SAGARPA and industry analysts.

### *U.S. Baseline*

The 2010 baseline reflects a substantially different agricultural economic situation than has existed over much of the period since World War II. In short, higher grain prices than pre-2007 levels increase HFCS prices and competition for land. While it is easy to oversimplify, higher grain prices reflect both increased costs of production due mainly to higher energy prices and increased use of corn for ethanol production. Both economic and political conditions foretell little likelihood of a relaxation of these pressures on grain prices.

The 2010 sugar baseline reflects the fact that production expenses have increased dramatically with 40-60% increases in expenses for seed, pesticides, and fertilizer. Although the figures are uncertain (USDA only publishes sugar beet expenses), the 2010-2019 baseline shows lower average net returns per acre to both sugar beets and sugar cane than the 2005-2008 average. Sugar prices at historical norms (23 cents per pound) would result in even lower levels of U.S. sugar production, as some producers could not cover costs or would find other crops more attractive. Even at relatively high current prices, U.S. sugar beet acreage is far below pre-2007 levels. Likewise, HFCS prices are above pre-2007 levels, which are projected to continue. While the U.S. sugar market continues to be politically managed, in this environment there is no reason to anticipate that USDA sugar program managers would take action to run prices at below 23 cents per pound. The 2008 farm bill requires, except in time of shortage, that non-NAFTA imports are maintained at the WTO-required levels, which makes it more difficult for USDA to manage the price of sugar.

In FY 2010, tight U.S. sugar supplies have led to record high prices in the domestic market. While these high prices are viewed as an anomaly, they provide an incentive to cane and beet producers to increase the area they devote to sugar production this year, which should lead to a larger U.S. sugar crop in FY 2011 (Table 4). Baseline sugar acreage is projected to be fairly stable in later years, but yields increase in line with past trends to result in modest growth in U.S. sugar production.

**Table 4.** U.S. sweetener supply, utilization, and prices: baseline projections.

<b>Fiscal year</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
<b>Area harvested</b>	<i>(Thousand acres)</i>									
Sugarcane	821	857	866	844	842	842	841	839	835	832
Sugar beets	1,145	1,315	1,205	1,183	1,190	1,195	1,201	1,197	1,196	1,197
<b>Sugar supply and use</b>	<i>(Thousand short tons, raw value)</i>									
Production	7,837	8,913	8,611	8,541	8,681	8,831	8,985	9,084	9,192	9,316
Imports	2,157	2,067	2,144	2,136	2,118	2,094	2,062	2,030	2,000	1,964
(from Mexico)	340	550	625	615	594	568	534	499	467	428
Domestic use	10,293	10,401	10,544	10,532	10,616	10,749	10,859	10,923	11,004	11,096
Exports	168	161	161	161	160	160	160	161	160	160
Ending stocks	984	1,403	1,453	1,437	1,459	1,475	1,503	1,534	1,562	1,585
<b>HFCS supply and use</b>	<i>(Thousand short tons)</i>									
Production	8,790	8,790	8,834	8,969	9,058	9,117	9,152	9,202	9,249	9,303
Domestic use	8,232	8,116	8,078	8,127	8,141	8,142	8,128	8,135	8,139	8,151
Net exports	558	675	756	842	917	975	1,025	1,067	1,110	1,153
<b>Per-capita consumption</b>	<i>(Pounds)</i>									
Refined sugar	61.9	62.0	62.2	61.6	61.4	61.6	61.7	61.4	61.3	61.2
HFCS	53.0	51.7	51.0	50.8	50.4	49.9	49.4	48.9	48.5	48.1
Sum	114.9	113.7	113.2	112.4	111.9	111.5	111.0	110.4	109.8	109.3
<b>Prices</b>	<i>(Cents per pound)</i>									
Raw cane sugar	31.1	26.5	25.7	26.3	26.5	26.8	26.9	26.9	27.0	27.1
Refined beet sugar	45.3	35.0	33.8	34.6	34.8	35.2	35.3	35.2	35.3	35.4
HFCS	26.3	25.2	25.5	25.9	26.2	26.7	27.1	27.1	27.3	27.4

**Source:** Author estimates using the FAPRI U.S. model and the Sherwell, Westhoff, and Knutson Mexico model.

Refined sugar consumption per capita projections remain around 61-62 pounds per capita over the next decade. Consistent with recent trends, HFCS consumption projections fall from 53 pounds per capita in FY 2010 to 48 pounds per capita in FY 2019.

