The Impact of the U.S. Sugar Program Redux

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The Sweetener Users Association, an industry group seeking to reform the current U.S. sugar program, commissioned this independent analysis.

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The Impact of the U.S. Sugar Program Redux

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Abstract: We analyze the various welfare costs, transfers, trade, and employment consequences of the current U.S. sugar program for U.S. consumers, other sugar users, sugar refiners, cane and beet growing and processing industries, other associated agricultural sectors, and world markets. The removal of the sugar program would increase U.S. consumers' welfare by $2.9 to $3.5 billion each year and generate a modest job creation of 17,000 to 20,000 new jobs in food manufacturing and related industries. Imports of sugar containing products would fall dramatically, especially confectioneries substituting for domestic inputs under the sugar program. Sugar imports would rise substantially to 5 to 6 million short tons raw sugar equivalent. World price increases would be minor, equivalent to about 1 cent per pound.

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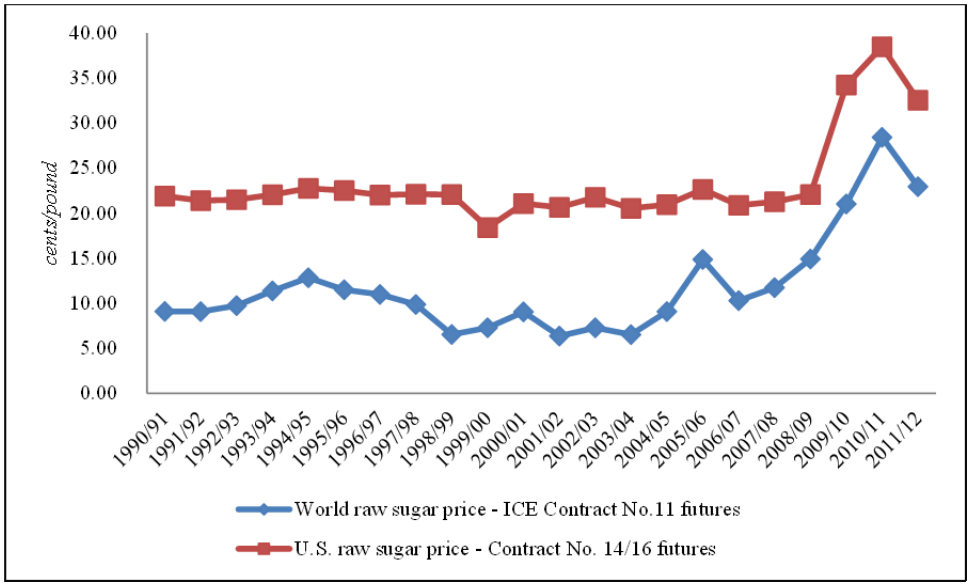
1. Introduction

The sugar industry in the United States has been heavily protected, even well before the federal sugar program was enacted in 1934. As it stands today, the sugar program provides price guarantees to sugarcane and sugar beet producers through price support loans to sugar processors, marketing allotments limiting the quantity of sugar sold by each processor, import quotas, and a feedstock flexibility program for biofuel producers.[1] The current program is administered by the U.S. Department of Agriculture (USDA) and authorized by the 2008 farm bill (Jurenas 2013). This support of sugar producers has kept the U.S. sugar prices high, typically two to three times higher than the world sugar price, as is evident in Figure 1.

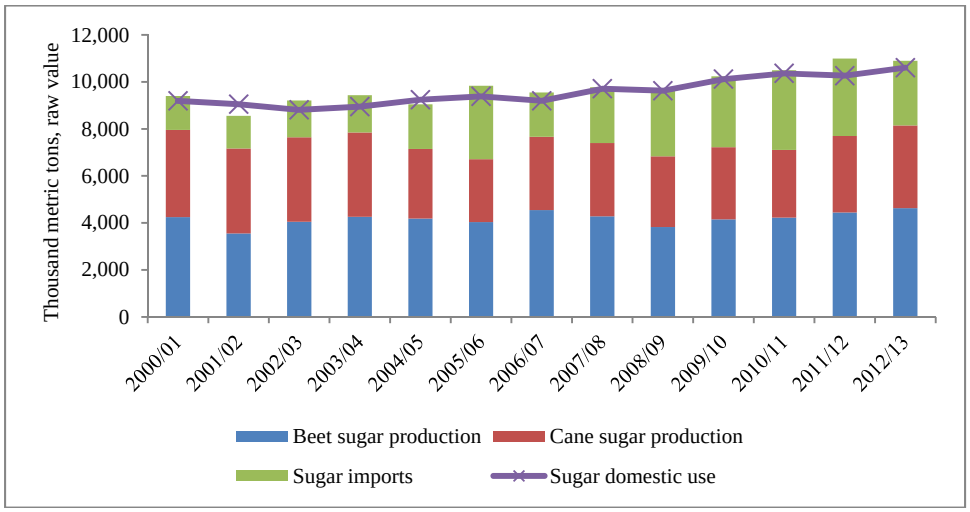


Source: USDA/ERS 2013a

Figure 1. United States and world raw sugar prices, fiscal year (Oct. to Sept.)

[1] The overall allotment quantity is set each year by USDA at not less than 85% of estimated U.S. human consumption of sugar for food. Under the Feedstock Flexibility Program, the USDA is authorized to sell surplus sugar and sugar acquired under loan forfeitures to biofuel (ethanol) producers. Jurenas (2013) provides a concise description of the program.

The United States grows both sugarcane and sugar beets for sugar production. Sugarcane is produced in Florida, Louisiana, Hawaii, and Texas. Sugar beets are grown in the Red River Valley (western Minnesota and eastern North Dakota), the Upper Great Plains (north-central Wyoming, Montana, and western North Dakota), the Central Great Plains (southeastern Wyoming, Colorado, and Nebraska), the Northwest (Idaho, Washington State, and portions of Oregon), and the Far West (California). Figure 2 presents the sugar supply and use in the United States between 2000/01 and 2012/13. Sugar production averaged about 7.5 million metric tons raw value over the last decade, with beet sugar making up about 60% of total production and sugarcane accounting for 40%. Sugar imports have been growing steadily, from 1.4 million metric tons in 2000/01 to about 3 million metric tons in 2012/13, to meet the domestic sugar demand not covered by domestic production.



Source: USDA/ERS 2013b

Figure 2. United States supply and use, fiscal year

Despite the recent drop in U.S. and world raw-sugar prices, from historic levels in 2010/11, both prices remain high with the U.S. price averaging 32.5 cents per pound in 2011/12 relative to the world's 22.9 cents per pound. Many have argued that, given the dramatic increase

in world sugar prices and the negative effects of continued high sugar prices in the United States, the sugar program should be abolished.

We present a new analysis of the various costs, transfers, and employment consequences of the current U.S. sugar program for U.S. consumers and other sugar users, sugar refiners, cane and beet growing and processing industries, other associated agricultural sectors, and associated world markets. Many assessments of the sugar program exist in the context of a unilateral policy reform (Abler et al. 2008; Beghin 2007; Beghin et al. 2003; Orden 2007; Orden et al. 2002; USGAO 2000; Wohlgenant 2011) or as part of multilateral reforms (Elobeid and Beghin 2006; Larson and Borrell 2001; Mitchell 2005; Van der Mensbrugghe et al. 2003; and Wohlgenant 1999). Three reasons motivate the analysis.

First, as mentioned above, world sugar prices have risen dramatically and are predicted to remain high in the foreseeable future. This high-price environment means that U.S. sugar producers would survive well under free trade if such high world prices prevailed in domestic markets. These high world price levels tend to magnify the much higher U.S. price level resulting from the current program. The second motivation for a new analysis relates to the employment effects of the sugar program. Although they have been debated (Promar 2011b), employment effects have not been formally analyzed. Last, imports of sugar containing products (SCPs) have expanded to circumvent the cost of the current sugar program and these imports have negatively affected economic activity in U.S. food processing sectors using sweeteners.

This paper is organized into five sections. Section 2 outlines the policy reform scenario. Section 3 provides the modeling approach with a description of the models utilized as well as the major model modifications required for this analysis. Section 4 presents the scenario results for

the producers and end users of sugar and the impacts on employment, trade, and taxpayers. Section 5 presents summary and conclusions.

2. The Policy Reform Scenario

Our analysis looks at the various impacts of removing the current program (price support, allotment) and moving to free trade in sugar as one way to assess the effects of current U.S. sugar policy, a similar approach as the Government Accountability Office (GAO) and Wohlgenant analyses (USGAO 2000; Beghin et al. 2003; Wohlgenant 2011). Looking at the complete elimination of the sugar program is a transparent way to estimate the various effects and transfers on all agents; however, Abler et al., Orden, and Orden et al., among others, investigated partial reforms. As the sugar program is removed and borders opened, U.S. imports of sugar increase and U.S. sugar prices, raw and refined, fall to their world levels. Simultaneously, the increase in imports slightly increases world prices of sugar. U.S. sugar prices fall despite higher world prices.

In addition, it is assumed that to preserve acreage of cane and beet, cane and beet processors will change their contractual arrangements with cane and beet growers to entice them to grow by offering them a larger share of the output price than the shares offered under the sugar program (see pages 9–10 for details). Last, the inventory behavioral equation is modified in the scenario—we reduce the response of inventories to the lower sugar price to moderate the magnitude of inventories to realistic levels under free trade.

The policy shocks are imposed on market projections from 2013 to 2020. The results are expressed in deviation from a baseline uniquely developed for the purpose of the analysis using an augmented FAPRI-ISU model approach, which derives and quantifies these effects in a

consistent modeling framework.[2] The approach encompasses both changes in raw and refined sugar prices. The difference between raw and refined prices has become an important development in recent years, as U.S. refined sugar prices have exhibited a high margin above the U.S. raw sugar price. With trade liberalization, both prices decrease in the United States, but with a steeper decline for the refined sugar price than for the raw sugar price. Our baseline projection is consistent with the OECD-FAO and USDA baseline projections, in that in all three baselines, world prices are expected to remain high for the foreseeable future.[3] Trade flows are of comparable magnitudes.

3. Modeling Approach

3.1. Major modeling steps

This section presents the modeling steps in a non-technical exposition. A model appendix (Appendix 1 available from the authors) provides more details and equations underlying the model. The model structure, described in more detail in the following section, is based on the FAPRI-ISU modeling system for raw sugar and sugar crops, biofuel, and associated crops, and an added U.S. food-processing sub-model specially developed for this analysis. This approach follows the spirit of the GAO analysis (USGAO 2000; and Beghin et al 2004.), which is expanded here to account for SCP imports, and the effects of the sugar program and SCP trade on employment in key food processing industries intensive in sweeteners. The food-processing sub-model provides U.S. aggregate demands for refined sugar and high fructose corn syrup (HFCS), which feed into the FAPRI-ISU models as arguments in the utilization of sugar and HFCS in the U.S. economy. The U.S. FAPRI-ISU models incorporate the important features of

[2] FAPRI-ISU is the Food and Agricultural Policy Research Institute at Iowa State University.
[3] OECD is the Organization for Economic Cooperation and Development. FAO is the Food and Agriculture Organization of the United Nations.

NAFTA. The models endogenize the world prices of raw sugar, U.S. prices of raw sugar and sugar crops, HFCS, corn and other crops linked to sugar production.

Beyond adding a U.S. food-processing module to the FAPRI-ISU models, modifications are made to account for the world supply of refined sugar and for the sugar use in foreign SCP goods imported into the United States. Although these are small relative to world supplies, they are likely to have a small effect on world prices of sugar. The SCP trade has a potential substantial effect on the output and labor use of some food-processing sectors. World sugar balances are carefully accounted for consistency and accuracy. The standard FAPRI-ISU sugar model does not disaggregate raw and refined sugar. All sugars are expressed in raw sugar equivalent. We complement the existing FAPRI-ISU sugar model with an additional component to link the world price of refined sugar to the world price of raw sugar following the removal of the refined sugar tariff rate quota (TRQ) in the United States. This point is explained in the world sugar model section below.

3.2. The FAPRI-ISU modeling system

The models used in this analysis are a sub-set of the models that are part of the FAPRI-ISU agricultural modeling system. This modeling system is comprised of international multi-market, partial-equilibrium, and non-spatial models as well as two country models for the United States and Brazil. The models are econometric and simulation models covering all major temperate crops, sugar, ethanol and biodiesel, dairy, and livestock and meat products for all major producing and consuming countries, and are calibrated on a regular basis on most recently available data. Extensive market linkages exist in these models, reflecting derived demand for feed in livestock and dairy sectors, competition for land in production, and consumer substitution possibilities for close substitutes such as vegetable oils and meat types. Agricultural and trade

policies are included in the models to the extent they affect the supply and demand decisions of the economic agents. Historical data are used to calibrate the models, and the models provide 10 or more years of projections for supply and utilization of commodities (namely production, consumption, trade, and stocks) as well as prices. Specifically for this analysis, the U.S. agricultural model, the U.S. cost of production model, and the international sugar model were used. Given the importance of Brazilian sugar and ethanol in world sugar markets, the Brazilian agricultural model and the international ethanol model were also included.

3.2.1. Description of the U.S. sugar model

The U.S. sugar model is embedded in the FAPRI-ISU U.S. agricultural model, a partial-equilibrium model that includes behavioral equations to determine crop planted acreage, domestic feed, food and industrial uses, trade, and ending stocks in marketing years.[4] The model solves for the set of prices that brings annual supply and demand into balance in all markets. For crops with by-products, behavioral equations for the by-products are also included, for example HFCS, ethanol, and corn oil from corn, and soybean meal, soybean oil, and biodiesel from soybeans. For each commodity, a market-clearing price is calculated at equilibrium.

Specifically, in the sugar module the areas planted for sugarcane and sugar beet are modeled by major producing state and are a function of real own-net returns, the real net returns of competing crops, and sugar allotments. The latter have been mostly nonbinding under the 2008 farm bill since they are set much above actual production. They also do not influence the projections. Crop production is the product of the area harvested and trend yield. Using recovery rates, sugar beet and sugarcane production is converted to raw sugar equivalent.

Raw sugar demand is determined by the real sugar retail price, HFCS domestic

[4] The U.S. agricultural model was initially developed and maintained by FAPRI at the University of Missouri-Columbia. This analysis uses a modified version of this model.

deliveries, net imports of SCPs, real consumer expenditure, and a trend. This demand is modified later to account for food processing sectors and the raw/refined sugar types (see following sections). Sugar stocks are a function of the raw sugar price and sugar production. Since the model is based on annual data, intra-year factors such as the fill rate of sugar TRQs are not easily accommodated. Exports are determined by the ratio of domestic to world sugar price and Mexican (NAFTA) sugar imports, which are determined in the international sugar model through a behavioral trade equation based on the relative Mexican to U.S. sugar price. Additionally, HFCS demand by Mexico is determined in the Mexico model and accounted for in HFCS exports in the U.S. model.[5]

The equilibrium domestic raw sugar price is achieved by equating supply and demand in the sugar market. Imports from countries other than Mexico are exogenous, reflecting the tariff rate quotas limiting U.S. imports of sugar from these countries. Other prices used in the model, namely the refined beet sugar price, the retail sugar price, the sugarcane price and the sugar beet price, are determined through price transmission equations based on the solved raw sugar price. Behavioral equations in the U.S. sugar model are explained in the modeling appendix along with the data sources for the variables.

The price received by beet farmers is based on a linear relationship between the wholesale price of refined sugar and the beet price. This represents the sharing of the beet-processing margin. This distinction is somewhat contrived, as beet farming and processing are vertically integrated in cooperatives owning the processing plants in all production areas. The aggregated returns to beet growing and processing often accrue to the same agents. The model keeps separate surplus measures for beet farmers and for the beet-processing sector. The linear

[5] The U.S. agricultural model includes supply and demand equations for HFCS and solves endogenously for the equilibrium HFCS price. This domestic HFCS price is linked to Mexico HFCS model equations to determine Mexico's demand for U.S. HFCS.

relationship between the two prices is calibrated on the most recent available beet price and wholesale refined sugar price. Given the refined beet sugar price and the sugar beet price, the gross margin for beet sugar processors is computed. The sugar beet price is a function of the refined beet sugar price as farmers get a proportion of the refined price. Once support policies are removed, the prices of both refined beet sugar and the crop would decline and the impact on the gross margin in beet processing would be a reduction in the margins. In the scenario, we assume that the share of the sugar price captured by growers increases by 45% to entice planted acreage, which would otherwise decline considerably.

The gross margin of cane processors is a function of the price they receive for raw cane sugar and the price they pay for the cane crop.[6] Although the price received by cane farmers is directly linked to the raw sugar price, both prices vary. The cane price reflects the sharing agreement between growers and processors of cane. With sugar trade liberalization, both prices fall. The raw cane sugar prices fall by more than the cane crop price since the latter is assumed to represent a larger fraction of the raw sugar price. We assume that the share of the raw cane sugar price received by growers (and offered by processors) increases by 30% with trade liberalization to entice growers to keep producing cane to be processed.

