

# **Analysis of U.S.-Mexico Sugar Trade:**

## **Impacts of the North American Free Trade Agreement (NAFTA) and Projections for the Future**

**Daisuke Sano**

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Boca Raton

*Analysis of U.S.- Mexico Sugar Trade:  
Impacts of the North American Free Trade Agreement (NAFTA) and Projections for the Future*

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To my parents and sister

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Abstract of Dissertation Presented to the Graduate School  
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ANALYSIS OF U.S.-MEXICO SUGAR TRADE: IMPACTS OF THE NORTH  
AMERICAN FREE TRADE AGREEMENT (NAFTA) AND PROJECTIONS FOR THE  
FUTURE

By

Daisuke Sano

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Chair: Thomas H. Spreen

Cochair: Lisa A. House

Major Department: Food and Resource Economics

This study examines U.S.-Mexico sugar trade with special attention given to the impact of changes in trade and market environments caused by implementation of the North American Free Trade Agreement (NAFTA) and the introduction of high fructose corn syrup (HFCS). These two factors contributed to shaping sugar markets in the United States and Mexico as well as sugar trade between the two countries. The study includes two sections: (1) a description of the sugar markets from an historic point of view and (2) an empirical study forecasting the market and trade outlook.

In section one, characteristics of the sugar industry and transition of the sugar markets brought by the two factors (NAFTA and HFCS) are presented. Adoption of HFCS shaped the U.S. sweetener market in the 1980s and a similar phenomenon appears to be beginning in Mexico. This is explained by not only income growth but also the provisions of NAFTA that facilitate U.S. HFCS to enter the Mexican market and restrict

Mexican sugar to the U.S. market. Although Mexico is promised favorable access to the U.S. market under NAFTA, it has not been successful in exporting sugar; rather, the focus has been to suppress HFCS adoption in the domestic market.

Next, an empirical study comprised of three analyses is presented. Regression results from the market analysis showed that the estimated price elasticities for both sugar demand and supply are significant and inelastic. These estimates are built into the second model that examines bilateral trade. Results from simulations of the trade analysis indicate Mexico's HFCS adoption rate will determine the magnitude of Mexico's sugar export, which consequently poses a significant influence on U.S. markets. Also the way the U.S. government allocates quotas among exporters will have a significant impact, particularly on the costs of the U.S. sugar program. Game theory analysis is then used to assess what strategies the involved participants will prefer. The results suggest that there will be a conflict of interests and that the U.S. HFCS industry may play an influential role in forming a sugar policy.

## CHAPTER 1 INTRODUCTION

This chapter introduces the research problem for U.S.-Mexico sugar trade. Background, the researchable questions, and objectives are provided, followed by the organization of the dissertation.

### **Background**

Trade issues surrounding the world sugar market are often seen as classic examples in agricultural economics, yet the market still provides us with important questions today. In the case of the U.S.–Mexico sugar trade, the main issues boil down to two aspects: the provisions of North American Free Trade Agreement (NAFTA) and the role of high fructose corn syrup (HFCS), a substitute for sugar, in sweetener markets. In the following section, a summary of this area, focusing on these two aspects, is provided.

NAFTA was implemented in 1994, creating a freer trade environment among Mexico, the United States, and Canada by eliminating tariffs. Among other regional trade agreements involving North America, Latin and Caribbean countries, it is the least ambitious on paper of the major trade agreements, but it has been the most successful adhering to the negotiated schedule in lowering tariffs (McCoy, 2002). In terms of agricultural trade between Mexico and the United States, many tariffs were eliminated immediately while others being phased out over periods of 5 to 15 years (USDA, 2001c). In addition to a transition period of up to 15 years for certain products, NAFTA has

special safeguards to protect import-sensitive crops, including sugar, which are defined under side agreements between Mexico and the United States (USDA, 2001c).

When trading sugar with the United States, the Mexican sugar industry faces two counteracting conditions under the NAFTA regime: increased access to the U.S. market which would facilitate sugar exports at favorable prices; and the pressure of increased imports of HFCS from the United States which have been gaining an increasing share of Mexico's sweetener market since 1994. Under the provisions of NAFTA, both an over-quota tariff for Mexican sugar which enters into the United States and a tariff on exported HFCS which enters the Mexican market are regulated in such a way that both tariffs will be reduced to zero by 2008 and 2004, respectively. In addition to the rules of the tariffs, Mexican sugar is subject to U.S. import quota allocations. Mexico is allowed to access two kinds of quotas, depending on Mexico's domestic balance in the sweetener market: if Mexico's sugar production exceeds its sweetener consumption (the sum of sugar and HFCS consumption in two consecutive years - "net surplus sweetener producer status"), Mexico receives 25,000 MT of sugar import quota; and if not, Mexico receives 7,258 MT of quota. Additionally beginning in 2000, the sugar import quota expands from 25,000 MT to 250,000 Mt as long as Mexico satisfies the conditions of a net surplus sweetener producer. Mexico can export over the 7,258 MT quota without attaining net surplus sweetener, but any sugar exported in this scenario would be subject to taxation in the form of tariffs as mentioned above. In 2008 when all the restrictions, i.e. both tariffs and quotas, are lifted, Mexico will have free and unlimited access to the U.S. sugar market.