U.S. sugar imports remain relatively stable at about 2 million tons per year. Imports from countries other than Mexico are largely determined by the TRQ and other special programs. The baseline assumes the TRQ is increased slightly in FY 2010 to slightly alleviate the current tight supply situation but then is set at the minimum level permitted under international trade agreements in subsequent years.

Baseline U.S. sugar prices retreat from the current peak in FY 2011 but remain slightly above the levels that prevailed prior to FY 2010. This result is contingent on competing crop prices that remain above the historic norm because of continued growth in biofuel production, the assumed recovery of the world economy, and oil prices that slowly increase over time. After having a price advantage relative to sugar in FY 2010, HFCS prices are projected to be generally near prices for raw cane sugar in FY 2011 and beyond.

*Mexican Baseline*

Poor weather reduced the Mexican sugar crop in both FY 2009 and FY 2010. If growing conditions return to normal, current high prices should provide an incentive for increased Mexican sugar production in FY 2011 (Table 5). The area devoted to sugar production in Mexico is projected to remain fairly steady in later years so production only increases with very modest growth in yields.

Mexican sugar consumption is constrained in FY 2010 by high prices, substitution of non-caloric sweeteners, and the weak economy. If greater supplies result in lower prices, Mexican sugar consumption could rebound in FY 2011. Total sweetener consumption per capita could increase from 118 pounds per capita in FY 2011 to 128 pounds in FY 2019, a rate of growth consistent with that observed in recent years. Most of the growth after FY 2011 would likely occur in HFCS consumption, which is assumed to modestly increase its share of the soft drink market.

**Table 5.** Mexico sweetener supply, utilization, and prices: baseline projections.

<b>Fiscal year</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
<b>Area harvested</b>	<i>(Thousand hectares)</i>									
Sugarcane	667	696	699	700	701	702	702	702	702	702
<b>Sugar supply and use</b>	<i>(Thousand metric tons)</i>									
Production	4,974	5,349	5,274	5,302	5,326	5,352	5,373	5,389	5,407	5,425
Imports	511	442	438	439	440	442	443	445	446	448
Domestic use	4,819	5,014	5,072	5,123	5,174	5,222	5,273	5,325	5,374	5,423
Exports	309	500	567	558	539	516	485	454	424	390
(to the U.S.)	309	499	567	558	539	515	484	453	424	389
Ending stocks	889	1,111	1,129	1,133	1,131	1,131	1,135	1,135	1,135	1,140
Residual	55	55	55	55	55	55	55	55	55	55
<b>HFCS supply and use</b>										
Production	335	331	330	332	335	338	342	344	347	349
Domestic use	782	887	961	1,041	1,111	1,168	1,217	1,258	1,299	1,341
Net imports	447	556	631	709	777	830	875	914	953	992
<b>Per-capita consumption</b>	<i>(Pounds)</i>									
Refined sugar	98.0	101.2	101.6	101.9	102.2	102.5	102.8	103.2	103.5	103.9
HFCS	15.4	17.2	18.5	19.8	20.9	21.8	22.4	23.0	23.5	24.0
Sum	113.4	118.4	120.1	121.7	123.1	124.3	125.3	126.2	127.0	127.9
<b>Prices</b>	<i>(Cents per pound)</i>									
Standard sugar	38.6	29.4	29.6	29.9	30.5	30.8	31.0	31.2	31.6	31.6
Refined sugar	45.0	34.8	35.0	35.3	35.8	36.1	36.3	36.6	36.9	36.9

**Source:** Author estimates using the FAPRI-MU U.S. model and the SAGARPA Mexico model.

Tight supplies limit Mexican sugar exports in FY 2010, and exports remain far below the FY 2009 level over the 10-year baseline. Given the projected supply-demand balance, Mexico simply does not have adequate sugar supplies to capture a large share of the U.S. market. Note that projected Mexican refined sugar prices are very similar to those prevailing in the U.S.

market. The more integrated the North American sugar market is, the more closely those prices will tend to follow one another. However, seasonal price variation and a variety of other factors mean that Mexico may be able to export modest amounts of sugar to the United States even when the season-average price of sugar in Mexico is equal to or greater than the U.S. season-average price.