The markup between the raw and refined sugar prices is an instrumental parameter in the model since the refined price feeds back into the sugar demand and influences model results once the sugar support policies are removed. The refined beet sugar price is a function of the raw sugar price. Historically, in the last five years (2007–2011), the price differential between the two prices ranged between 4.86 cents per pound and 17 cents per pound (non-adjusted for the raw/refined conversion). The model projects this differential to be about 15 cents per pound at the beginning of the projection period and about 14 cents per pound toward the end of the

[6] This is calculated as (price of sugar x raw sugar per ton of cane) – price paid for cane.

projection period in 2020. Margins in cane refining fall to 8 cents (non-adjusted) per pound in the scenario. Note that the 8-cent non-adjusted margin is equivalent to a little more than 6 cents adjusted for the raw/refined conversion (refined sugar price-1.07 raw sugar price).

3.2.2. Description of the U.S. cost of production model

Projections for variable costs of production for crops in the U.S. agricultural model are generated in a separate cost of production model. These costs are used to calculate the expected net returns for sugar beet and sugarcane used in the U.S. sugar model to determine planted area. These costs of production are also shown in appendix 1. Since data for sugarcane variable costs are not available from USDA, the sugarcane costs are determined by multiplying the sugar beet variable costs by 1.6, based on the relative field cost information for beet and cane production presented in USDA's January 2011 Sugar and Sweetener Outlook. Data sources are also provided in the same appendix.

The cost of production model then projects variable costs for sugar beet and sugarcane (and other crops) from 2008 to 2025. For each of the cost components (seed, fertilizer, fuel, repairs, etc.), the projections are determined by the projected producer price index (PPI). Projections of price indices such as the PPI are obtained from IHS Global Insight. Once costs are determined and projected, the expected net returns for sugar beet and sugarcane can be calculated by state. The expected net returns then enter into the planted-area equations by state in the U.S. sugar model as explained above.

3.2.3. Description of the international sugar model

The international sugar model is a non-spatial, partial-equilibrium econometric world model consisting of several countries/regions, including a rest-of-the-world aggregate to close the model. Major sugar producing, exporting, and importing countries are included in the model.

The model specifies only raw sugar production, use, and trade between countries/regions and does not disaggregate refined trade from raw trade. Consequently, there is no categorization between importers as refiners or toll refiners because the countries that specialize in that role are well known and stable over time.

The general structure of the country sub-model includes behavioral equations for area harvested, yield, and production for sugar beet and sugar cane on the supply side, and per capita consumption and ending stocks for raw sugar on the demand side. Equilibrium prices, quantities, and net trade are determined by equating excess supply and excess demand across countries and regions. The sugar model uses price transmission equations to link the world and domestic markets for each country. Via the price transmission equations, the domestic price of each country or region is linked with a representative world price reported by USDA (currently ICE No. 11 futures price). For the most recent historical year, the model uses recent nearby futures prices as USDA's reported price is not available.

We incorporate a world price of refined sugar to be linked to the consumption side of the model. We maintain a five-cent difference per pound between the refined and raw sugar prices in the world market to express arbitrage in refining in world markets. As the world price of refined sugar is an FOB price quoted in non-U.S. ports, we add three cents of handling and transportation to account for the transaction cost between markets. In total, eight cents separate the raw and refined prices as landed at the United States border. For a given fixed world price of raw sugar, the perceived supply of refined sugar is horizontal at a price 8 cents above the raw sugar price (about 6 cents if accounting for 7% of sugar loss in the raw/refined conversion).

Planted area is modeled as a function of lagged planted area, lagged cane or beet sugar price, lagged prices of alternative crops, real fertilizer price, real livestock revenue, and a trend.

Yield is modeled as a function of lagged yield, the ratio of real sugar to fertilizer price, total area, and a trend. The output to input price in the yield equation captures the potential intensification impact of prices, which reflects more intensive use of inputs such as fertilizer when revenue grows faster than cost. Total area captures the extensification impact, which reflects declining yield as more marginal land is brought into production. To complement the yield intensification specification, a fertilizer component is included in which growth in yield from a purely intensification effect is associated with a change in the rate of nitrogen-phosphorous-potassium (N-P-K) fertilizer application per hectare. Crop production is the product of planted area and yield. Total sugar production is obtained by converting beet and cane production into raw sugar equivalent.

Sugar consumption per capita is determined by the real consumer price of raw sugar and income per capita. Total demand is the product of per capita consumption and population. Inventory demand is a function of lagged ending stock, sugar consumption, and the real consumer price of raw sugar.

In many countries, the beet or cane prices are set by policy and can be treated as being predetermined. Some countries lack information on the agricultural price of raw sugar, so the real consumer price is used instead of the agricultural prices in the specification of the acreage response.

The excess demand (supply) of each country enters into the world market for raw sugar and the sum of all excess demands and supplies is equal to zero by market clearing to determine the world market price. Price transmission equations account for exchange rates and other price policy wedges, such as tariffs, and transfer-service margins. The typical price transmission equation assumes that agents in each country are price-takers in the world market. Countries are

either natural importers or exporters if their autarkic price falls above or below the world price, respectively. Depending on data availability, domestic prices in the sugar model can be farm, wholesale, or retail prices. Because of the homogeneous nature of sugar, quality adjustments are not incorporated in the price transmission equations. In general, only one domestic price is used in the model. Consumer and producer prices are differentially specified only in countries that have a deficiency type of producer support or explicit tax on consumption.

This general structure is slightly modified to accommodate policy interventions other than price distortions, such as quantitative restrictions on area, supply, or trade flows. For example, imports constrained by binding tariff rate quotas are treated as exogenous and domestic prices are solved endogenously. Policy interventions providing a price floor are treated as such and are effective whenever the domestic producer price falls to the price floor level. The interaction with other components of the FAPRI-ISU commodity models is limited to cross-price effects in supply (wheat, rice, and soybeans). There are no links in consumption. Data sources for the international sugar model are further described in the appendix.

3.3. Major modifications to the FAPRI-ISU sugar models for this analysis

The allocation of final demand for sugar in the original FAPRI-ISU model is in raw sugar equivalent. It is the sum of raw cane sugar use (from imports and domestic production of both raw and refined cane sugar) and refined sugar from beet production. In the augmented model, the aggregate raw sugar use is split into refined sugar from cane plus sugar from beet (a perfect substitute for refined cane sugar), and raw sugar going as an input to sugar refining. The intermediate demand for refined sugar comes from food processing industries other than sugar industries. This intermediate demand is explained in the next section.

Among food industries processing sugar we distinguish NAICS sectors 311311

(Sugarcane Mills), 311312 (Cane Sugar Refining), and (311313 Beet Sugar Manufacturing) as the three sectors producing raw sugar and refined sugar (from raw cane sugar and beets) and employing workers. The sum of the production of sectors 311312 and 311313 constitutes the total domestic production of refined sugar or sector 31131. This production, plus the imports of refined sugar, provides the total availability of refined sugar. Imported raw sugar goes into raw sugar refining and ends up as refined sugar. The food sectors modeled in the analysis are Breakfast cereal 31123, Sugar (refined) 31131, Chocolate and confectionery 31132, Confectionery manufacturing 31133, Non-chocolate confectionery 31134, Frozen food 31141, Fruit and vegetable canning 31142, Ice cream 31152, Bread and bakery 31181, Cookies, crackers 31182, Snack food manufacturing 31191, Flavoring syrup 31193, and Soft drinks 31211. These sectors correspond to those selected in an analysis of employment effects of the sugar program by Promar International (Promar International 2011a), with the addition of "sugar," which represents retail and food service demand for sugar.

3.3.1. Modeling food processing industries

We follow and update the approach of USGAO (2000), and more recently Miao et al. (2012), to model food-processing industries. We extend these approaches by incorporating the trade of SCPs, an important source of trade diversion and indirect imports of sugar. These SCP imports are also a source of employment reduction in food industries, induced by reducing the production of SCPs at home.

The approach assumes constant-returns-to-scale technology and a price markup by food processors allowing for food prices to be above their unit cost. Constant returns imply that the cost per unit is equal to the marginal cost and equal to the sum of input prices weighted by their optimum level per unit of output. This structure implies that the change in unit cost is equal to

the change in marginal cost. Whenever the sugar input price changes, the unit cost changes accordingly in a proportion equal to the sugar price change (in percent) weighted by the sugar input cost share. The price charged by food producers-retailers is set above unit cost with a fixed price markup of 10 cents per 2007 constant dollar of retail (i.e., $1=$0.1markup margin + $0.9 unit cost). This approach abstracts from explicitly modeling the food wholesale and retail pricing behavior but acknowledges the markup. Under the assumption of constant markup, the decrease in sugar prices from removing the sugar program is transmitted to consumers of sweetener-intensive foods through lower input prices and thus output prices. Similarly, if the price of HFCS is affected by the change in sugar policy through some feedback effect via the demand for corn and the world corn price, the resulting change in the HFCS price translates into a similar proportional change in the food price.

The change in output in the food industries depends on the change in food demand and the change in trade of similar SCPs. Production is equal to domestic demand plus export demand net of imports. From this equality, changes in production output can be derived.

The intermediate demands for sweeteners in the United States are affected by, and follow from, the constant-returns-to-scale assumption maintained for food processing. They are the sum of a scale effect coming from an expansion of food output after liberalization, and the effects of lower input prices multiplied by the price elasticities of input demand with respect to sweetener prices. The sectoral sweetener input uses are aggregated over all food industries into total intermediate use of refined sugar and HFCS in food industries in the United States.

With the sugar program removal, several SCP imports decrease and SCP exports increase because of the new parity between U.S. and world sugar prices; and, domestic food demand increases through lower food prices. The sum of the three effects gives the expansion of output

in each of the 12 NAICS industries (other than sugar industries) analyzed in the investigation.

Imports of processed food are characterized by significant persistence and trade diversion to bypass the expensive sugar TRQ system. Some of these SCP imports vanish to a great extent without the sugar program rationale, as they represent an uncompetitive way to bring in sugar or compete with domestic SCPs in the United States under unfettered markets. Other SCP imports represent genuine trade integration and are little affected by changes in the sugar program. We account for the trade diversion in the modeling of SCP imports as described in appendix 1. Exports of SCPs do not show persistence (no clear time trend). The higher the U.S. sugar price is relative to the world price, the less competitive these exports are. Hence we assume that food export demands respond negatively to the relative (U.S./world) price of raw sugar as shown in Appendix 1.

3.3.2. Food demand

The approach to model food demand follows the approach used in the 2000 GAO study but considering traded goods with a market equilibrium condition including trade flows. The LINQUAD incomplete demand systems approach (LaFrance 1998) is flexible in its ability to reflect consumer preferences by incorporating the quadratic price term. The LINQUAD incomplete demand system approach is easy to calibrate while imposing proper curvature (Beghin et al. 2004) based on existing or consensus estimates of income and own-price elasticities. The system leads to an exact welfare measure for the final consumer. The specification of demand is linear in income and quadratic in food prices. The demands satisfy all traditional properties imposed on consumer demand systems.

When the sugar program is removed, new lower prices prevail for food since the unit cost of these food goods decreases as explained previously. These new prices lead to welfare gains

measured by the equivalent variation (EV) relative to original higher prices. The EV is interpreted as the dollar amount the consumer would have to be given to reach the same higher utility reached under free-trade prices, but under the higher food prices prevailing under the sugar program.

3.3.3. Employment effects

Employment effects follow from effects in food production sectors and are computed recursively because compensated labor demand hardly responds to sugar input prices. The price of labor is assumed constant because changes in these industries would be too small to influence wages. Labor is a derived demand for the labor input in the 13 NAICS industries (food processing sectors+ sugar industries). Labor is not a direct substitute for sweetener. To keep matters transparent, we assume that labor use in NAICS industries depends on the scale of activities with constant return to scale technology. Total change in labor use in food processing industries is computed by aggregating the labor changes over all food industries of interest. The data on labor use come from U.S. Census data Survey of Manufacturers. Values are available for 2010. However, the last year detail material data are available for is 2007, so we use labor data for 2007 as well to calibrate these labor effects consistently. We then recalibrate projections in 2008–2010 to match census data and then keep the same 2010 adjustment factor in later years (2013–2020).

3.3.4. Return margins of food processors

Each food processor/retailer marks up the unit cost of production to sell to consumers. Note that as we do not model retailers explicitly, we aggregate the retailing function with the processor sector. The FAPRI-ISU U.S. sugar model provides a retail price of sugar, so for that sector we can explicitly compute a retailer gross margin. Assuming the constant price margin of 10 cents

per dollar of retail food value in 2007 prices inclusive of the margin ($1=0.1 margin+0.9 unit cost), then consumer prices fall by as many cents as the corresponding unit costs do. Consumers benefit from price decreases (in cents per unit) equivalent to the dollar cost savings experienced by food processors. The changes in returns margins (returns above cost) of the food processors/sellers are then equal to the price markup (10 cents in 2007 dollars) multiplied by the expansion of output.

3.4. The calibration of the added food processing and consumer module

The calibration is explained in detail in the model appendix. Here we summarize key points and a few changes undertaken after an evaluation of the initial calibration. This calibration of the demand system initially follows similar steps as in the robust approach of Miao et al. (2012), and uses data from 2007 for food shipments. We use a similar set of elasticities but modify the own-price elasticity of final sugar demand and set it equal to -0.10. Miao et al. have a value of -0.30.

Retail prices are set initially equal to $1 in 2007 prices, except for sugar, which is explained next. The $1 prices then vary over time with various components. The cost of sweeteners reflects the use and unit cost of sugar and HFCS in the FAPRI-ISU projections. The other cost component grows with the food CPI. The return margin of 10 cents (in 2007 dollars) also grows nominally with the food CPI. Hence these nominal prices evolve during the projection period. Real prices are obtained by deflating income and prices by the general CPI re-centered on 2007. Real prices increase over the baseline period because the food CPI is projected to grow faster than the general CPI.

The retail price of sugar comes from the FAPRI-ISU model where it is specified as being determined by the lagged retail price, and the current wholesale and raw sugar prices. We modified that equation in the FAPRI-ISU model to reduce the persistence (from the lagged price

coefficient, which is reduced to 0.1, and with a doubling of coefficient on wholesale and raw sugar prices). This modification means that changes in the wholesale price translate faster into changes in the retail price of sugar. This modification is incorporated in the new baseline. In the free trade scenario we constrain the retail-wholesale margin on refined sugar not to exceed its level (in cents per pound) in the baseline in the corresponding year. This is done to convey the expected strong competition in retailing sugar to consumers.

Regarding the calibration of intermediate demand for sugar in food processing, we set the own-price elasticities of the sweetener input demands to -0.2 and the cross prices elasticities to 0.1. This is consistent with the view that these input demands for raw inputs are price-inelastic.

Finally, in calibrating SCP imports, we had to experiment and calibrate the import demands of several sectors with smaller price responses, which had been initially set too responsive. The historical data on SCP trade came from Agralytica. Agralytica also provided a transparent mapping of HS chapters into NAICS industries. We followed the latter for the most part in combination with the concordance between HS and NAICS provided by the U.S. Census Bureau. For sectors not covered by HS chapters involving sugar, we impose the sugar intensity per dollar of the corresponding domestic food-processing sector. Similarly, SCP exports exhibit the same intensity as domestic sectors and an adjustment factor is added to calibrate the projected sugar content of SCP exports on historical data.

4. Scenario Results

We present the results for the scenario in deviation from the baseline established for the analysis for the years 2013–2020. The scenario is expressed in percentage change from the baseline. Results are presented in two sets of tables. Tables 1A-1C show the results for food processors, consumers, SCP imports, and employment effects. Tables 2A-2D present results for the cane and

beet sectors and their processing, and cane refining and sugar imports. Each table shows the baseline and scenario levels. The scenario levels are shown in Appendix 2 (available upon request).[7]

4.1. Key drivers

The two key drivers of the scenario results are the arbitrage between the world and U.S. prices of raw sugar and a similar arbitrage between world and U.S. prices of refined sugar. The U.S. price of raw sugar falls by 24% to 34% (rounded) depending on the year of the projection. The wholesale refined sugar price falls by 32% to 40%, and the retail refined sugar price falls by 26% to 33%. These effects are net of the increase in the world price of sugar induced by larger imports by the U.S. economy. The raw sugar price on the world market increases by 2% to 4% or by about 1 cent per pound. These U.S. price changes reduce the cost of sugar in food processing and sugar retailing with benefits accruing to food processors and consumers. However, they induce contracting margins for all U.S. sugar industries from sugar crops to refiners. Domestic sugar production (beet sugar and raw cane sugar) initially declines about 10% and then recovers to nearly unchanged. Consumption rises about 15%, and imports rise about 80%. Cane sugar refiners operate at full capacity using raw sugar imports as input. The United States shifts from being a net importer of sugar-containing products to being a net exporter. More detailed results follow for each sector.