In Mexico, the sugar industry has played an important role in the economy and the politics of the country. In spite of experiencing drastic economic and political changes,

including NAFTA, devaluation, privatization of the sugar cane processing industry in the 1990s, and several changes in the policy regime, sugar production has shown steady expansion over the past 10 years: Mexican sugar production expanded from 3.2 million MT in 1990 to 4.7 million MT in 2000 (COAAZUCAR, 2003a). A significant amount of surplus sugar destined to export has been generated since 1995, ranging from 200,000 MT in 1995 to over 1.1 million MT in 1998 (COAAZUCAR, 2003a). These records may appear favorable; however, Mexico stood to benefit little from NAFTA. From 1996 through 1999 Mexico successfully received a 25,000 MT import quota as a result of attaining net surplus producer status, yet it did not enjoy the expanded quota (250,000 MT) from 2000 through 2002 (USDA, 2003a), the amount equivalent to 20 percent of the U.S. minimum sugar import requirement under GATT, because Mexico's production fell short relative to its sweetener consumption. This indicates that Mexico missed the opportunity to export sugar under-quota even though it generated a significant surplus.

Combined with a slump in production that occurred in 1999 and 2000, the Mexican sugar industry underwent an economic crisis. In September 2001, the Mexican government expropriated 27 of 60 of Mexico's functioning sugar mills in order to maintain the industry (USDA, 2002b). Today, the circumstances surrounding the sugar industry remain unfavorable. At the industry level, many mills are financially vulnerable and suffer from low efficiency of production due to old technology or poor infrastructure. Foreign investment has not been successfully encouraged to provide capital for needed investments in new capital equipment. At the farm level, production efficiency is low due to fragmented farmland, which is a result of the *Ejido* system (Mexico's agrarian law) and social security program specifically tailored to sugar cane growers. Lack of credit



and old technology also contribute to low productivity. Although the price of sugar at the wholesale level has been privatized, the sugar price paid to growers is still controlled by a government agency, and hence farmers have little incentive to grow sugar cane other than to receive social benefits from the Mexican sugar program. At the national level, the Mexican government faces a dilemma between gaining competitiveness in the international market and maintaining social stability through offering employment and financial supports to the livelihood of a large number of growers and related workers. Overall, there has been little benefit to the Mexican sugar industry resulting from NAFTA.

The U.S. sugar market, where a large quantity of sugar is traded by a large number of sellers, has maintained commodity balance by assigning tariffs and import quotas to foreign sellers and maintaining domestic price support through the U.S. sugar program. As a result of GATT, the United States committed to accept a minimum import quota of 1.256 million MT of sugar in 1990; however, the U.S. sugar market has been maintained unchanged until today through successful lobbying efforts by the American Sugar Alliance (ASA), the sugar producers' primary alliance.

In the meantime, HFCS had been gaining its share in the U.S. sweetener market since the early 1970s when commercial production of HFCS became possible by the advancement of wet-milling technology. Today, more than 50 percent of caloric sweetener consumption in the United States is derived from corn syrup including HFCS (Congressional Research Service, Library of Congress, 1999). A similar phenomenon appears to be beginning in Mexico. The implementation of NAFTA resulted in opening the door for HFCS consumption in Mexico where nearly all caloric sweetener

consumption was derived from domestically-produced sugar before 1994. Reflecting this threatening trend of replacing domestic sugar consumption with HFCS, in 1996, the Mexican government imposed tariffs on HFCS claiming that U.S. companies were dumping HFCS at an unfair price and affecting the export volume and value of Mexican sugar. This action evolved into a trade dispute between the United States and Mexico and ended when the WTO panel ruled against Mexico's claim (Garcia Chaves et al., 2002 and 2004). Overall, NAFTA has not brought about significant changes in the U.S. sugar market because the Mexican exporters have been unable to significantly expand shipments to the United States. Rather, attention was poured into issue of HFCS and its immediate impact on the Mexico's sweetener market.

In this study, the direction of U.S.-Mexico sugar trade is examined using quantitative methods, with close attention to issues related to NAFTA and HFCS adoption in Mexico. Demand and supply analyses in both countries and a bilateral trade model using mathematical programming provide insights for the market balance in the future including political implications. Aggregated results from various simulations on the trade model are examined using a game theory analysis to investigate possible policy recommendations through assessing gainers and losers in sugar trade.