## **Scenario Analysis**

In 2008, Mexico and the United States entered a new free trading era. The effects of this policy appeared to be less severe than many in the U.S. sugar industry had anticipated when the NAFTA provisions were negotiated. In the baseline just discussed, the liberalization of U.S.-Mexican sugar trade does not appear to have dramatic effects over the next decade. While sugar prices in the two countries come in closer alignment to one another, exports of Mexican sugar to the United States remain limited. In spite of common concerns that the NAFTA liberalization would make the U.S. sugar price support program unworkable, baseline sugar prices remain above the levels that would require the government to take actions to support prices (approximately 20 cents per pound for raw cane sugar).<sup>6</sup>

Of course, actual market outcomes will differ from these baseline projections. At least two plausible scenarios could result in significantly more Mexican sugar exports to the United States. These would have important implications for both countries. The scenarios selected relate to: (1) the impacts of increased substitution of HFCS for sugar in the production of Mexican soft drinks and (2) the impacts of increased Mexican sugar imports.

### *Increased Mexican Use of HFCS*

The “more HFCS in Mexico” scenario increases Mexican HFCS consumption by 8.5 pounds per capita by FY 2019. This is sufficient to allow HFCS to dominate the soft drink market and would free up Mexican sugar supplies for export to the United States. It assumes that Mexican consumers would accept soft drinks sweetened with HFCS.

Table 6 summarizes the major economic impacts of this scenario in terms of the percentage changes from the baseline. As soft drink manufacturers expand their use of HFCS, sugar use in Mexico falls relative to the baseline. This results in lower prices for sugar in the Mexican market; by FY 2019, Mexican prices for standard sugar fall by 19% relative to the baseline. This results in a modest reduction in Mexican sugar production, but it also makes Mexican sugar more competitive in the U.S. market. The result is a 178% increase in Mexican sugar exports to the United States.

Increased imports of Mexican sugar result in lower prices in the U.S. sugar market. These lower prices result in a modest reduction in U.S. sugar production. Meanwhile, HFCS prices actually increase, as the effect of increased HFCS exports to Mexico outweighs the effect of lower sugar prices in the domestic market. The combination of higher HFCS prices and lower sugar prices encourages some U.S. HFCS users to switch to sugar.

---

<sup>6</sup> The “loan rate” for raw cane sugar is currently 18.25 cents per pound, but seasonal price variability and other factors mean that the price support program generally begins to have an effect when raw sugar prices fall below about 20 cents per pound. Note that baseline raw cane sugar prices never dip below 25 cents per pound.

While this scenario does result in lower U.S. sugar prices, it does not result in prices low enough to trigger government price support activity. The effects on the U.S. market are less than some might expect. One reason is that an extra pound of HFCS used by the Mexican soft drink industry does not translate into a pound of additional exports of sugar to the United States. In FY 2019, for example, Mexican HFCS consumption exceeds baseline levels by 1.03 million metric tons, but Mexican sugar exports exceed baseline levels by just 0.69 million metric tons. The reduction in Mexican sugar prices results in some reduction in Mexican sugar production and encourages a slight increase in sugar consumption outside the soft drink industry.

Poor weather reduced the Mexican sugar crop in both FY 2009 and FY 2010. If growing conditions return to normal, current high prices should provide an incentive for increased Mexican sugar production in FY 2011 (Table 5). The area devoted to sugar production in Mexico is projected to remain fairly steady in later years so production only increases with very modest growth in yields.

Mexican sugar consumption is constrained in FY 2010 by high prices, substitution of non-caloric sweeteners, and the weak economy. If greater supplies result in lower prices, Mexican sugar consumption could rebound in FY 2011. Total sweetener consumption per capita increases from 118 pounds per capita in FY 2011 to 128 pounds in FY 2019, a rate of growth consistent with that observed in recent years. Most of the growth after FY 2011 occurs in HFCS consumption, which is assumed to modestly increase its share of the soft drink market.

**Table 6.** Economic Impacts of Mexican substitution of HFCS for sugar in caloric sweetened soft drinks.

Fiscal year	United States				Mexico		
	Sugar imports	Raw sugar price	Sugar production	HFCS price	Sugar exports	Standard sugar price	Sugar production
	<i>(percent change from baseline)</i>						
2011	3.8	-1.2	-0.3	1.4	14.4	-3.3	0.0
2012	7.7	-1.1	-0.7	1.4	25.7	-5.7	-0.4
2013	11.2	-1.5	-0.9	2.2	39.1	-8.1	-0.8
2014	15.2	-2.0	-1.2	2.8	54.1	-10.3	-1.3
2015	19.3	-2.4	-1.5	3.5	71.0	-12.4	-1.7
2016	23.6	-2.8	-1.8	4.1	91.2	-14.5	-2.1
2017	28.3	-3.2	-2.1	4.8	114.9	-16.4	-2.6
2018	33.1	-3.5	-2.4	5.6	141.5	-18.4	-3.0
2019	38.8	-4.0	-2.7	6.2	177.5	-19.3	-3.4

**Source:** Author estimated changes relative to the baseline.

### *Increased Mexican Imports of Sugar*

The “more Mexican sugar imports” scenario adjusts the Mexican TRQ to allow 1.5 million tons of additional sugar to be imported at the world price by FY 2018. Because the world price is typically far below the sugar price in Mexico, imports would be expected to increase by the full

amount of any increase in the TRQ. The assumed increase in imports would add more than 20% to the Mexican sugar supply.