4.2. Food processors

Food processors experience lower cost of production by a few percentage points translating into a 1% to 3% price decrease (rounded) for the 12 processed goods. These reductions are modest

[7] There is also an appendix 3, available from the authors, that shows the macro economic variables used in the projections. These do not change between the baseline and the scenario.

because sweeteners represent a small cost share in production cost. Nevertheless, these translate to an increase in demand for their food products. These expansion effects are amplified by changes in SCP trade. There is a substantial reduction of the SCP imports, which existed to bypass the sugar program and the high cost of sugar. In addition, there is an expansion of exports of food products, which become more competitive without the sugar program. These effects are particularly potent in two sectors (Chocolate & Confectionery, and Non Chocolate Confectionery) for which output increases by 39% to 58% (first sector) and 19% to 27% (second sector). These sectors see imports nearly vanish with reductions of 88% and 86% in the later years of the projection period. Other import reductions are much more modest. In aggregate, the sugar equivalent of SCPs and other food imports falls by 37% to 58% during the projection period.

To compute return margins for food processor-retailers, we keep a constant 10 cents per dollar of shipments at 2007 prices. The expansion of the processors' margins is derived through the expansion of their output. Cost savings are assumed to be passed through to consumers. The food processors/retailers return margins increase by $770 to $975 million dollars at current prices depending on the projected year. The largest margin changes arise in the two confectionary sectors previously mentioned (see Table 1C).

These sectors use more sugar input, which explains the expansion of the intermediate demand for sugar. The intermediate use increases through two effects: the lower price of refined sugar used as input for roughly 6% to 8%, and more importantly through the expansion of output in all food sectors, summing up to roughly 18% to 23% increase in intermediate demand. The latter expansion is particularly important in the two confectionary sectors. The total increase in the intermediate use of sugar is between 25% and 30%.

4.3. Final consumers

Large gains accrue to final consumers through lower retail prices for sugar and for food items intensive in sweeteners. The prices for the 12 food products included in the consumption basket fall modestly (see Table 1B). However, these small price changes, inclusive of the lower retail sugar price, translate into $9 to $11 (rounded) of welfare gains per consumer; and, this, multiplied by the whole U.S. population, amounts to $2.929 to $3.501 billion dollars of consumer welfare gains (see Table 1C). These consumer welfare effects are larger than those obtained in the USGAO analysis because the price changes (dollar differences) induced by the policy change are much larger in the 2013–2020 projection than they were in 1996 or 1998, the two years analyzed by the GAO investigation (Beghin et al. 2003). Our consumer welfare figures are very slightly larger than those of Wohlgenant (2011), and slightly smaller than the $4 billion consumer cost estimated by Promar International (2011b) because the latter analysis used recent (2011) data when prices in the United States were at their highest level relative to their world price counterparts. Hence, our results are consistent with these reference figures.

4.4. Employment effects

Employment grows proportionally with the expansion of activities in the food processing sectors. In aggregate, the 12 sectors show between 17,000 and 20,000 (rounded) new jobs depending on the year projected (see Table 1C). The sugar crop processing sectors see some contraction but sugar refining increases as cheap raw sugar imports get refined beyond the volume refined under the sugar program. The net effect on the sugar complex is modest from -0.5% to +5.4% changes in labor use depending on the year. The latter figures can be disaggregated into the employment effects in raw sugar production, refined cane sugar production, and beet refined sugar production. Raw cane sugar production loses between 1% and 12% of its employment base

depending on the year; refined cane sugar increases its employment by 24%; and refined beet sugar production loses between 2% and 11% of its employment, depending on the year projected. The net increase in employment inclusive of the sugar sectors remains in the 16,900–20,100 range (rounded figures). The largest proportional job creations occur in the confectionery sectors because they exhibit the largest relative increases in output.

4.5. Sugar industries

4.5.1. Sugar beet and sugarcane growing industries

Historically, average net returns per cane acre have been around $126 per acre for the period 2006/7 to 2010/11, which compares roughly to recent wheat returns per acre (averaging around $124 per acre based on latest FAPRI-ISU estimates for 2009/10 and 2010/11, and also based on estimated historical net returns in our model for 2006/7 to 2010/11). In more recent years (2009/10 and 2010/11) cane net returns have been higher averaging $228 per acre as estimated in our model. Beet net returns have been much higher than most other commodities at $672 per acre (as estimated in our model for 2006/7 to 2010/11). In particular, they have been historically above corn and soybean returns. FAPRI University of Missouri at Columbia reports recent net returns for corn and soybean for 2009/10 and 2010/11 averaging $405 per acre for corn and $324 per acre for soybean. We estimate beet return for the same years averaging $863 per acre. These informal comparisons are made under several caveats given different model assumptions, land quality differences, different variability over time, and regional variation not considered here. Nevertheless, they provide some relative magnitudes.

With the removal of the U.S. sugar support policy and the consequent reduction in the domestic sugar price, sugar harvested beet area falls by a percent change between 2% and 11% depending on the year projected (see Table 2B). Given the partial lagged element in the price

expectation (current and lagged prices enter the expectation), the beet area falls more at first and then recovers with slightly higher world prices in later years. Sugarcane harvested area also declines relative to the baseline, ranging between 1% and 12%, with a similar pattern of larger reductions occurring with the partial lag in price expectation in early years and then a recovery of planted area in later years as world prices follow an upward pattern.

As shown in Table 2d, net returns fall in cane and beet growing. Sugar beet growers' net returns fall by 4% to 24% during the projection period, with the decreases being first pronounced and then tapering at the end of the projection period when world prices increase. The net returns of cane growers fall by 9.2% to 113% with similar patterns of strong decreases in early years and then a recovery of net returns later in the projection period. The variations in gross market revenues are less substantial, varying between 1% and 16% decreases for cane growers, and 2% to 14% decreases for beet growers.

4.5.2. Sugar industries

Given the reductions in sugarcane and sugar beet production, beet sugar and raw cane sugar production decline by similar percent changes. The margins of beet processors deteriorate as they receive a lower refined sugar price and have to compensate growers to entice them to plant beets. The estimated decreases in their margin range between 50% and 61%. Cane processors see their margins fall as well by 3% to 54%. U.S. sugar refiners decrease their reliance on domestic raw sugar. However, sugar refiners expand their output by about 24% as imports of raw sugar can occur at lower prices once the border is open. Refiners expand their output up to their capacity (7.2 million tons of refined sugar). Refiners see their margins (output times per unit margin) affected by two opposite forces. The margin per unit of output deteriorates, as the lower price of raw sugar does not fully offset the reduction in the U.S. refined sugar price. The per-unit margin

falls by 57% to 58% depending on the projected year. As their output expands by 24%, U.S. refiners can offset some of the losses on the per-unit margin by selling much larger volumes of refined sugar. The total margin (output times per unit margin) still falls by about 47% to 48%.

Although the declines in processor margins appear large in percentage terms, it needs to be kept in mind that these declines are relative to a baseline in which these industries' margins far exceed their historic averages due to the operation of policies in the 2008 farm bill. In fact, the scenario results can also legitimately be interpreted as returning these margins to nearer their historic levels. The lower sugar price encourages more demand for sugar, with domestic deliveries increasing by changes ranging between 14% and 17% over the projection period relative to the baseline. These changes come from increased consumer demand for sugar, increased intermediate demand for sugar in food processing, the latter being driven by a substantial decrease in SCP net imports and increase in SCP exports.

The impact on the gross margins of cane processors, cane refiners, and beet processors is summarized visually in Figure 3. The impact of the 2008 farm bill in FY 10-12 has been to increase gross margins for all sectors by roughly $4 billion annually (average of $3.390 billion for 2006/7–2008/09 and $7.426 billion for 2009/10–2011/12). The reform scenario brings these gross margins well within their recent historical values (pre 2008 farm bill) from their recent peaks in 2011/12 to an average of $3.669 billion for 2013–15 and 3.984 billion for the whole projection period as margins improve in later years.

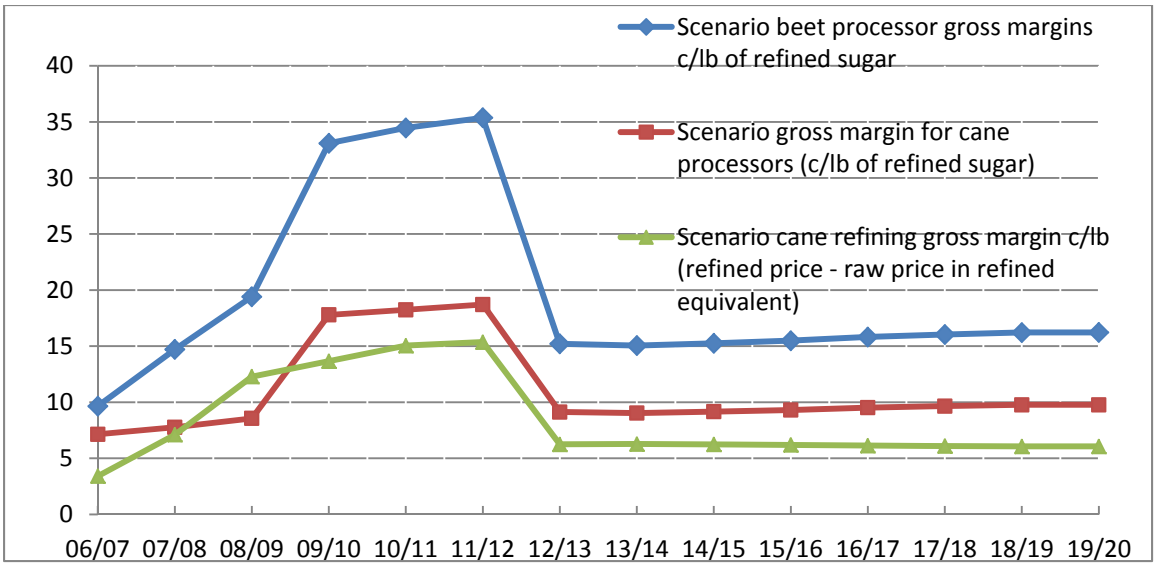


Figure 3. Gross margins in sugar processing and refining – history and scenario

4.6. HFCS sector

HFCS producers see their gross margins deteriorate because the intermediate demand for HFCS falls as the sugar input use increases in food processing. HFCS use and output fall by 3% to 4%. HFCS prices fall as a result by 3% to 6% depending on the year projected. Corn prices change little because the change in HFCS is very small relative to the total use of corn at the world level. The deterioration of HFCS margins comes solely from the decreases in output and output prices rather than from any effect on the input cost via changes in the price of corn, which is negligible. The total margins fall by 8% to 15% depending on the year projected.

4.7. Trade impact

Trade impacts comprise two components, the SCP trade impact already discussed in the food processing section, and a second concerning sugar imports. To summarize the impact of SCP trade changes, the SCP import reductions correspond to the refined sugar equivalent of these imports to fall by 37% to 59%; larger SCP exports lead to their sugar equivalent to rise by 12% to 20% during the projection period. Under free-trade, U.S. refiners would import a large amount

of raw sugar to meet their capacity to optimize their processing margins and make up for the lower raw sugar production in the United States. Total sugar imports increase substantially, with increases between 52% and 84% depending on the year projected. Both refined and raw sugar imports increase because current domestic refining capacity and beet sugar production are not sufficient to satisfy domestic demand. Refined imports reach 1.53 million tons short ton raw value (strv) when beet sugar production bottoms and then decrease progressively to 755,000 tons in 2020, but are still well above baseline levels.

4.8. Impact on taxpayers

The impact on taxpayers comprises the impact on farm program outlays, import tax revenues and income and corporate taxes. All these effects are second-round effects and tend to be small by their very nature. The impact on farm policy program outlays of the removal of the sugar program is negligible. However, by eliminating the possibility of budget outlays under the Feedstock Flexibility Program, the policy changes would presumably eliminate several hundred million dollars in future taxpayer costs (roughly $50 million annually from 2015 to 2021) that are now projected in the Congressional Budget Office baseline to 2021 (Hull, Langley, and Hitz 2011).

As commodity prices remain high(er) under the scenario and as feedback from sugar crops to other crops is limited, there are no significant changes in domestic program outlays, which are made up of decoupled payments received independently from production. This abstracts from crop insurance and other insurance programs. The change in tariff revenues from SCP trade is limited as well as many of these imports originate in Mexico and Canada for which the applied duties are zero. The “spaghetti bowl” of regional trade agreement exemptions and heterogeneous rates complicates the computation of such effects beyond stating they are likely to be small.

5. Summary and Conclusions

We analyzed the consequences of eliminating all components of the U.S. sugar program, paying special attention to welfare, trade and employment. The elimination of the U.S. sugar program and the associated import quotas and tariffs beginning with the 2012/13 marketing year would result in significant decreases in domestic sugar prices and a resulting increase in use and reliance on sugar imports. U.S. sugar production would decline by about 10% during the first half of the projection period and then recovers to the 2011/12 level by 2020/21. Impacts on world market prices are moderate.

Domestic sugar deliveries would rise as U.S.-produced foods and beverages replace products that were formerly imported. The United States once again would become a net exporter of SCPs. Sugar imports would increase by 52%–84% during the projection period. U.S. cane sugar refiners would operate at full capacity throughout the period. Imports include both raw and refined sugar because we assumed no increase in cane sugar refining capacity.

Employment would grow with the expansion of activities in the food processing sectors. In aggregate, the 12 sectors show an expansion of between 17,000 and 20,000 new jobs depending on the year projected. The net effect on the sugar complex would be modest from -0.5% to +5.4% changes in labor use depending on the year.

We find a $2.9–3.5 billion gain in consumer welfare caused by the lower sugar and food prices. This is about $10 per person. This small individual amount is typical of rent-seeking situations with diffuse losses for individual consumers and concentrated gains for producers. These gains are large in aggregate for the U.S. economy and they are explained by the high sugar prices prevailing in the period of analysis. Gross margins of sugar crop growers and processors had increased sharply with full implementation of the 2008 farm bill during 2009/10–2011/12.

They were up by an average of $4.0 billion per year to $7.4 billion. With the reform, in the projection period they fall back closer to the $3.4 billion average that prevailed during 2006/07–2008/09, averaging just below $4 billion for 2012/13 to 2019/20.

In sum, the sugar program has become costlier over time because of its welfare, employment, and trade diversion consequences. The effective rent-seeking by the U.S. sugar industry can only explain why such a costly program has remained in place for so long.