### **Problem Statement**

The future outlook for the U.S.-Mexico sweetener market needs to be quantitatively analyzed in a manner that includes influential factors such as trade agreements under NAFTA; trends in HFCS consumption in Mexico; and other related economic and political issues in the sweetener markets.

### **Researchable Questions**

The study attempts to answer the following set of questions.

1. What was the impact of changes in the trade regime in the U.S. and Mexican sweetener market since NAFTA was implemented in 1994?
2. How much surplus sugar can Mexico generate and how much sugar will cross the border both under- and over-quota? What will happen after 2008 when all the restrictions are eliminated on Mexican sugar?
3. What will be the impact of changes in Mexico's market on both the United States and Mexico? How much influence will HFCS adoption cause in both the U.S. and Mexican sweetener markets?
4. What will be the impact of changes in U.S. sugar policy on both the United States and Mexico?
5. Is there alternative sugar policy for the United States to current price support?

### **Objectives**

The primary objective of the study is to develop a bilateral trade model of the U.S.-Mexico sugar industry that reflects provisions of NAFTA, as well as related market conditions in order to forecast the outlook of the sweetener market through various simulations, encompassing hypothetical changes in Mexican sweetener situations and U.S. sugar policy.

Secondly, the study aims to provide policy recommendations by examining aggregated results from these simulations, paying attention to identify gainers and losers under different scenarios. By doing so, the study hopes to illustrate conflicts of interest among the various players in the U.S.-Mexico sweetener market.

### **Organization of the Study**

The remainder of the dissertation is organized as follows. In chapter 2, the sugar industries in both the United States and Mexico are introduced in the context of the sweetener market in each country as well as the integrated market, paying close attention to historical and political perspectives. In chapter 3, the conceptual and theoretical

framework employed to analyze U.S.-Mexico sugar trade is presented. In chapter 4 and 5, empirical procedures as well as data set used in the study and the results from the empirical study are presented. Lastly, conclusions and implications for policy are discussed in chapter 6.

## CHAPTER 2 SUGAR INDUSTRIES AND SWEETENER MARKETS IN THE UNITED STATES AND MEXICO

Sugar, one of the basic commodities with a long history of utilization, is traded in mature markets in many parts of the world with established business practices and networks. The recent trend towards freer markets in the international trade area has not left the industry unchanged. The sugar industries in the United States and Mexico are not exceptions. They have experienced more changes in the face of this recent trend towards rapid trade liberalization. In fact these two industries have become more economically inseparable than ever before as the sweetener markets in the United States and Mexico have been integrated under North American Free Trade Agreement (NAFTA). In this chapter, sugar industries in both the United States and Mexico are examined in the context of the sweetener market as well as the integrated market, paying close attention to historical and political perspectives.

First, the Mexican sugar industry and sweetener market are introduced with fundamental characteristics of the structure and government involvement. The status of Mexico as a sugar exporter is also presented in conjunction with Mexico's relation to the U.S. market under the provisions of NAFTA. Next, the development and adoption of high fructose corn syrup (HFCS) is presented. Lastly, the U.S. sugar industry and sweetener market is introduced with emphasis on the current political environment surrounding that market.

## **The Mexican Sugar Industry and Sweetener Market**

The Mexican sugar industry has a long history of playing an important role in the nation's economy and policy. A large number of small-scale sugarcane growers and antiquated sugar milling facilities still remain as the driving force of an industry under the protection of the government.

### **Mexico's Sugarcane Production**

Most regions of Mexico have a suitable climate for sugarcane production, except for the northern region of the country where the climate tends to be cooler and drier. Sugarcane production is widely spread across the southern and coastal regions of the country under different environmental conditions. Production occurs at altitudes that vary from sea level to over 1,300 meters (4,333 feet) above sea level; annual average temperature from 17 to 35 °C (from 63 to 95 °F); and annual rainfall from 500 mm to over 3,000 mm (from 20 to over 118 inches) rainfall.

In the 2001/02 crop season, total net sugarcane production in Mexico was 41.5 million MT, with a yield of 4.9 million MT of raw sugar (COAAZUCAR, 2003a). Among producing regions, the state of Veracruz has the largest production accounting for 38.5 percent of national production (COAAZUCAR, 2003a). The total area harvested in Mexico was 610,121 ha in 2002 (COAAZUCAR, 2003a), making sugarcane the second largest agricultural crop by area, following only coffee (maize, wheat, alfalfa, beans, and oranges follow sugarcane) in 2002 (SAGARPA, 2003). Although sugarcane is a relatively low maintenance crop, sometimes referred to as the "lazy man's crop," varieties have been developed with higher disease resistance, higher sucrose content, and lower fiber content, yielding better sugar production. In order to avoid poor yields, sugarcane fields are usually replanted every six or seven years (Greene, 1998).