Table 7 summarizes the major economic impacts of the scenario. The increase in supplies on the Mexican market would significantly reduce Mexican sugar prices. Lower prices, in turn, would result in a reduction in Mexican sugar production and an increase in Mexican sugar consumption, partially at the expense of reduced consumption of HFCS. Lower Mexican sugar prices also make Mexican sugar more competitive in the U.S. market, and Mexican sugar exports in FY 2019 exceed baseline levels by 270%. The resulting increase in U.S. sugar imports results in lower U.S. sugar prices, reduced U.S. sugar production, increased domestic consumption of sugar, and reduced domestic consumption and prices for HFCS.

The interesting story here again is that the increase in exports to the United States is noticeably less than the increase in third-country imports by Mexico. In FY 2019, Mexican sugar imports would increase by 1.50 million metric tons, but sugar exports would increase by 1.05 million metric tons because of the reduction in production and the increase in domestic use that result from lower prices. Therefore, increased sugar imports by Mexico impact Mexican sugar producers more adversely than they affect U.S. sugar producers.

**Table 7.** Economic impacts of 1.5 million tons of additional Mexican sugar imports from the world market.

Fiscal year	United States				Mexico		
	Sugar imports	Raw sugar price	Sugar production	HFCS price	Sugar exports	Standard sugar price	Sugar production
<i>(percent change from baseline)</i>							
2011	7.4	-2.7	-0.7	-0.5	27.7	-8.0	-0.1
2012	14.4	-3.7	-1.9	-1.5	49.2	-13.0	-1.0
2013	21.4	-4.8	-2.8	-1.6	74.3	-17.8	-1.9
2014	28.6	-6.0	-3.6	-2.0	102.0	-22.0	-2.8
2015	36.0	-7.0	-4.5	-2.3	132.8	-26.2	-3.7
2016	44.3	-8.2	-5.4	-2.6	171.1	-29.4	-4.6
2017	53.6	-9.2	-6.6	-3.0	217.9	-31.0	-5.3
2018	58.6	-9.2	-7.2	-2.8	250.6	-31.2	-5.8
2019	58.9	-8.5	-7.0	-2.5	269.5	-31.1	-6.0

**Source.** Author estimated changes relative to the baseline.

## Conclusions and Implications

There were many dire predictions by U.S. sugar producer interests that opening the U.S. market for sugar under NAFTA would ruin the U.S. sugar industry. This did not happen, and the results of this study indicate that it is unlikely to happen in the near future under reasonable assumptions. Clearly, NAFTA's effects on the U.S. sugar industry have been less than anticipated for several reasons related to the Mexican market. At least so far, Mexico has not demonstrated an ability to significantly increase domestic production at the level of prices that prevail in U.S. markets. Soft drink manufacturers have not made a wholesale replacement of

sugar with HFCS, and Mexico has not greatly increased sugar imports to arbitrage low world sugar prices and high prices in the U.S. market.

NAFTA's effects on the U.S. sugar market have also been less than anticipated because of unexpected developments in U.S. and Mexican markets. From a U.S. perspective, increased biofuel production, rising production expenses, and a range of other factors have resulted in less domestic sugar production than many expected. Further, domestic sugar consumption has held fairly steady as HFCS has absorbed most of the reduction in domestic sweetener consumption. From a Mexican perspective, there appear to be greater limitations on Mexico's sugar production capacity than might have been anticipated. Under current market conditions, there are less incentives for Mexican sugar users to substitute sugar for HFCS than has been the case for U.S. agribusiness firms. Rising HFCS prices meant there was less incentive for users to switch from sugar to HFCS in 2008 and 2009. The current high price of sugar in North American and world markets is not expected to persist, and it is likely that high corn prices will help keep HFCS prices above historical norms. In reaction to the current situation, Mexico could increase sugar imports. However, this would depress prices in the Mexican market, with important negative implications for the Mexican sugar industry, even if it did result in increased sugar exports to the United States.