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Table 1A. Baseline: Food Processing Sectors

Year	2013	2014	2015	2016	2017	2018	2019	2020
Aggregate Sweetener measures								
Refined sugar final demand (1000 short ton (st))	4224	4279	4332	4388	4445	4503	4560	4617
Total estimated refined sugar from exports SCP (1000 st)	588	587	591	599	610	617	623	625
Total estimated refined sugar from imports SCP (1000 st)	1367	1380	1387	1385	1373	1358	1341	1327
Intermediate demand refined sugar	3771	3828	3885	3949	4023	4098	4171	4242
Total final + intermediate demand sugar (1000 short ton raw value)	8554	8675	8792	8920	9061	9204	9342	9480
Total SCP net imports (imports-exports) (1000 strv)	834	849	851	841	817	792	769	752
HFCS demand	6830	6900	6960	7056	7153	7253	7337	7425
Real food prices								
Breakfast cereal	1.043	1.042	1.040	1.040	1.040	1.040	1.041	1.042
Sugar (refined)	0.599	0.585	0.576	0.564	0.550	0.536	0.524	0.512
Chocolate and confectionery	1.059	1.058	1.056	1.055	1.054	1.052	1.052	1.052
Confectionery manufacturing	1.046	1.044	1.044	1.043	1.043	1.042	1.043	1.044
Non-chocolate confectionery	1.054	1.053	1.052	1.050	1.049	1.048	1.048	1.048
Frozen food	1.027	1.027	1.027	1.027	1.029	1.030	1.031	1.033
Fruits and vegetables canning	1.026	1.026	1.026	1.026	1.028	1.029	1.030	1.032
Ice cream	1.032	1.031	1.031	1.031	1.032	1.032	1.034	1.035
Bread and bakery	1.034	1.034	1.033	1.033	1.034	1.034	1.036	1.037
Cookies, crackers	1.043	1.042	1.042	1.041	1.041	1.041	1.042	1.043
Snack food manufacturing	1.026	1.026	1.026	1.026	1.028	1.029	1.031	1.033
Flavoring syrup	1.028	1.027	1.027	1.026	1.026	1.026	1.027	1.028
Soft drinks	1.026	1.026	1.026	1.026	1.027	1.027	1.028	1.030
Total final demand								
Breakfast cereal	9758	9884	10025	10164	10295	10430	10562	10700
Sugar (refined) (million lbs)	8448	8559	8664	8775	8891	9007	9120	9235
Chocolate and confectionery	5725	5787	5852	5915	5975	6038	6097	6157
Confectionery manufacturing	10124	10234	10348	10460	10566	10676	10782	10888
Non-chocolate confectionery	6989	7065	7143	7221	7294	7370	7443	7516
Frozen food	26366	26767	27232	27690	28106	28541	28962	29406
Fruits and vegetables canned	37160	37842	38644	39415	40063	40778	41422	42104
Ice cream	9017	9132	9257	9379	9490	9607	9718	9832
Bread and bakery	37114	37594	38128	38658	39156	39669	40172	40696
Cookies, crackers	19606	19860	20142	20422	20685	20956	21222	21498
Snack food manufacturing	24743	25062	25418	25772	26104	26446	26781	27131
Flavoring syrup	9001	9137	9296	9453	9595	9743	9887	10038
Soft drinks	49636	50192	50760	51309	51802	52338	52820	53300

Year	2013	2014	2015	2016	2017	2018	2019	2020
Exports of SCP food products (2007 $million)								
Breakfast cereal	848	847	851	858	868	875	880	882
Chocolate and confectionery	952	951	955	962	972	979	984	986
Non-chocolate confectionery	401	400	404	411	421	428	433	435
Frozen food	1373	1372	1376	1383	1393	1400	1405	1407
Fruits and vegetables canned	2645	2645	2645	2645	2645	2645	2645	2645
Ice cream	57	57	57	58	59	60	60	60
Bread and bakery	733	732	736	743	753	760	765	767
Cookies, crackers	376	375	380	386	396	403	408	410
Snack food manufacturing	729	728	733	739	749	756	761	763
Flavoring syrup	437	436	441	447	458	464	469	471
Soft drinks	491	490	494	501	511	518	523	525
Total estimated refined sugar from SCP exports (1000 metric ton (mt))	533	533	537	543	554	560	565	567

Year	2013	2014	2015	2016	2017	2018	2019	2020
SCP food imports (2007 $million)								
Breakfast cereal	411	411	411	411	411	411	410	410
Chocolate and confectionery	2349	2384	2404	2405	2384	2353	2318	2287
Non-chocolate confectionery	1747	1769	1778	1771	1747	1715	1683	1656
Frozen food	2630	2631	2627	2616	2596	2577	2560	2549
Fruits and vegetables canned	5030	5055	5075	5092	5105	5114	5121	5127
Ice cream	42	42	43	43	43	43	43	43
Bread and bakery	2354	2363	2370	2375	2379	2382	2384	2386
Cookies, crackers	673	673	673	672	670	668	667	665
Snack food manufacturing	376	382	386	388	387	385	381	378
Flavoring syrup	213	213	213	212	210	208	206	205
Soft drinks	2312	2323	2331	2336	2338	2337	2336	2335
Total estimated refined sugar from imports SCP (1000 mt)	1240	1253	1258	1257	1246	1232	1217	1204
Food production								
Breakfast cereal	11228	11354	11498	11644	11785	11927	12065	12204
Chocolate and confectionery	3712	3739	3788	3857	3948	4048	4148	4241
Confectionery manufacturing	9206	9316	9430	9542	9648	9759	9864	9971
Non-chocolate confectionery	5867	5920	5994	6084	6192	6307	6417	6519
Frozen food	25922	26322	26795	27271	27717	28178	28621	29078
Fruits and vegetables canned	37910	38568	39349	40104	40740	41445	42082	42759
Ice cream	7664	7778	7903	8026	8138	8256	8367	8481
Bread and bakery	34609	35079	35610	36142	36645	37163	37669	38193
Cookies, crackers	20050	20302	20589	20877	21152	21432	21704	21984
Snack food manufacturing	25787	26100	26456	26815	27157	27508	27852	28206
Flavoring syrup	8885	9020	9184	9348	9502	9660	9810	9964
Soft drinks	43820	44365	44929	45479	45981	46524	47013	47496
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Employment								
Breakfast cereal	13592	13766	13967	14171	14367	14564	14756	14950
Sugar	13741	13738	13817	13875	13930	13997	14071	14160
Chocolate and confectionery	7437	7483	7569	7690	7850	8026	8200	8364
Confectionery manufacturing	25571	25913	26267	26615	26944	27287	27615	27945
Non-chocolate confectionery	16770	16938	17172	17460	17802	18166	18516	18841
Frozen food	91263	92665	94327	96000	97564	99185	100739	102343
Fruits and vegetables canned	85436	86974	88800	90565	92052	93702	95192	96773
Ice cream	19255	19494	19755	20011	20244	20491	20723	20960
Bread and bakery	205907	208900	212284	215673	218880	222175	225401	228738
Cookies, crackers	50218	50898	51673	52451	53194	53950	54687	55443
Snack food manufacturing	44876	45471	46149	46831	47482	48151	48805	49478
Flavoring syrup	6731	6832	6954	7077	7192	7309	7422	7537
Soft drinks	69614	70425	71265	72084	72832	73640	74368	75088
Total employment with sugar	650411	659498	670000	680502	690332	700644	710494	720619
Total employment without sugar	636670	645760	656183	666627	676403	686647	696423	706459

Table 1B. Scenario: Impact of the Removal of the U.S. Sugar Program on Food Processing Sectors (percent change from baseline levels)

Year	2013	2014	2015	2016	2017	2018	2019	2020
Aggregate Sweetener measures								
Refined sugar final demand	3.8%	3.8%	3.7%	3.4%	3.1%	2.9%	2.7%	2.6%
Total estimated refined sugar from exports SCP	17.9%	18.0%	17.2%	15.9%	14.0%	12.7%	11.8%	11.5%
Total estimated refined sugar from imports SCP	-37.4%	-51.3%	-56.4%	-58.2%	-58.6%	-58.4%	-58.0%	-57.6%
Intermediate demand refined sugar	27.9%	30.4%	30.7%	29.9%	28.1%	26.6%	25.4%	24.6%
Total final + intermediate demand sugar	15.2%	16.3%	16.5%	16.0%	15.0%	14.2%	13.5%	13.2%
Total SCP net imports (imports-exports)	-79%	-102%	-111%	-115%	-117%	-118%	-119%	-119%
HFCS demand	-1.7%	-1.7%	-1.6%	-1.5%	-1.3%	-1.2%	-1.1%	-1.1%
Real food prices								
Breakfast cereal	-1.44%	-1.44%	-1.38%	-1.29%	-1.17%	-1.09%	-1.02%	-0.98%
Sugar (refined)	-32.4%	-33.1%	-32.6%	-31.3%	-29.3%	-27.9%	-26.8%	-26.3%
Chocolate and confectionery	-2.66%	-2.62%	-2.54%	-2.39%	-2.17%	-2.01%	-1.89%	-1.82%
Confectionery manufacturing	-1.61%	-1.58%	-1.53%	-1.44%	-1.30%	-1.21%	-1.13%	-1.09%
Non-chocolate confectionery	-2.29%	-2.22%	-2.16%	-2.03%	-1.84%	-1.70%	-1.60%	-1.55%
Frozen food	-0.13%	-0.13%	-0.12%	-0.11%	-0.10%	-0.10%	-0.09%	-0.09%
Fruits and vegetables canning	-0.08%	-0.07%	-0.07%	-0.06%	-0.06%	-0.05%	-0.05%	-0.05%
Ice cream	-0.54%	-0.52%	-0.50%	-0.47%	-0.42%	-0.39%	-0.37%	-0.35%
Bread and bakery	-0.71%	-0.70%	-0.67%	-0.63%	-0.57%	-0.53%	-0.50%	-0.48%
Cookies, crackers	-1.41%	-1.39%	-1.35%	-1.27%	-1.15%	-1.06%	-1.00%	-0.96%
Snack food manufacturing	-0.05%	-0.04%	-0.04%	-0.04%	-0.04%	-0.03%	-0.03%	-0.03%
Flavoring syrup	-0.34%	-0.24%	-0.22%	-0.20%	-0.18%	-0.17%	-0.16%	-0.16%
Soft drinks	-0.13%	-0.09%	-0.08%	-0.07%	-0.06%	-0.06%	-0.06%	-0.06%
Total final demand								
Breakfast cereal	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Sugar (refined)	3.82%	3.81%	3.68%	3.45%	3.14%	2.91%	2.72%	2.60%
Chocolate and confectionery	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Confectionery manufacturing	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Non-chocolate confectionery	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Frozen food	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Fruits and vegetables canned	3.24%	3.20%	3.03%	2.81%	2.54%	2.33%	2.17%	2.08%
Ice cream	1.30%	1.29%	1.23%	1.15%	1.04%	0.96%	0.90%	0.86%
Bread and bakery	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Cookies, crackers	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Snack food manufacturing	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Flavoring syrup	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Soft drinks	1.46%	1.45%	1.38%	1.29%	1.18%	1.09%	1.02%	0.98%
Exports of SCP food products								
Breakfast cereal	11.36%	11.41%	10.95%	10.17%	8.99%	8.21%	7.64%	7.43%
Confectionery manufacturing	10.12%	10.16%	9.76%	9.07%	8.02%	7.33%	6.83%	6.65%
Frozen food	24.02%	24.15%	23.06%	21.24%	18.52%	16.77%	15.53%	15.07%
Fruits and vegetables canned	7.01%	7.04%	6.77%	6.31%	5.60%	5.13%	4.79%	4.66%
Ice cream	0.04%	0.04%	0.04%	0.03%	0.03%	0.03%	0.03%	0.02%
Bread and bakery	16.87%	16.96%	16.24%	15.03%	13.20%	12.01%	11.15%	10.84%
Cookies, crackers	13.13%	13.20%	12.65%	11.74%	10.35%	9.44%	8.79%	8.54%
Snack food manufacturing	25.59%	25.74%	24.55%	22.59%	19.67%	17.80%	16.46%	15.98%
Flavoring syrup	13.20%	13.27%	12.72%	11.80%	10.41%	9.49%	8.83%	8.59%
Soft drinks	22.02%	22.14%	21.15%	19.51%	17.05%	15.46%	14.32%	13.91%

Table 1B (continued)

Year	2013	2014	2015	2016	2017	2018	2019	2020
Total estimated refined sugar from exports from SCP	19.61%	19.71%	18.85%	17.41%	15.26%	13.86%	12.85%	12.48%
SCP food imports								
Breakfast cereal	-0.23%	-0.35%	-0.40%	-0.41%	-0.40%	-0.37%	-0.35%	-0.33%
Chocolate and confectionery	-55.0%	-75.9%	-83.9%	-86.9%	-88.0%	-88.3%	-88.3%	-88.3%
Non-chocolate confectionery	-56.2%	-76.0%	-82.9%	-85.3%	-86.0%	-86.1%	-86.0%	-85.8%
Frozen food	-5.80%	-8.71%	-10.0%	-10.4%	-10.1%	-9.59%	-9.10%	-8.76%
Fruits and vegetables canned	-0.54%	-1.01%	-1.42%	-1.74%	-1.98%	-2.16%	-2.30%	-2.41%
Ice cream	-0.63%	-1.17%	-1.62%	-1.98%	-2.23%	-2.40%	-2.53%	-2.63%
Bread and bakery	-0.10%	-0.18%	-0.24%	-0.28%	-0.30%	-0.32%	-0.32%	-0.32%
Cookies, crackers	-2.27%	-3.40%	-3.91%	-4.03%	-3.90%	-3.70%	-3.50%	-3.35%
Snack food manufacturing	-6.89%	-12.6%	-17.1%	-20.6%	-23.1%	-24.9%	-26.2%	-27.2%
Flavoring syrup	-7.16%	-10.8%	-12.4%	-12.8%	-12.5%	-11.9%	-11.3%	-10.9%
Soft drinks	-1.03%	-1.83%	-2.43%	-2.83%	-3.06%	-3.17%	-3.22%	-3.23%
Total estimated refined sugar from imports SCP	-37.4%	-51.3%	-56.4%	-58.2%	-58.6%	-58.4%	-58.0%	-57.6%
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Food production								
Breakfast cereal	1.50%	1.49%	1.42%	1.32%	1.18%	1.08%	1.01%	0.97%
Chocolate and confectionery	38.6%	52.2%	56.8%	57.5%	56.1%	54.0%	51.8%	49.9%
Confectionery manufacturing	0.85%	0.84%	0.80%	0.75%	0.68%	0.63%	0.59%	0.57%
Non-chocolate confectionery	19.30%	25.25%	27.02%	27.09%	26.26%	25.23%	24.21%	23.39%
Frozen food	2.32%	2.58%	2.60%	2.50%	2.30%	2.12%	1.97%	1.87%
Fruits and vegetables canned	3.25%	3.28%	3.16%	2.98%	2.75%	2.56%	2.42%	2.34%
Ice cream	1.66%	1.64%	1.56%	1.46%	1.32%	1.22%	1.14%	1.09%
Bread and bakery	1.06%	1.06%	1.01%	0.94%	0.85%	0.78%	0.73%	0.70%
Cookies, crackers	1.27%	1.29%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Snack food manufacturing	1.17%	1.25%	1.26%	1.24%	1.17%	1.12%	1.08%	1.06%
Flavoring syrup	2.61%	2.66%	2.57%	2.40%	2.16%	1.98%	1.84%	1.76%
Soft drinks	1.92%	1.95%	1.90%	1.80%	1.65%	1.54%	1.45%	1.40%
Employment								
Breakfast cereal	1.72%	1.71%	1.63%	1.51%	1.35%	1.23%	1.15%	1.10%
Sugar	0.99%	-0.48%	-0.19%	0.85%	2.54%	3.93%	4.97%	5.44%
Chocolate and confectionery	33.76%	45.69%	49.84%	50.55%	49.41%	47.70%	45.89%	44.32%
Confectionery manufacturing	0.95%	0.94%	0.89%	0.83%	0.76%	0.70%	0.65%	0.63%
Non-chocolate confectionery	21.42%	28.00%	29.93%	29.95%	28.98%	27.79%	26.63%	25.68%
Frozen food	2.31%	2.57%	2.60%	2.49%	2.29%	2.11%	1.96%	1.87%
Fruits and vegetables canned	3.37%	3.40%	3.27%	3.09%	2.84%	2.65%	2.50%	2.41%
Ice cream	1.38%	1.37%	1.31%	1.22%	1.11%	1.02%	0.96%	0.92%
Bread and bakery	1.14%	1.13%	1.08%	1.01%	0.91%	0.84%	0.78%	0.75%
Cookies, crackers	1.37%	1.39%	1.35%	1.26%	1.14%	1.05%	0.97%	0.93%
Snack food manufacturing	1.28%	1.36%	1.37%	1.35%	1.28%	1.22%	1.17%	1.15%
Flavoring syrup	2.57%	2.63%	2.54%	2.37%	2.13%	1.95%	1.81%	1.73%
Soft drinks	1.80%	1.83%	1.78%	1.69%	1.55%	1.45%	1.36%	1.32%
Total employment with sugar	2.61%	2.93%	2.99%	2.93%	2.80%	2.68%	2.58%	2.50%
Total employment without sugar	2.65%	3.01%	3.06%	2.98%	2.81%	2.66%	2.53%	2.44%

Table 1C. Impact of Removal of U.S. Sugar Program on Consumer Welfare and Processing Profits

Year	2013	2014	2015	2016	2017	2018	2019	2020
Increase in total number of jobs	17005	19346	20031	19960	19355	18802	18304	18014
Increase in 12 food sector number of jobs	16868	19411	20057	19842	19001	18252	17605	17244
Welfare of individual consumer current ($/person)	10.80	10.84	10.71	10.29	9.58	9.08	8.71	8.56
Welfare of individual consumer (2007 $/person)	9.73	9.57	9.26	8.71	7.95	7.39	6.95	6.71
Total welfare of consumers (2007 $billion)	3.11	3.09	3.02	2.87	2.64	2.48	2.36	2.29
Total welfare of consumers (nominal $billion)	3.45	3.50	3.49	3.39	3.18	3.05	2.95	2.93
Food production margins (2007 $million)								
Breakfast cereal	16.81	16.93	16.36	15.41	13.95	12.92	12.15	11.83
Chocolate and confectionery	143.31	195.15	215.30	221.86	221.35	218.49	214.79	211.57
Confectionery manufacturing	7.79	7.83	7.56	7.15	6.57	6.14	5.81	5.65
Non-chocolate confectionery	113.22	149.47	161.96	164.80	162.58	159.10	155.38	152.47
Frozen food	60.04	67.92	69.74	68.13	63.62	59.61	56.24	54.40
Fruits and vegetables canned	123.29	126.33	124.24	119.66	111.93	106.15	101.70	99.90
Ice cream	12.69	12.77	12.36	11.71	10.75	10.05	9.51	9.26
Bread and bakery	36.80	37.16	36.03	34.14	31.26	29.17	27.57	26.87
Cookies, crackers	25.39	26.26	25.77	24.51	22.43	20.88	19.67	19.12
Snack food manufacturing	30.18	32.52	33.35	33.21	31.88	30.90	30.10	29.89
Flavoring syrup	23.16	24.03	23.61	22.47	20.55	19.12	18.01	17.50
Soft drinks	84.30	86.59	85.15	81.75	75.98	71.59	68.14	66.58
Change in return margins food processor except sugar sector (2007 $million)	676.97	782.96	811.43	804.80	772.87	744.12	719.07	705.04
Changes in return margins food processor except sugar sector (current $million)	770.14	909.47	962.41	974.65	956.33	940.73	928.57	929.32
Gains to sugar users (food processors + consumers) (current $billion)	4.225	4.411	4.456	4.362	4.140	3.988	3.880	3.858
Gains to sugar users (2007 $billion)	3.790	3.873	3.831	3.674	3.417	3.223	3.074	2.999