The total number of sugarcane growers is reported as approximately 158,000 (COAAZICAR, 2003b), which is equivalent to roughly 2 percent of the total labor force in the agricultural sector (INEGI, 2003). If related workers such as sugarcane cutters, cane-transport employees, factory workers and administrative, and technical and management personnel are included, total employment in the sugar sector exceeds 1,000,000 (Garcia Chaves et al., 2002) and accounts for more than 14 percent of agricultural labor.

Land area per grower ranges from less than 1 ha, which accounts for 3.6 percent of the total sugarcane area, to over 15 ha, which accounts for 17.5 percent of the land, averaging 3.9 ha per grower (COAAZUCAR, 2003b). When the number of growers is allotted to each land size category, a skewed distribution is revealed along the land scale spectrum with many small-land holders and a few large-land holders (Figure 2-1). A large number of small-scale sugarcane growers were created as a result of the Mexican revolution and the sugar program that evolved after the revolution: the communal land (*ejido*) has been divided and distributed among farmers since the revolution and the Mexican sugar program offers social security and medical services to each grower – proving to be a large incentive for farmers to grow sugarcane.

### **Mexico's Sugar Production**

There are 60 operating sugar mills located across 15 states in the nation (Figure 2-2). Sugar mills are responsible not only for milling sugarcane, but also supervising sugarcane cultivation and organizing the harvest. This includes inspecting and advising on cultivation, scheduling harvest dates, pooling and arranging laborers, and providing trucks and drivers for the harvest.

In the 2001/02 crop season, average sugarcane yield was 70.32 MT per hectare in Mexico, yielding 4,872,388 MT of sugar (COAAZUCAR, 2003a). Irrigation is one of the factors which influences cane yield; however, irrigation systems are found only in the area where less rainfall is expected (Figure 2-3): 30 percent of total sugarcane area has no irrigation system and 25 percent has full irrigation system (COAAZUCAR, 2003c).

Harvest is the most labor-intensive part of sugarcane production; the harvest season lasts for about six months starting between November and January and ending in June in most regions, depending on weather and size of enterprise. Harvest competes for grower's labor with other winter crops since many growers are also engaged in production of crops such as maize, vegetables and citrus. Most of the harvest is carried out manually; only 9 percent of total sugarcane processed at mills is harvested by machine; 27 out of 60 mills do not employ a machine harvester at all; however, a cane loader is used in most cases (COAAZUCAR, 2003d). Since the mills own machine harvesters, cane loaders, and trucks, growers do not need to own them; however, it means growers have no means to harvest and sell their sugarcane without the mill's assistance and coordination. Similar situations regarding grower's capacity in harvest are found in other crops such as citrus.

Upon harvest, sugarcane is bought by mills from growers and processed into sugar. Sugarcane quality is vital to the sugar production process; high sucrose content cane leads to high sugar production. Yet, it is often the case in Mexico that trucks endure long waiting times to unload cane due to limited milling capacities. The average wait time observed in 2001 was almost 30 hours across mills (COAAZUCAR, 2003e). The longer trucks wait, the lower the quality of sugarcane becomes. Scattered and fragmented



sugarcane fields and poor road conditions also contribute to longer transportation time, and hence decreased sugarcane quality.

Mexico's sugar production was approximately 4.8 million MT, raw equivalent, in 2002, ranking it seventh among all cane sugar-producing nations; Brazil and India are by far the largest cane sugar-producing nations, followed by China, the United States, Thailand and Australia (Table 2-1). Production in Mexico has been increasing for the past few decades (Figure 2-4).

### **The Mexican Sugar Industry and Government Involvement**

Mexico's sugar production accounts for 0.5 to 0.7 percent of its gross domestic product (Garcia Chaves et al., 2002; Farm Foundation, 2003). Since privatizing in the late 1980s, mills have neither successfully accumulated capital nor renewed their equipment leaving the industry financially vulnerable. In 2001, the Mexican government expropriated 27 mills, which represented approximately 50 percent of sugar production in Mexico. In February 2002, the Government of Mexico announced a National Sugar Policy for 2002 – 2006 which included a series of short- and long- term measures to help Mexico's ailing sugar industry with the main objective of regulating the sugar market and making the sugar sector profitable (USDA, 2002b). Today the sugar industry remains important in Mexico because it is considered crucial for maintaining social stability due to the large number of growers and related workers.

Among the public organizations that deal with the Mexican sugar industry, Commite de la Agroindustria Azucarera (COAAZUCAR) plays an important role by monitoring and compiling sugarcane and sugar production data at each mill. Although the industry has been privatized, COAAZUCAR is in charge of determining the cane price. It took over the task from the former body, Azucar, S.A. which was dismantled in 1991