An important question for the future is just how integrated the North American sugar market will prove to be. While U.S. and Mexican sugar prices have been correlated in recent years, by no means have they moved in lockstep. The modeling work reported here assumes the U.S. and Mexican markets continue to be imperfectly integrated. If they become more closely linked, trade will be even more sensitive to relative prices in the two markets, and a North American market will be supplied by the low-cost producers. In contrast, government policies and the actions of large players in the market could keep the ties between the two markets relatively weak.

NAFTA presents a new economic and trading environment for managers of firms that produce and utilize sugar. The results of this analysis indicate that in this environment, agribusiness managers will need to closely monitor conditions affecting production, consumption, imports, and exports to prevent adverse impacts on their operations in both Mexico and the United States. The fact that both producer and agribusiness experts in the sweetener sector may differ over the outlook for the future, sends a clear signal that there is good reason to closely follow developments in sweetener markets and be flexible. These results clearly suggest that we may be in a new economic environment with strategic implications that should not be taken lightly. It is also important to note that the conditions that lead to this conclusion and to its implications also apply to the broader scope of agricultural commodities. As in the past, these conditions will be affected by both political and economic variables. However, with freer trade, economic forces can play a greater role in influencing margins and returns. The usefulness of this research to agribusiness lies in providing greater insight into the economic and competitive forces influencing sweetener production, utilization, and more generally to the changing conditions in agricultural commodity markets.



## References

- Castillo, M.J., S. Bucaram, and A. Schmitz. 2008. "Price Relationships in the U.S. Sugar and Sweetener Market: A Cointegration Approach." *International Sugar Journal*. 110(131): 358-63.
- ERS, Economic Research Service, USDA. 2010. "USDA. Sugar and Sweeteners: Background" <http://www.ers.usda.gov/Briefing/sugar/background.htm> (accessed January 10, 2010).
- ERS, Economic Research Service, USDA. 2009. "Sugar and Sweetener Yearbook Tables," <http://www.ers.usda.gov/Briefing/Sugar/data.htm#yearbook> (accessed January 10, 2010).
- Farah, Hodan and Jean Buzby. 2008. "High-Fructose Corn Syrup Usage May Be Leveling Off." *Amber Waves*. ERS/USDA. Feb.
- FAPRI, Food and Agricultural Policy Research Institute. 2010. "FAPRI 2010 U.S. and World Agricultural Outlook." FAPRI Staff Report 10-FSR 1. FAPRI, Iowa State University, Ames, Iowa.
- Haley, Stephen and Erik Dohlman. 2009. Sugar and Sweetener Outlook. SSS-256, ERS/USDA. Oct.5.
- Haley, Stephen and Andy Jerardo. 2009. Sugar and Sweetener Outlook. SSS-255, ERS/USDA. June 2.
- Kennedy, P. Lynn and Andrew Schmitz. 2009. "Production Response to Increased Imports." *Journal of Agricultural and Applied Economics*. 41(12):777-89.
- Lieu, Gwo-Jiun M., M. Andrew Schmitz, and Ronald D. Knutson. 1987. "Gains and Losses of Sugar Program Policy Options." *American Journal of Agricultural Economics* 69(3): 591-602.
- Meyers, William H., Patrick Westhoff, Jacinto Fabiosa, and Dermot Hayes. 2010. "The FAPRI Global Modeling System and Outlook Process." *Journal of International Agricultural Trade and Development*. Forthcoming.
- Science Daily. 2007. "What Does Scientific Research Say About HFCS." August 23. <http://www.sciencedaily.com/releases/2007/08/070823094819.htm> (accessed January 11, 2010).
- Sherwell, Pablo, Patrick Westhoff, and Ronald D. Knutson. 2010. Mexico Agriculture Sector Baseline : Projections 2010-2019. SAGARPA. Forthcoming.
- AFDC, Alternative Fuels and Advanced Fuels Data Center. 2009. DOE, U.S. Department of Energy. "World Fuel Ethanol Production, 2008." [www.afdc.energy.gov/afdc/ethanol/production.htm?print](http://www.afdc.energy.gov/afdc/ethanol/production.htm?print) (accessed January 11, 2010).
- Westhoff, Patrick. 2008. "Farm Commodity Prices: Why the Boom and What Happens Now?" *Choices* 23(2):6-10.
- World Agricultural Outlook Board. 2010. "World Demand and Supply Estimates." WASDE-478, USDA. (January 12):16.