Table 2A. Baseline: U.S. Sugar Crops, Raw Sugar and HFCS Sectors

Fiscal year	2013	2014	2015	2016	2017	2018	2019	2020
Sugar beets								
Harvested area (1,000 a.)	1,107	1,099	1,095	1,087	1,083	1,079	1,076	1,075
Yield (tons/a.)	28	29	29	29	30	30	30	31
Production (1,000 tons)	31,265	31,388	31,642	31,772	31,981	32,231	32,494	32,820
Sugarcane								
Harvested area (1,000 a.)	860	836	828	821	810	800	792	784
Yield (tons/a.)	31.6	31.9	32.2	32.4	32.7	32.9	33.2	33.5
Production (1,000 tons)	27,209	26,660	26,624	26,612	26,465	26,360	26,283	26,239
Raw sugar								
Supply (1000 strv)	13,528	13,574	13,668	13,736	13,801	13,883	13,973	14,075
Beginning stocks	1,776	1,818	1,824	1,831	1,843	1,860	1,876	1,891
Production	8,352	8,343	8,418	8,477	8,532	8,599	8,673	8,761
Beet sugar	4,998	5,050	5,123	5,177	5,244	5,317	5,394	5,481
Cane sugar	3,354	3,293	3,295	3,300	3,288	3,282	3,279	3,280
Refined Production from Cane (in refined value)	5,824	5,820	5,821	5,816	5,809	5,802	5,796	5,790
Net imports	3,401	3,413	3,426	3,428	3,426	3,424	3,423	3,423
Net raw imports for refining	2,878	2,934	2,933	2,924	2,927	2,926	2,923	2,916
Refined imports	523	479	493	505	499	498	501	508
Disappearance								
Domestic deliveries	11,710	11,750	11,837	11,893	11,941	12,006	12,082	12,169
Ending stocks	1,818	1,824	1,831	1,843	1,860	1,876	1,891	1,907
Sugar-containing products Net imports	834	849	851	841	817	792	769	752
High fructose corn syrup								
Production	9,413	9,462	9,503	9,576	9,657	9,735	9,808	9,885
Domestic use	7,942	7,957	7,971	7,996	8,019	8,039	8,057	8,077
Net exports	1,471	1,504	1,532	1,580	1,638	1,696	1,751	1,808
Prices								
N.Y. spot raw sugar	37.37	37.28	37.54	37.44	37.09	36.79	36.60	36.39
Refined beet sugar	54.81	54.63	54.92	54.73	54.18	53.71	53.38	53.03
Retail refined sugar	66.46	66.25	66.60	66.57	66.19	65.84	65.62	65.40
Cane sugar loan rate	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75
Beet sugar loan rate	24.09	24.09	24.09	24.09	24.09	24.09	24.09	24.09
HFCS, 42% Midwest	24.41	24.66	25.37	25.40	25.20	25.09	25.15	25.14
World sugar price	24.03	23.86	24.43	25.09	26.06	26.71	27.23	27.30

Table 2B. Comparison Scenario - Baseline: U.S. Sugar Crops, Raw Sugar and HFCS Sectors

October-September year	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sugar beets								
Harvested area	-10.3%	-11.0%	-10.3%	-8.7%	-5.9%	-3.9%	-2.3%	-1.7%
Yield	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%
Production	-10.4%	-11.1%	-10.4%	-8.7%	-6.0%	-3.9%	-2.3%	-1.7%
Sugarcane								
Harvested area	-6.2%	-12.0%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.8%
Yield	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
Production	-6.1%	-11.9%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.7%
Raw sugar								
Supply	14.5%	15.5%	15.6%	15.2%	14.4%	13.8%	13.3%	12.9%
Beginning stocks	0.0%	11.0%	9.8%	9.4%	9.0%	8.6%	8.5%	8.3%
Production	-8.7%	-11.4%	-10.8%	-9.0%	-6.2%	-3.9%	-2.1%	-1.3%
Beet sugar	-10.4%	-11.1%	-10.4%	-8.7%	-6.0%	-3.9%	-2.3%	-1.7%
Cane sugar	-6.1%	-11.9%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.7%
Refined Production from Cane (in refined value)	23.6%	23.7%	23.7%	23.8%	24.0%	24.1%	24.2%	24.3%
Net imports	79.0%	83.6%	83.6%	78.3%	68.8%	60.9%	54.9%	52.0%
Net raw imports for refining	58.3%	63.7%	63.3%	61.4%	58.4%	55.5%	53.5%	52.6%
Refined imports	192.5%	205.4%	204.5%	176.3%	129.6%	92.8%	63.1%	48.8%
Disappearance								
Domestic deliveries	15.0%	16.4%	16.6%	16.2%	15.3%	14.6%	14.0%	13.7%
Ending stocks	11.0%	9.8%	9.4%	9.0%	8.6%	8.5%	8.3%	8.2%
Sugar-containing products								
Net imports	-79.1%	-102.5%	-111.2%	-114.7%	-116.5%	-117.7%	-118.5%	-119.0%
High fructose corn syrup								
Production	-3.3%	-3.7%	-3.7%	-3.5%	-3.2%	-2.9%	-2.8%	-2.7%
Domestic use	-3.7%	-4.1%	-4.2%	-3.9%	-3.6%	-3.3%	-3.1%	-3.1%
Net exports	-1.0%	-1.4%	-1.4%	-1.3%	-1.3%	-1.2%	-1.0%	-1.0%
Prices								
N.Y. spot raw sugar	-32.8%	-33.7%	-32.7%	-30.9%	-27.9%	-25.8%	-24.1%	-23.5%
Refined beet sugar	-39.6%	-40.1%	-39.4%	-38.1%	-35.9%	-34.2%	-33.0%	-32.5%
Retail refined sugar	-32.4%	-33.1%	-32.6%	-31.3%	-29.3%	-27.9%	-26.8%	-26.3%
Cane sugar loan rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Beet sugar loan rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HFCS, 42% Midwest	-5.6%	-3.6%	-3.2%	-2.9%	-2.6%	-2.5%	-2.5%	-2.5%
World sugar price	4.5%	3.7%	3.5%	3.2%	2.6%	2.3%	2.0%	1.9%

Table 2C. Baseline: U.S. Crop Producers & Processors and Refiner Margins

Marketing year	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Gross margin beet processors (1000 $)	3186590	3208104	3269914	3291965	3301398	3319296	3346563	3378911
Beet processor margins ($/ton of beet)	101	101	102	103	102	102	102	102
Beet processor margins (c/lb of refined sugar)	34	34	34	34	34	33	33	33
Gross margin cane processors (c/lb)	19.37	19.32	19.43	19.38	19.22	19.08	18.99	18.90
Margin for cane processors (1000 $)	1378074	1349762	1358269	1357030	1340808	1328614	1321071	1314695
Margin per unit (refined price - raw price in refined equivalence) (c/lb)	15	15	15	15	14	14	14	14
Gross margin cane refiners (1000 $)	1726490	1714928	1717653	1705944	1683526	1663626	1648016	1631834
Sugarcane returns								
Gross market revenue ($/acre)	1312	1323	1348	1358	1357	1358	1363	1368
Variable expenses ($/acre)	1101	1135	1157	1186	1206	1224	1243	1262
Net returns ($/acre)	211	188	190	172	151	134	120	106
Sugar beet returns								
Gross market revenue ($/acre)	1747	1773	1817	1843	1855	1871	1892	1911
Variable expenses ($/acre)	688	709	723	741	754	765	777	789
Net returns ($/acre)	1059	1064	1093	1101	1101	1106	1114	1123
HFCS gross margin (total) (1000 $)	2144424	2213686	2273330	2325181	2304675	2303232	2319309	2364112
HFCS (per unit) (c/lb)	15.84	16.11	16.51	16.62	16.40	16.28	16.28	16.35

Table 2D. Comparison (Scenario – Baseline) for U.S. Crop Producers & Refiner Margins (in % from baseline)

Marketing year	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Gross margin for beet processors	-60.1%	-60.6%	-60.0%	-58.4%	-55.8%	-53.8%	-52.3%	-51.6%
Beet processor margins	-55.6%	-55.9%	-55.5%	-54.6%	-53.2%	-52.2%	-51.3%	-51.0%
Beet processor margins	-55.4%	-55.7%	-55.3%	-54.5%	-53.0%	-52.0%	-51.2%	-50.8%
Gross margin for cane processors	-49.6%	-50.0%	-49.6%	-48.6%	-47.0%	-45.9%	-45.0%	-44.7%
Margin for cane processors	-50.8%	-54.3%	-53.6%	-51.6%	-48.5%	-45.7%	-43.6%	-42.6%
Margin per unit (refined price - raw price in refined equivalence)	-57.9%	-57.5%	-57.8%	-57.8%	-57.7%	-57.5%	-57.4%	-57.0%
Gross margin for cane refiners	-47.9%	-47.4%	-47.8%	-47.8%	-47.6%	-47.3%	-47.1%	-46.6%
Sugarcane returns								
Gross market revenue	-14.8%	-16.0%	-14.5%	-11.8%	-7.3%	-4.0%	-1.5%	-0.7%
Variable expenses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net returns	-92.2%	-113.0%	-102.7%	-93.0%	-65.8%	-41.0%	-17.6%	-9.2%
Sugar beet returns								
Gross market revenue	-13.7%	-14.4%	-13.4%	-11.2%	-7.7%	-5.1%	-3.1%	-2.3%
Variable expenses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net returns	-22.6%	-24.0%	-22.2%	-18.8%	-13.0%	-8.6%	-5.2%	-3.8%
HFCS gross margin(total)	-14.7%	-10.8%	-10.1%	-9.3%	-8.4%	-8.0%	-7.7%	-7.8%
HFCS (per unit)	-8.6%	-5.4%	-4.9%	-4.4%	-3.9%	-3.8%	-3.7%	-3.9%

Appendix 1
Modeling Approach for the Analysis
John Beghin and Amani Elobeid

1. Introduction

This appendix further describes the modeling approach specified to conduct the analysis of the impact of the U.S. sugar program for the SUA. This is a rather technical document as it describes model structure. Equations are contained in appendix tables and are written with the full name of the variables to simplify the reading of the document. The general approach is described in the body of the report.

The Policy Reform Scenario

The analysis looks at the impact of removing the current U.S. sugar program and associated trade barriers. As the sugar program is removed and borders open, U.S. imports of sugar increase and U.S. sugar prices fall. Simultaneously, the increase in imports affects world prices of sugar and associated markets and crops. The net effect on U.S. sugar prices is negative. The decrease from the removal of the TRQ and associated tariffs is larger in absolute value than the increase in world prices resulting from larger U.S. sugar imports. The augmented FAPRI model approach derives and quantifies these effects in a consistent modeling framework. We model both changes in refined and raw sugar prices. The difference between raw and refined prices has become an important development in recent years. U.S. refined sugar prices have exhibited a high margin above the U.S. raw sugar price. With trade liberalization, both prices decrease in the United States, but with a steeper decline for the refined sugar price than for the raw sugar price.

Major Modeling Steps

The following sections of the document first describe the structure of the FAPRI models with much detail including equations specifications and data sources. Then, the note follows with the added module on food demand including SCP trade.

2. The FAPRI Model

U.S. Cost of Production Model Description

How sugar beet and sugarcane cost of production projections are generated

Projections for variable costs of production for the two crops are generated in a cost of production model. These costs are used to calculate the expected net returns for sugar beet and sugarcane used in the U.S. sugar model to determine planted area,. Appendix table 1.1 shows the historical data for the variable cost of production for sugar beet and sugarcane. Since data for sugarcane variable costs are not available from USDA, the sugarcane costs are determined by multiplying the sugar beet variable costs by 1.46. Based on the field cost information presented in the January 2011 Sugar and Sweetener Outlook, this ratio is now higher at 1.6. The ratio of 1.6 was calculated based on the weighted average field cost for sugarcane divided by the weighted average field cost for sugar beet (weighted by the respective production shares). The costs were averaged over the 2005/06–2009/10 period (USDA/ERS, 2011).

Appendix Table 1.1. U.S. sugar beet and sugarcane variable cost of production

	2000	2001	2002	2003	2004	2005	2006	2007
Sugar Beet								
Seed	44.21	44.55	46.63	46.46	50.13	51.22	55.09	62.02
Fertilizer	46.86	59.24	47.41	57.45	59.22	67.28	72.5	89.03
Ag. chemicals	94.28	96.12	95.96	96.39	94.73	97.53	101.1	103.3
Custom services	36.04	32.23	32.77	34.54	34.92	36.24	36.86	37
Fuel	50.9	49.81	47.95	50.53	55.93	71.38	80.38	87.14
Repairs	41.42	43.6	45.78	47.38	48.26	48.95	50.37	51.66
Miscellaneous	36.43	36.15	36.07	38.61	40.27	43.87	50.58	54.22
Hauling allowance	-7.69	-7.31	-7.43	-7.29	-7.45	-8.32	-8.64	-9.65
Hired labor	58.7	60.45	61.76	63.53	66.62	69	72	74.13
Interest	10.31	6.02	2.92	1.93	3.03	7.08	10.75	10.85
Total variable costs	411.5	420.9	409.8	429.5	445.7	484.2	521	559.7
Sugarcane	600.7	614.5	598.3	627.1	650.7	707	760.7	817.2
Ratio of sugarcane to sugar beet costs	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46

Source: USDA/ERS Commodity Costs and Returns: Data
http://www.ers.usda.gov/Data/CostsAndReturns/TestPick.htm
Note: Data in the FAPRI models are updated to the latest historical numbers. In the case of cost of production variables, these are available only up to 2007 from USDA.

The cost of production model then projects variable costs for sugar beet and sugarcane (and other crops) from 2008 to 2025. For each of the cost components (seed, fertilizer, fuel, repairs, etc.), the projections are determined by the producer price index (PPI) as follows:

Cost of component in period t = Producer price index of component in period t/producer price index of component in period t-1)* cost of component in period t-1.

For example:

U.S. Seed $cost_t$ = (PPI_t seed/PPI_{t-1} seed)*U.S. seed $cost_{t-1}$

U.S. hired labor $cost_t$ = (PPI_t wages rates/PPI_{t-1} wages rates)*U.S. hired labor $cost_{t-1}$

Appendix Table 1.2 shows the producer price indices used in the projection of each cost component.

Appendix Table 1.2. Producer price index

Cost Component	Producer Price Index 1990–1992=100
Seed	Seed – Total
Fertilizer	Fertilizer – Mixed
Agricultural chemicals	Agricultural chemicals – Herbicide
Custom services	Farm services
Fuel	Fuel
Repairs	Repairs
Miscellaneous (other variable costs)	Farm supplies

Hauling allowance	Fuel
Hired labor	Wage rates
Interest on operating capital	Interest

Source: Agricultural Prices, USDA/NASS, http://quickstats.nass.usda.gov

Behavioral equations are used to obtain the projections for the different producer price indices. Appendix Table 1.3 presents the right-hand-side (RHS) variables in the behavioral equations for each producer price index.

Appendix Table 1.3. PPI equation variables

Producer Price Index*	RHS Variables
PPI Seed Total	Lag(PPI seed/PPI all commodities); Adoption of GMO
PPI Fertilizer – Mixed	0.8*(PPI electric power/PPI all commodities)+0.2*(PPI utility natural gas/PPI all commodities); Prime rate at commercial banks
PPI Agricultural Chemicals – Herbicide	Lag(PPI ag chemicals-herbicide/PPI all commodities); (PPI chemicals & allied products/PPI all commodities); Adoption of GMO – Herbicide
PPI Farm Services	Lag(PPI farm services/PPI all commodities); (employment cost index/PPI all commodities)
PPI Repairs	0.7*(PPI automobiles/PPI all commodities)+0.3*(PPI metals and metal products/PPI all commodities); employment cost index/PPI all commodities
PPI Farm Supplies	Lag(PPI farm supplies/PPI all commodities); 0.8*(PPI rubber and plastic products/PPI all commodities)+0.2*(PPI fuel, related products and power/PPI all commodities)
PPI Fuel	0.7*(PPI refined petroleum products/PPI all commodities)+0.3*(PPI fuel, related products and power)
PPI Wage Rates	Employment cost index/PPI all commodities
PPI Interest	0.2*prime rate at commercial banks+0.8*yield on AAA-rated corporate bonds; trend for farm debt level

Source: Agricultural Prices, USDA/NASS, http://quickstats.nass.usda.gov Note: In the equations, all PPI are divided by the "PPI all commodities" to generate the PPI projections (which are then multiplied by "PPI all commodities" to be used in the cost equations).

All the right-hand side price indices in Appendix Table 1.3 are obtained from IHS Global Insight including the projections. The projections for the regional cost components are obtained using the growth rate of the national cost component. For example for seed, the regional seed cost is determined as follows:

Regional seed $cost_t$ = Regional seed $cost_{t-1}$*(U.S. seed $cost_t$/U.S. seed $cost_{t-1}$)

There are 4 regions: Great Lakes, Red River Valley, Great Plains and Northwest.

Once regional costs are determined and projected, the expected net returns for sugar beet

and sugarcane can be calculated by state using the following formula:

Sugar beet expected net returns for each state = Lag(price*yield) –Lag(costs)

The expected net returns then enter into the planted area equations by state as described in the following section.

U.S. Sugar FAPRI Model Description

This section presents the detailed equations of the U.S. sugar FAPRI model. Appendix Table 1.4 presents the behavioral equations in the model. Appendix Table 1.5 presents the data sources for the model.

Appendix Table 1.4. Sugar equations in the U.S. model

Dependent variable	Equation	Comments
Sugar allotments under FCEA*	Sugar domestic deliveries+0.13*total use (normal stock proxy) – imports (TRQ & others) – beginning stocks	Total use is sugar domestic deliveries + exports
Beet sugar allotment	0.5435*sugar allotments under FCEA	
Cane sugar allotment	Sugar allotments under FCEA minus beet sugar allotments	
Expected sugar beet price	Ratio = [Intercept+α*lag(U.S. sugar beet yield/U.S. sugar beet trend yield)]*U.S. sugar beet price	Parameters α, β,θ, etc. are equation specific in all the equations in Appendix table 1.4. Sugar beet price * expected sugar beet price ratio + additive adjustment
Expected sugarcane price	Ratio = [Intercept+α*lag(U.S. sugarcane yield/U.S. sugarcane trend yield)+ β*lag(U.S. sugar beet yield/U.S. sugar beet trend yield)]* U.S. sugarcane price	Sugarcane price*expected sugarcane price ratio + additive adjustment
Beet sugar recovery rate	Intercept + α*(time –1980)	
Cane sugar recovery rate	Intercept + α*(time–1980)	
Sugar beet expected net returns, by state (California, Colorado, Idaho, Michigan, Minnesota, Nebraska, North Dakota, Oregon, Wyoming)	Revenue by state – beet expenses by regions	Revenue = (state sugar beet price*expected sugar beet price)/(U.S. sugar beet price * state sugar beet trend yield)
Sugarcane expected net returns, by state (Florida, Hawaii, Louisiana, Texas)	Revenue by state – sugarcane expenses by regions	Revenue = (state sugarcane price*expected sugarcane price)/(U.S.

		sugarcane price * state sugarcane trend yield)
Sugar beet yield or sugarcane yield, by state	Intercept + α*(time –1980)	
Sugar beet area planted, by state	Intercept + α* **state** sugar beet real expected net returns – θ*Max(0, (**state** sugar beet expected net return – 2000/GDP deflator)) – $\sum_{i=1}^{n}$ (β_i * *n* competing crops' real expected net returns for the region) + λ * (time – 1980) + allotment effects	

* Sugar allotments were effective historically but since sugar production is lower than the allotment levels in the recent past and in the projections, they no longer have an effect on area.

Appendix Table 1.4. (continued)

Dependent variable	Equation	Comments
Sugarcane area planted, by state	Intercept + α* **state** sugarcane real expected net returns – θ*Max(0, (**state** sugarcane expected net return – 3000/GDP deflator) + μ*lag(**state** sugarcane real expected net returns) – lag[Max(0, (**state** sugarcane expected net return – 3000/GDP deflator))] – $\sum_{i=1}^{n}$ (β_i * *n* competing crops' real expected net returns for the region) - λ * (time – 1980) + allotment effects	
Sugar deliveries per capita	Intercept – α*sugar retail price/CPI – β*HFCS domestic deliveries/population – θ*net imports of sugar-containing productions/population + λ*LN(real consumer expenditure/population) – μ*trend for 2000-2002	Total sugar deliveries per capita = Sugar deliveries from LINQUAD + residual deliveries
Sugar exports	Intercept – α*U.S. raw sugar price/world raw sugar price + β*Mexican sugar imports	
Sugar non-CCC stocks	Intercept – α*real raw sugar price + β* sugar production + θ*(sugar allotment dummy*Max(0, sugar production – sugar allotment)) – λ*CCC stocks	
Sugar CCC stocks	Intercept + α*lag(CCC stocks) + β*Max(0, cane sugar loan rate – 0.87* 2-year average of raw sugar price) + λ*Max(0, beet sugar loan rate – 0.93* 2-	

	year average of refined beet sugar price)	
Sugar-containing product net imports	Intercept + α*lag(sugar-containing products net imports) + β*U.S. raw sugar price/world raw sugar price + λ*(time – 1980)	SCP net imports from LINQUAD so this equation is not used
Refined beet sugar price	Intercept + α*U.S. raw sugar price – β*(time – 1980)	
Retail sugar price	Intercept + α*lag(retail sugar price) + β*U.S. raw sugar price + λ*refined beet sugar price + θ*(time – 1980)	
Sugarcane price	Intercept + α*U.S. raw sugar price * x*cane recovery rate/100 * 20	x=1 in the baseline; x=1.3 in the scenario*
Sugar beet price	Intercept + α*U.S. refined beet sugar price * x*beet recovery rate/100 * 20	x=1 in the baseline; x=1.45 in the scenario**

* This reflects a larger share of the sugar price accruing to sugarcane farmers with the removal of the sugar policy relative to the baseline.

** This reflects a larger share of the sugar price accruing to sugar beet farmers with the removal of the sugar policy relative to the baseline.

Appendix Table 1.5. US Sugar Model Data Sources

Sugar data	Unit	Data Source
Sugar allotment Beet sugar allotment Cane sugar allotment	1000 tons, raw	Sugar & Sweetener Outlook
Sugar production Beet sugar production Cane sugar production Sugar total imports Sugar TRQ imports Sugar other program imports Sugar high-tier & other imports Sugar NAFTA duty-free imports Sugar domestic deliveries Sugar exports Sugar ending stocks Sugar non-CCC stocks Sugar CCC stocks (1000 tons, raw)	1000 tons, raw	Sugar & Sweeteners Yearbook
Sugar NAFTA high-duty imports	1000 tons, raw	Sugar & Sweeteners Outlook
Sugar RY raw price Refined beet sugar price Sugar retail price	cents per pound	Sugar & Sweeteners Yearbook
Cane sugar loan rate	cents per	FSA

Beet sugar loan rate	pound	
Sugar beet price Sugarcane price	dollars per ton	USDA/NASS Online Database
Net imports of SCPs	1000 tons, raw	Sugar & Sweeteners Outlook
Beet area planted, US & by state Beet area harvested, US & by state Sugar beet production, US & by state All sugarcane area, US & by state Cane for sugar area, US & by state Cane sugar production, US 7 by state	1000 acres	USDA/NASS Online Database
Sugar beet price by state Sugarcane price, by state	dollars per ton	USDA/NASS Online Database
Beet variable expenses US and by region	dollars per acre	ERS website (pre-2000, takes 20% of interest)
Macro-data		
GDP Deflator	index	IHS Global Insight
CPI	index	US Department of Labor, Bureau of Labor Statistics
Real consumer expenditure	Billion 1992 dollars	IHS Global Insight
Population	million	US Census Bureau

More Details on the International Sugar FAPRI Model

This section complements the model description in the paper by providing more details on the price transmission equations and data sources. Price transmission equations account for exchange rates and other price policy wedges, such as tariffs and transfer-service margins. The typical price transmission equation assumes that agents in each country are price-takers in the world market. Countries are either natural importers or exporters if their autarkic price falls above or below the world price, respectively. Abstracting from any spatial consideration and assuming an "ad valorem tariff only" regime, the domestic price can be expressed as $P^d = \alpha + \beta * P^w * r * (1+d)$, where P^d is the domestic price, P^w is the world price of sugar including international transportation cost if the country is an importer (FOB price for exporters), r is the exchange rate, and d summarizes policy interventions between the world and domestic markets and is expressed in ad valorem form. Parameter α captures the divergence of the domestic and border price that does not depend on the price level but rather reflects transaction costs arising between farm-gate and the marketplace, and/or marketing markups. Parameter β allows imperfect transmission between world and domestic prices.

Data for sugar production, consumption, trade, and ending stocks are obtained from the USDA-FAS (Foreign Agricultural Service) Production, Supply, and Distribution (PS&D Online) data set. Additional data for area, yield, sugarcane and sugar beet production, as well as prices and policies are gathered from the USDA FAS GAIN Reports (various years) and the Food and Agricultural Organization (FAO) of the United Nations. Cane and beet production is tied to

sugar production through the extraction rate. Macroeconomic data such as real GDP, GDP deflator, population, and exchange rate were gathered from various sources, including the International Monetary Fund and IHS Global Insight. Population data is from IDB, U.S. Census Bureau.

3. Modifications to the FAPRI Sugar Models for the SUA Analysis

The demand for Sugar in the SUA Analysis

Appendix Table 1.6 shows the 13 sectors used in the demand system for the representative consumer. The same set of sectors is used in modeling food processing using sweeteners.

Appendix Table 1.6. Sectors included in the food processing and consumer demand modeling

Food Sectors in the SUA analysis and NAICS code
Breakfast cereal 31123
Sugar (refined) 31131
Choc & confec. 31132
Confec. Mfg 31133
Nonchoc confec 31134
Frozen food 31141
Fruit & Veg can 31142
Ice cream 31152
Bread & Bakery 31181
Cookies, cracker 31182
Snack food man 31191
Flavoring syrup 31193
Soft drinks 31211

Modeling food processing industries

We follow the approach of GAO (2000) and more recently Miao et al. (forthcoming) to model food processing industries. We extend these approaches by incorporating the trade of sugar containing products (SCPs), an important source of trade diversion and indirect import of sugar. These SCP imports are also a source of employment reduction in food industries, induced by reducing the production of SCPs at home.

In a nutshell, the approach assumes constant return to scale technology and a price markup by food processors allowing for food prices to be above their unit cost. Constant returns imply that the average cost is equal to the marginal cost and equal to the sum of input prices weighted by their optimum level per unit of output. This structure implies that the change in unit cost is equal to the change in marginal cost and is also equal to the sum of the proportional changes in underlying input prices weighted by their cost shares. See first equation in Appendix table 1.7. The new price (without the sugar program) is equal to the old price under the program multiplied by (1+ the percent change implied by equation (1)). In the Appendix table, *d* ln indicates the log differential of any variable, the cost share of input is the share of the input in total cost in industry *j*. Whenever an input price changes, such as the sugar input price, the unit cost changes accordingly in a proportion equal to the input price change (in %) weighted by the input cost share.

The price charged by food producers-retailers is set above unit cost with a fixed price

markup (Equation (2)). We assume this markup remains approximately constant given that the change in prices will be small as sugar inputs are a relatively small share of retail food prices. This approach abstracts from explicitly modeling the food wholesale and retail pricing behavior but acknowledges the markup. This markup can be analyzed further in sensitivity analysis.

Under the assumption of constant markup, the decrease in sugar prices from removing the sugar program is transmitted to consumers of sweetener-intensive foods through lower input prices and thus output prices. This is shown in Equation (3). The implicit tax from the sugar program on the refined sugar input price would vanish. The refined sugar price paid by U.S. food industries and by U.S. consumers (for non-industrial uses) is inflated by the sugar program. A change in the U.S. sugar program has two effects on the sugar price paid by food processors. The implicit tax is removed but the world price of refined sugar increases as U.S. sugar imports increase, because of increasing scarcity on world sugar markets.

Similarly, if the price of HFCS is affected by the change in sugar policy through some feedback effect via the demand for corn and the world corn price, the resulting change in the HFCS price will translate into a similar proportional change in the food price. The change in the sugar program would then lead to a change in the price in food processing sectors as shown in equation (5). Equation (5) summarizes the price decrease food industries would experience in absence of the sugar program. This assumes that the food industries pass on their cost savings to consumers. The change in their output depends on the change in food demand and the change in trade of similar SCPs. This is explained below after the description of the demand for sweetener in food processing.

Appendix Table 1.7. Equations for the modified refined sugar demand

Variable explained	Equation and equation number	Comments
% Change in the unit cost of food production sector *j* (% change)	$d\ln unit\ cost_j = \sum_{k=sweeteners} share_{jk} d\ln price_{input\ k}$ (1)	Shares are cost shares (cost of input k/total cost). Considers two prices (HFCS, sugar)
Price markup in food sector *j* ($ per pound)	$markup_j = price_{food\ j} - unitcost_j$ (2)	This markup is assumed constant; this assumption can be changed to no pass-through to consumers but cost savings to processors
Change in U.S. refined sugar input price (cents per pound)	$dprice_{sugar} = dworldprice_{sugar} - price\ wedge\ from\ sugar\ program$ (3) See the U.S. sugar model Appendix table for the equation determining U.S. price of refined sugar under the program Price wedge=U.S. refined price-world refined price	The new refined sugar price contains two effects: the removal of the tax from the sugar program and an increase in the world price of refined sugar
Change in world price of refined	$d\ worldprice_{sugar} = d\ world\ price_{raw\ sugar}$ (4)	This comes from the link of the two world prices

sugar (cents per pound)		by a constant markup of 4 cents
Change in food price in sector *j* (cents per unit)	$dprice_{foodj} = dunit\ cost_j = unit\ cost_j \left[share_{jsugar} d\ln price_{sugar} + share_{jhfcs} d\ln price_{hfcs} \right]$. (5)	The change in unit cost from lower sweetener prices passed on to food prices
% Changes in input demand for sweeteners(sugar, HFCS) in food industries (percent changes)	$d\ln input\ use_{sugarj} = d\ln output_{foodj} + \sum_{k=sugar,hfcs} elasticity_{sugar\ kj}\ d\ln price_{input\ k}$, and $d\ln input\ use_{hfcsj} = d\ln output_{food\ j} + \sum_{k=sugar,hfcs} elasticity_{hfcs\ kj} d\ln price_{input\ k}$. (6)	The elasticities are the own- and cross-price elasticities of sweetener demands in food sector j. these elasticities are set to -0.2 for own prices and +0.1 for cross price effects as explained in the report
Change in aggregate demand for sugar and HFCS in food processing (all sectors) (Tons of refined sugar and tons of HFCS)	$dtotal\ input\ use_{sugar} = \sum_{j=1}^{11} dinput\ use_{sugar\ j}$, and $dtotal\ input\ use_{hfcs} = \sum_{j=1}^{11} dinput\ use_{hfcs\ j}$. (7)	This is just the sum of the changes in input in each food sector (see (6)) summed up over the 11 food sectors

Equilibrium in food industry *j* (units in real dollars with price set to 1 in 2007)	$output_{foodj} + import_{foodj} = export_{foodj} + demand_{foodj}$ (8	Supply (import+domestic output)=demand (export + domestic demand) in each food sector
Imports of SCP food items per food sector (food units in real dollars)	$import_{foodj}$=intercept$_{importj}$+slope1$_{importj}$ lagged $import_{food}$+slope2$_{importj}$ ($price_{rawsugar}$/$world\ price_{raw\ sugar}$) (9) all slopes are positive and specific to HS chapters mapped back into NAICS sectors. Imports are constrained to be non-negative	This specification reflects current FAPRI equation. We could use the ratio of refined sugar prices as the driver of imports rather the raw sugar price ratio
Exports of SCPs (food units in real dollars of exports)	$export_{foodj}$=intercept$_{exportj}$+ slope$_{exporttj}$ ($price_{rawsugar}$/$world\ price_{raw\ sugar}$) (10) the slope is negative and sector specific.	Is in (9), the price ratio could be for refined sugar rather than raw sugar
Food demand in sector j (real dollars units)	$demand_{foodj} = \varepsilon_{foodj} + \sum_{k=1}^{2} price_{foodk} v_{jk} + \chi_j [Income - \sum_{k=1}^{12} \varepsilon_{foodk} price_{foodk} - \frac{1}{2} \sum_{k-1}^{12} \sum_{i=1}^{12} (price_{foodk} v_{ij} price_{foodi})]$ (11)	Elements v_{ij} come from a symmetric negative definite matrix calibrated on price elasticities and levels of demand quantities and prices. elements ε are also calibrated from similar data. χ is derived from income

		elasticities and demand and income levels
Marshallian demand price elasticity (unit less)	$\eta_{jk}^{M} = [v_{kj} - \chi_j(\varepsilon_k + \sum_{t=1}^{12} v_{kt}\, price_{foodt})]\frac{price_{foodk}}{demand_{foodj}}$ (12)	Elasticity values are used in combination with levels of prices and demand to identify parameters ε and v
Income elasticity (unit less)	$\eta_{jI} = \chi_j \frac{Income}{demand_{foodj}}$. (13)	Parameters χ are recovered using elasticity estimates, income and demand levels
Equivalent variation (dollars)	$EquivalentVariation =$ $(Income - \boldsymbol{\varepsilon}' price_{\substack{new \\ food}} - \frac{1}{2} price_{\substack{new \\ food}}' \mathbf{V} price_{\substack{new \\ food}})$ $\exp(\boldsymbol{\chi}'(price_{\substack{old \\ food}} - price_{\substack{new \\ food}}) -$ $(Income - \boldsymbol{\varepsilon}' price_{\substack{old \\ food}} - \frac{1}{2} price_{\substack{old \\ food}}' \mathbf{V} price_{\substack{old \\ food}})$ (14)	Matrix V is made of the elements v in previous equations. Similar remark for vectors ε and χ. exp is the exponential function
Relative change in labor use in industry *j* (workers)	$dlabor\ use_j = (labor\ use_j / output_{food\ j})\, doutput_{foodj}$ (15)	The change in labor is driven by the scale effect in these industries. No price effect is included because sweetener and labor have small cross price responses.
Total change in labor (workers)	$dtotal\ labor\ use = \sum_{j=1}^{12} dlabor\ use_j$ (16)	Just a simple aggregation
Change in profits in food processing sector j. (dollars of profits)	$dprofit_j = price\ markup_{food\ j}(doutputf_{oodj})$ (17)	

Next, in Equation (6) we look at the demand for sweeteners in the United States. To see what will happen to sugar and HFCS uses under sugar reform, we express the intermediate demands for sweetener (sugar, HFCS) in each food industry *j* as they are implied by constant return to scale. They are the sum of a scale effect coming from an expansion of food output and consumption after liberalization and the effects of lower input prices multiplied by the price elasticities of input demand with respect to sweetener prices. These price and scale effects are summarized in Equation (6).

The cross- and own-price elasticities of the sweetener input demand are based on Miao et al. and reflect the consensus view that demand for commodity input tends to be price inelastic.

Then, these sectoral input uses have to be aggregated over all food industries to yield the total intermediate use of refined sugar and HFCS in food industries in the United States. This aggregation is shown in Equation (7).

Food industries trade and equilibrium

Next, we address the expansion of domestic output (and consumption) of food processing industries to derive the scale effects $d\ln output_{foodj}$ in each industry *j* resulting from the sugar reform. The scale effect boosts sugar and HFCS input demand beyond their response to price effects. From market equilibrium in each food industry *j*, we know that the sum of domestic

production and imports is equal to the sum of domestic consumption (domestic demand) and export demand (foreign demand for U.S. food goods), as shown in Equation (8).

With the sugar program removal, several SCP imports decrease and SCP exports increase because of the new parity between U.S. and world sugar prices; and domestic demand increases through lower food prices. These three effects summed up in Equation (8) give the expansion of output in sector j in the 12 NAICS industries analyzed in the investigation. We explain the specification of the three components (imports, exports, domestic demand) sequentially.

Imports of processed food are characterized by significant trade diversion to bypass the expensive sugar TRQ system. Some of these SCP imports would vanish to a great extent without the sugar program rationale as they represent an uncompetitive way to bring in sugar or compete with domestic SCPs in the US under unfettered markets. Other SCP imports represent genuine trade integration and are little affected by the change in the sugar program.

Looking at imports by HS chapter, in chapter 17, three quarters of these imports are sugar confectionery. These would vanish entirely and revert to U.S. food industries. The last quarter represents imports that would "survive" the removal of the sugar program. In chapter 18, about three-quarters of the imports are bulk chocolate confectionery ingredients and one quarter retail. Most of the bulk trade too would fade away as there is no advantage to originating the cocoa portion via Mexico and would be replaced by U.S. substitutes. Chapters 19, 20, and 22 imports reflect trade integration growth caused by greater integration in NAFTA economies rather than the sugar program distortions. In HS chapter 21 the main items are bulk food preparations like iced tea and other beverage mixes, and gelatin/sugar mix. Import of those would probably decline considerably and be replaced by domestic substitute. We posit these would decrease considerably but not vanish.

Changes in SCP imports are driven by the sensitivity of these imports to the difference between the high sugar price and the world price of sugar. "Trade diversion" imports are highly sensitive to this relative price. Accordingly, we disaggregate imports of SCPs into three groups.

Imports under HS 17 and 18 are a function of the ratio of U.S. and world sugar prices with a very high elasticity and lagged SPS imports under the same chapter. There is a lot of persistence in these imports—they trend up—under the sugar program and the lagged response captures the persistence. Once the sugar program is removed the two sugar prices are at parity and given the strong positive price response, these imports nearly vanish. Imports under chapter 21 follow a similar logic but with a more moderate decrease once the relative prices reach parity, to reflect the fact that not all imports under HS 21 constitute trade diversion to bypass the sugar TRQs. Third, imports under HS 19, 20, and 22 respond minimally to the relative sweetener prices and would continue their trending up reflecting genuine trade integration. The generic specification of imports of SCPs is shown in Equation (9).

These imports under HS are mapped to NAICS imports using US Census concordance Appendix tables between HS and NAICS classification obtained from US Census. Grossly the concordance maps chapter 17 to 311340, chapter 18 to 311330, chapter 19 to 31181, chapter 20 to 31142, chapter 21 to 311920 and 311930, (roughly 50% each), and chapter 22 to 31211.

Exports of SCPs ($export_j$) do not show persistence (no clear time trend). The higher the US sugar price is relative to the world price, the less competitive these exports are. Hence we assume that food export demands $export_j$ respond negatively to the relative (US/world) price of raw sugar as shown in Equation (10).

Next, we turn to domestic food demand. The approach follow the approach used in the 2000 GAO study but the demand is for both US and imported goods, which are treated as perfect

substitutes for tractability. Else, the approach follows a similar logic.

The LINQUAD incomplete demand systems approach (LaFrance 1998) is flexible in its ability to reflect consumer preferences by incorporating the quadratic price term. The LINQUAD incomplete demand system approach is easy to calibrate while imposing proper curvature (Beghin, Bureau, and Drogué 2004) based on income and own-price elasticities. The system leads to an exact welfare measure for the final consumer.

The LINQUAD Marshallian demand equations for food goods are shown in Equation (11). The specification is linear in income and quadratic in food prices. The demands are well-behaved by imposing structure on the Slutsky substitution matrix represented by elements v in Equation (11). The Marshallian price elasticity for food j with respect to the price of food k is shown in the Appendix table along with the income elasticity of demand. Equations (11) through (13) are used in the calibration to recover the preference parameters using estimates of the elasticities and levels of prices and quantities. Then the same parameters allow to specify and calibrate the welfare measure for the consumer. This is explained next.

Welfare measure for the US consumer

When the sugar program is removed, new lower prices prevail for food since the unit cost of these food goods decreases as explained previously. These new prices lead to welfare gains measured by the equivalent variation (EV) relative to original higher prices. The EV is shown in Equation (14). It should be interpreted as the dollar amount the consumer would have to be given to reach the same higher utility reached under world prices, but under the sugar program and higher food prices.

Employment Effects

Employment effects follow from Equation (8) and can be computed recursively because labor hardly responds to sugar input prices. The price of labor is assumed constant because these industries would be too small to influence wages. Labor is a derived demand for the labor input in the NAICS industries. Labor is not a direct substitute for sweetener. To keep matters simple we assume that labor use in NAICS industry j just depends on the scale of activities $output_{food}$ following our constant return to scale assumption and the absence of labor price effect. Total change in labor use in food processing industries is computed by aggregating the labor changes over all food industries of interest. These two changes (sectoral and aggregate) are shown in Equations (15) and (16). The data on labor use came from U.S. Census data, survey of manufacturers. Values are available for 2010. However, the last year detail material data are available for is 2007, so we use labor data for 2007 as well to calibrate these labor effects consistently. Employment in the baseline is kept proportional to the projected output of each sector.

Margins of food processors/retailers

Each food processor/retailer marks up the unit cost of production to sell to consumers. Assuming the constant price margin, then consumer prices fall as much as the unit cost does. Consumers benefit from price decreases (in cents) equivalent to the cost savings. The changes in margins (gross returns above cost) of the food processors/sellers are then equal to the price markup multiplied by the expansion of output coming out of Equation (8). Other markup behaviors can be assumed. The only tradeoff taking place is between consumers and food processors/sellers. With the removal of the sugar program, the aggregate gains to sugar users (processors *cum*

consumers) increase by nearly the same amount, regardless of how the gains are distributed between the two types of agents. This result was also present in the GAO analysis.

Calibration of the New Model Component

Calibration of demand parameters

This calibration approach follows similar steps as in Miao et al. (forthcoming) to select robust and central values of price and income elasticities. To recover the parameter values in the LINQUAD demand system for the food goods, measures of the income elasticity, own-price elasticity, eventual cross-price elasticities, income prices, and consumption levels are needed.

Income elasticity and price elasticities: The USDA/ERS Commodity and Food Elasticity Dataset provides a collection of existing elasticities. The estimates come mostly from academic and government research, as published in journals and working papers. Additional elasticity sources include Bhuyan and Lopez (1997); Reed, Levedahl, and Clark (2003); Reed, Levedahl, and Hallahan (2005); and Chouinard et al. (2010). We follow the selection of Miao et al. (see their Appendix table 1.6). The selected values base on Miao et al. are shown in Appendix Table 1.8.

Appendix Table 1.8. Elasticity values for demand calibration

Food Sector	Own price elasticity	Income elasticity
Breakfast cereal 31123	-0.47	0.23
Sugar cane beet 31131	-0.50 (changed to 0-1)	0.05
Choc & confec. 31132 Confec. Mfg 31133 Nonchoc confec 31134	-0.10 (Miao et al. use 0.5)	0.05
Frozen food 31141	-0.85	0.38
Fruit & Veg can 31142	-1.97	0.49
Ice cream 31152	-0.83	-0.17
Bread & Bakery 31181 Cookies, cracker 31182 Snack food man 31191	-0.47	0.23
Flavoring syrup 31193	-0.85	0.38
Soft drink 31211	-0.93	-0.03

Income: Annual GDP data come from Global Insight and are the same as the data used in the FAPRI model. We calibrate the demand system on 2007 data to recover parameters χ, ε, and $\mathbf{V}$. Then, 2007 initial prices are linked to the producer price index for food industries and its projection from Global Insights. Income projections are also used and food demand for the 12 sugar-intensive goods is projected to 2020. Income projections are from Global Insight as explained in previous sections.

Unit cost, price and quantities: We use the value of shipments from the 2007 Survey of Manufacturers for the 12 sectors indicated above and in Appendix table 1.1. All prices are initially set equal to 1, and expenditures are read as quantities for domestic goods. Prices are set up above unit cost by the seller's margin by 10 cents as explained in the text.

Similarly, matching imports and export values are used to define import and export quantities with normalized prices equal to 1. This type of price normalization is often used in models for which individual price data are not available. Consumer expenditure shares are derived by taking the ratio of the value of shipments plus imports net of exports over the income estimate. In addition, for sugar shipments (sector 31131), we disaggregate shipments going into food processing as intermediate demand and those going to final consumers. To do so we use USDA's Sugar and Sweetener Situation and Outlook Appendix table 20a--U.S. sugar deliveries for human consumption by type of user, calendar year.

Trade flows: Trade data for sugar come from USDA and trade data for SCPs come from Promar International based on USDA data and HS classification and from "USA Trade on line" from the Census Bureau based on the NAICS sectoral classification. The detailed mapping of HS chapters into NAICS is available upon request.

Calibration of output and derived demand for sugar in food processing

We use data on sweetener expenditures for all NAICS industries of interest for 2007. We also use wholesale prices of sugar and HFCS, hence, we can estimate the sugar and HFCS use by industry. Elasticities of input demand are set with the own-price elasticities at -0.2 and the cross-price elasticities at +0.1.

We also know how much raw sugar goes into raw sugar refining as we know the imports of raw sugar and how much raw sugar is produced in the United States. The sum of the two and their cost is known. This information allows us to calibrate the cane refining industry for which we have data from U.S. census—we have value of shipments and the wholesale of sugar so we can estimate refined cane sugar output. We compute a gross margin for the cane refining industry and its changes with the sugar reform using wholesale price of refined sugar and the raw sugar price.

The Impact of the U.S. Sugar Program
John Beghin and Amani Elobeid
Appendix 2 Detailed Result tables

Appendix Table 2.1A. Baseline: Food processing

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Aggregate Sweetener measures														
Refined sugar final demand (1000 st)	4058	4104	4104	4109	4124	4161	4224	4279	4332	4388	4445	4503	4560	4617
Total estimated refined sugar from exports SCP (1000 st)	579	597	569	609	622	552	588	587	591	599	610	617	623	625
Total estimated refined sugar from imports SCP (1000 st)	1335	1294	1203	1268	1278	1349	1367	1380	1387	1385	1373	1358	1341	1327
Intermediate demand refined sugar	4678	4466	4322	3793	3692	3616	3771	3828	3885	3949	4023	4098	4171	4242
Total final + intermediate demand sugar (1000 strv)	9347	9169	9015	8455	8364	8321	8554	8675	8792	8920	9061	9204	9342	9480
Total SCP net imports (imports-exports) (1000 strv)	809	746	678	705	701	854	834	849	851	841	817	792	769	752
HFCS demand	6778	6248	6077	6593	6594	6819	6830	6900	6960	7056	7153	7253	7337	7425
Real food prices														
Breakfast cereal	1.000	1.019	1.046	1.048	1.053	1.048	1.043	1.042	1.040	1.040	1.040	1.040	1.041	1.042
Sugar (refined)	0.515	0.502	0.541	0.585	0.619	0.625	0.599	0.585	0.576	0.564	0.550	0.536	0.524	0.512
Chocolate and confectionery	1.000	1.023	1.055	1.063	1.073	1.065	1.059	1.058	1.056	1.055	1.054	1.052	1.052	1.052
Confectionery manufacturing	1.000	1.021	1.049	1.049	1.057	1.050	1.046	1.044	1.044	1.043	1.043	1.042	1.043	1.044
Non-chocolate confectionery	1.000	1.025	1.055	1.057	1.068	1.059	1.054	1.053	1.052	1.050	1.049	1.048	1.048	1.048
Frozen food	1.000	1.017	1.039	1.031	1.035	1.030	1.027	1.027	1.027	1.027	1.029	1.030	1.031	1.033
Fruits and Vegetables canning	1.000	1.017	1.039	1.030	1.035	1.029	1.026	1.026	1.026	1.026	1.028	1.029	1.030	1.032
Ice cream	1.000	1.019	1.042	1.036	1.042	1.035	1.032	1.031	1.031	1.031	1.032	1.032	1.034	1.035
Bread and Bakery	1.000	1.019	1.043	1.038	1.044	1.038	1.034	1.034	1.033	1.033	1.034	1.034	1.036	1.037
Cookies, crackers	1.000	1.020	1.047	1.047	1.054	1.048	1.043	1.042	1.042	1.041	1.041	1.041	1.042	1.043
Snack food man	1.000	1.017	1.038	1.030	1.034	1.029	1.026	1.026	1.026	1.026	1.028	1.029	1.031	1.033
Flavoring syrup	1.000	1.022	1.046	1.032	1.040	1.030	1.028	1.027	1.027	1.026	1.026	1.026	1.027	1.028
Soft drinks	1.000	1.019	1.042	1.030	1.036	1.029	1.026	1.026	1.026	1.026	1.027	1.027	1.028	1.030

Appendix Table 2.A. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Per capita demands from LINQUAD														
Breakfast cereal	31.1	30.7	30.2	30.2	30.2	30.4	30.5	30.6	30.7	30.9	31.0	31.1	31.2	31.3
Sugar (refined)	26.8	26.9	26.7	26.4	26.3	26.3	26.4	26.5	26.6	26.6	26.7	26.8	26.9	27.0
Chocolate and confectionery	18.3	18.1	17.8	17.8	17.8	17.8	17.9	17.9	17.9	18.0	18.0	18.0	18.0	18.0
Confectionery manufacturing	32.3	32.0	31.5	31.5	31.4	31.5	31.6	31.7	31.7	31.8	31.8	31.8	31.8	31.8
Non-chocolate confectionery	22.3	22.1	21.8	21.8	21.7	21.8	21.8	21.9	21.9	21.9	21.9	22.0	22.0	22.0
Frozen food	85.4	83.7	81.1	81.1	81.1	81.9	82.4	82.9	83.5	84.1	84.5	85.0	85.5	86.0
Fruit and Vegetable canned	126.7	121.2	113.2	113.1	112.5	114.5	116.1	117.1	118.5	119.7	120.5	121.5	122.3	123.1
Ice cream	29.2	28.7	27.9	27.9	27.8	28.0	28.2	28.3	28.4	28.5	28.5	28.6	28.7	28.7
Bread and Bakery	118.3	116.9	114.9	114.9	115.0	115.6	116.0	116.4	116.9	117.4	117.8	118.2	118.6	119.0
Cookies, crackers	62.5	61.8	60.7	60.7	60.7	61.1	61.3	61.5	61.8	62.0	62.2	62.4	62.6	62.9
Snack food manufacturing	78.9	78.0	76.6	76.6	76.6	77.1	77.3	77.6	77.9	78.3	78.5	78.8	79.0	79.3
Flavoring syrup	29.2	28.6	27.7	27.7	27.7	27.9	28.1	28.3	28.5	28.7	28.9	29.0	29.2	29.4
Soft drinks	161.6	158.7	154.5	154.3	153.5	154.3	155.1	155.4	155.6	155.8	155.8	155.9	155.9	155.8
Total final demand														
Breakfast cereal	9408	9383	9299	9394	9487	9629	9758	9884	10025	10164	10295	10430	10562	10700
Sugar (refined) (million lbs)	8116	8207	8207	8218	8248	8321	8448	8559	8664	8775	8891	9007	9120	9235
Chocolate and confectionery	5529	5524	5490	5540	5581	5654	5725	5787	5852	5915	5975	6038	6097	6157
Confectionery manufacturing	9777	9767	9709	9797	9869	9997	10124	10234	10348	10460	10566	10676	10782	10888
Non-chocolate confectionery	6749	6743	6702	6763	6812	6901	6989	7065	7143	7221	7294	7370	7443	7516
Frozen food	25839	25538	24954	25214	25455	25943	26366	26767	27232	27690	28106	28541	28962	29406
Fruits and Vegetables canned	38314	36999	34861	35168	35302	36293	37160	37842	38644	39415	40063	40778	41422	42104
Ice cream	8834	8757	8601	8679	8739	8883	9017	9132	9257	9379	9490	9607	9718	9832
Bread and Bakery	35781	35689	35368	35729	36082	36625	37114	37594	38128	38658	39156	39669	40172	40696
Cookies, crackers	18902	18853	18684	18875	19061	19348	19606	19860	20142	20422	20685	20956	21222	21498
Snack food manufacturing	23854	23793	23578	23819	24054	24416	24743	25062	25418	25772	26104	26446	26781	27131
Flavoring syrup	8821	8718	8518	8607	8690	8856	9001	9137	9296	9453	9595	9743	9887	10038
Soft drinks	48856	48421	47571	47954	48164	48902	49636	50192	50760	51309	51802	52338	52820	53300

Appendix Table 2.1A. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Exports of SCP food products (2007 $million)														
Breakfast cereal	855	858	851	867	879	814	848	847	851	858	868	875	880	882
Chocolate and confectionery	959	962	955	971	983	919	952	951	955	962	972	979	984	986
Non-chocolate confectionery	408	411	404	421	432	368	401	400	404	411	421	428	433	435
Frozen food	1380	1383	1376	1392	1404	1340	1373	1372	1376	1383	1393	1400	1405	1407
Fruits and Vegetables canned	2645	2645	2645	2645	2645	2644	2645	2645	2645	2645	2645	2645	2645	2645
Ice cream	58	58	57	59	60	54	57	57	57	58	59	60	60	60
Bread and Bakery	741	743	736	753	765	700	733	732	736	743	753	760	765	767
Cookies, crackers	384	386	379	396	408	343	376	375	380	386	396	403	408	410
Snack food man	737	739	732	749	761	696	729	728	733	739	749	756	761	763
Flavoring syrup	445	447	440	457	469	404	437	436	441	447	458	464	469	471
Soft drinks	499	501	494	511	523	458	491	490	494	501	511	518	523	525
Total estimated refined sugar from exports from SCP (1000 mt)	526	542	516	553	565	500	533	533	537	543	554	560	565	567
SCP food imports (2007 $million)														
Breakfast cereal	410	411	411	411	411	411	411	411	411	411	411	411	410	410
Chocolate and confectionery	2058	2062	2102	2144	2160	2306	2349	2384	2404	2405	2384	2353	2318	2287
Non-chocolate confectionery	1496	1501	1538	1574	1586	1717	1747	1769	1778	1771	1747	1715	1683	1656
Frozen food	2350	2429	2492	2530	2539	2630	2630	2631	2627	2616	2596	2577	2560	2549
Fruits and Vegetables canned	4833	4868	4904	4936	4964	5003	5030	5055	5075	5092	5105	5114	5121	5127
Ice cream	40	41	41	41	42	42	42	42	43	43	43	43	43	43
Bread and Bakery	2222	2258	2287	2310	2327	2342	2354	2363	2370	2375	2379	2382	2384	2386
Cookies, crackers	595	628	647	657	661	672	673	673	673	672	670	668	667	665
Snack food man	341	342	346	351	353	370	376	382	386	388	387	385	381	378
Flavoring syrup	175	188	197	202	203	213	213	213	213	212	210	208	206	205
Soft drinks	2167	2200	2229	2253	2271	2298	2312	2323	2331	2336	2338	2337	2336	2335
Total estimated refined sugar from imports SCP (1000 mt)	1211	1175	1091	1151	1159	1224	1240	1253	1258	1257	1246	1232	1217	1204

Appendix Table 2.1A. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Food production														
Breakfast cereal	9853	10180	10772	10884	10989	11066	11228	11354	11498	11644	11785	11927	12065	12204
Chocolate and confectionery	4430	3756	3728	3753	3789	3651	3712	3739	3788	3857	3948	4048	4148	4241
Confectionery manufacturing	9777	8575	8791	8879	8951	9080	9206	9316	9430	9542	9648	9759	9864	9971
Non-chocolate confectionery	5662	5754	5792	5833	5883	5776	5867	5920	5994	6084	6192	6307	6417	6519
Frozen food	24870	23964	24652	24890	25134	25467	25922	26322	26795	27271	27717	28178	28621	29078
Fruits and Vegetables canned	36126	36046	35738	36013	36120	37071	37910	38568	39349	40104	40740	41445	42082	42759
Ice cream	8851	7320	7249	7329	7390	7526	7664	7778	7903	8026	8138	8256	8367	8481
Bread and Bakery	34299	33829	32932	33288	33635	34098	34609	35079	35610	36142	36645	37163	37669	38193
Cookies, crackers	18691	18875	19156	19354	19548	19759	20050	20302	20589	20877	21152	21432	21704	21984
Snack food manufacturing	24249	24701	24655	24908	25153	25433	25787	26100	26456	26815	27157	27508	27852	28206
Flavoring syrup	9090	8619	8422	8522	8615	8707	8885	9020	9184	9348	9502	9660	9810	9964
Soft drinks	47188	44580	41841	42216	42421	43067	43820	44365	44929	45479	45981	46524	47013	47496
Employment														
Breakfast cereal	13704	13269	12958	13113	13259	13367	13592	13766	13967	14171	14367	14564	14756	14950
Sugar	13392	12381	12803	13336	13466	13800	13741	13738	13817	13875	13930	13997	14071	14160
Chocolate and confectionery	7733	7329	7464	7508	7571	7329	7437	7483	7569	7690	7850	8026	8200	8364
Confectionery manufacturing	30355	25718	24283	24556	24779	25178	25571	25913	26267	26615	26944	27287	27615	27945
Non-chocolate confectionery	17916	16653	16532	16663	16820	16481	16770	16938	17172	17460	17802	18166	18516	18841
Frozen food	87269	85615	86801	87638	88494	89662	91263	92665	94327	96000	97564	99185	100739	102343
Fruits and Vegetables canned	84424	81975	80357	80999	81249	83473	85436	86974	88800	90565	92052	93702	95192	96773
Ice cream	18481	18190	18389	18556	18682	18968	19255	19494	19755	20011	20244	20491	20723	20960
Bread and Bakery	218412	206854	195224	197488	199700	202647	205907	208900	212284	215673	218880	222175	225401	228738
Cookies, crackers	50488	49081	47801	48335	48860	49431	50218	50898	51673	52451	53194	53950	54687	55443
Snack food manufacturing	46125	44096	42724	43205	43671	44204	44876	45471	46149	46831	47482	48151	48805	49478
Flavoring syrup	6789	6173	6385	6460	6529	6598	6731	6832	6954	7077	7192	7309	7422	7537
Soft drinks	70244	69795	66666	67225	67530	68492	69614	70425	71265	72084	72832	73640	74368	75088
Total employment including sugar	665332	637129	618387	625081	630611	639631	650411	659498	670000	680502	690332	700644	710494	720619
Total employment without sugar	651940	624748	605584	611745	617145	625831	636670	645760	656183	666627	676403	686647	696423	706459

Appendix Table 2.1G. Scenario: Impact of the removal of the U.S. sugar program on food processing

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Aggregate Sweetener measures														
Refined sugar final demand (1000 st)	4058	4104	4104	4109	4124	4161	4386	4442	4491	4539	4585	4634	4684	4737
Total estimated refined sugar from exports SCP (1000 st)	579	597	569	609	622	552	693	693	693	694	695	696	696	696
Total estimated refined sugar from imports SCP (1000 st)	1335	1294	1203	1268	1278	1349	856	673	605	579	569	565	564	563
Intermediate demand refined sugar	4678	4466	4322	3793	3692	3616	4823	4990	5079	5130	5153	5188	5229	5288
Total final + intermediate demand sugar (1000 strv)	9347	9169	9015	8455	8364	8321	9853	10093	10240	10346	10420	10510	10608	10727
Total SCP net imports (imports-exports) (1000 strv)	809	746	678	705	701	853	174	-21	-95	-123	-135	-140	-142	-143
HFCS demand	6778	6248	6077	6593	6594	6819	6712	6783	6849	6951	7059	7166	7253	7342
Real food prices														
Breakfast cereal	1.000	1.019	1.046	1.048	1.053	1.048	1.028	1.027	1.026	1.026	1.028	1.029	1.030	1.031
Sugar (refined)	0.515	0.502	0.541	0.585	0.619	0.625	0.405	0.391	0.388	0.388	0.388	0.386	0.383	0.378
Chocolate and confectionery	1.000	1.023	1.055	1.063	1.073	1.065	1.031	1.030	1.030	1.030	1.031	1.031	1.032	1.033
Confectionery manufacturing	1.000	1.021	1.049	1.049	1.057	1.050	1.029	1.028	1.028	1.028	1.029	1.030	1.031	1.032
Non-chocolate confectionery	1.000	1.025	1.055	1.057	1.068	1.059	1.030	1.029	1.029	1.029	1.030	1.030	1.031	1.032
Frozen food	1.000	1.017	1.039	1.031	1.035	1.030	1.026	1.025	1.025	1.026	1.028	1.029	1.031	1.033
Fruits and Vegetables canning	1.000	1.017	1.039	1.030	1.035	1.029	1.025	1.025	1.025	1.026	1.027	1.028	1.030	1.032
Ice cream	1.000	1.019	1.042	1.036	1.042	1.035	1.026	1.026	1.026	1.026	1.028	1.028	1.030	1.032
Bread and Bakery	1.000	1.019	1.043	1.038	1.044	1.038	1.027	1.026	1.026	1.027	1.028	1.029	1.031	1.032
Cookies, crackers	1.000	1.020	1.047	1.047	1.054	1.048	1.028	1.028	1.027	1.028	1.029	1.030	1.032	1.033
Snack food manufacturing	1.000	1.017	1.038	1.030	1.034	1.029	1.025	1.025	1.025	1.026	1.028	1.028	1.030	1.032
Flavoring syrup	1.000	1.022	1.046	1.032	1.040	1.030	1.024	1.024	1.024	1.024	1.024	1.024	1.025	1.026
Soft drinks	1.000	1.019	1.042	1.030	1.036	1.029	1.025	1.025	1.025	1.025	1.026	1.026	1.028	1.029

Appendix Table 2.1B. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Per capita demands from LINQUAD														
Breakfast cereal	31.1	30.7	30.2	30.2	30.2	30.4	30.7	30.8	30.9	31.1	31.1	31.2	31.3	31.4
Sugar (refined)	26.8	26.9	26.7	26.4	26.3	26.3	27.4	27.5	27.5	27.6	27.6	27.6	27.7	27.7
Chocolate and confectionery	18.3	18.1	17.8	17.8	17.8	17.8	18.0	18.1	18.1	18.1	18.1	18.1	18.1	18.1
Confectionery manufacturing	32.3	32.0	31.5	31.5	31.4	31.5	31.9	31.9	32.0	32.0	32.0	32.0	32.0	32.0
Non-chocolate confectionery	22.3	22.1	21.8	21.8	21.7	21.8	22.0	22.0	22.1	22.1	22.1	22.1	22.1	22.1
Frozen food	85.4	83.7	81.1	81.1	81.1	81.9	83.5	84.0	84.5	85.1	85.4	85.9	86.3	86.7
Fruit and Vegetable canned	126.7	121.2	113.2	113.1	112.5	114.5	119.9	120.9	122.1	123.1	123.6	124.3	124.9	125.7
Ice cream	29.2	28.7	27.9	27.9	27.8	28.0	28.5	28.6	28.7	28.8	28.8	28.9	28.9	29.0
Bread and Bakery	118.3	116.9	114.9	114.9	115.0	115.6	116.8	117.2	117.7	118.1	118.5	118.8	119.2	119.6
Cookies, crackers	62.5	61.8	60.7	60.7	60.7	61.1	61.7	61.9	62.2	62.4	62.6	62.8	62.9	63.2
Snack food man	78.9	78.0	76.6	76.6	76.6	77.1	77.9	78.1	78.5	78.8	79.0	79.2	79.4	79.7
Flavoring syrup	29.2	28.6	27.7	27.7	27.7	27.9	28.5	28.7	28.9	29.0	29.2	29.3	29.4	29.6
Soft drinks	161.6	158.7	154.5	154.3	153.5	154.3	157.4	157.6	157.8	157.8	157.7	157.6	157.5	157.4
Total final demand														
Breakfast cereal	9408	9383	9299	9394	9487	9629	9829	9955	10093	10229	10355	10486	10615	10751
Sugar (refined) (million lbs)	8116	8207	8207	8218	8248	8321	8771	8885	8983	9078	9170	9268	9368	9475
Chocolate and confectionery	5529	5524	5490	5540	5581	5654	5769	5832	5895	5956	6012	6072	6130	6189
Confectionery manufacturing	9777	9767	9709	9797	9869	9997	10202	10312	10423	10531	10632	10738	10840	10945
Non-chocolate confectionery	6749	6743	6702	6763	6812	6901	7042	7119	7195	7270	7339	7412	7483	7555
Frozen food	25839	25538	24954	25214	25455	25943	26717	27120	27573	28013	28403	28819	29224	29661
Fruits and Vegetables canned	38314	36999	34861	35168	35302	36293	38365	39053	39813	40522	41081	41728	42321	42979
Ice cream	8834	8757	8601	8679	8739	8883	9134	9250	9370	9486	9588	9700	9805	9917
Bread and Bakery	35781	35689	35368	35729	36082	36625	37384	37864	38389	38906	39383	39881	40373	40891
Cookies, crackers	18902	18853	18684	18875	19061	19348	19749	20003	20280	20553	20805	21068	21328	21602
Snack food manufacturing	23854	23793	23578	23819	24054	24416	24922	25243	25593	25937	26255	26587	26915	27261
Flavoring syrup	8821	8718	8518	8607	8690	8856	9121	9258	9413	9563	9696	9838	9976	10126
Soft drinks	48856	48421	47571	47954	48164	48902	50359	50919	51462	51973	52413	52908	53359	53825

Appendix Table 2.1B. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Exports of SCP food products (2007 $million)														
Breakfast cereal	855	858	851	867	879	815	944	944	944	945	946	947	947	947
Chocolate and confectionery	959	962	955	971	983	919	1048	1048	1048	1049	1050	1051	1051	1051
Non-chocolate confectionery	408	411	404	421	432	368	497	497	497	498	499	500	500	500
Frozen food	1380	1383	1376	1392	1404	1340	1469	1469	1469	1470	1471	1472	1472	1472
Fruits and Vegetables canned	2645	2645	2645	2645	2645	2644	2646	2646	2646	2646	2646	2646	2646	2646
Ice cream	58	58	57	59	60	54	67	67	67	67	67	67	67	67
Bread and Bakery	741	743	736	753	765	700	829	829	830	830	831	832	832	832
Cookies, crackers	384	386	379	396	408	343	473	472	473	473	474	475	476	476
Snack food manufacturing	737	739	732	749	761	696	825	825	826	826	827	828	829	829
Flavoring syrup	445	447	440	457	469	404	534	533	534	535	535	536	537	537
Soft drinks	499	501	494	511	523	458	587	587	588	588	589	590	590	590
Total estimated refined sugar from exports from SCP (1000 mt)	526	542	516	553	565	501	629	628	629	630	631	631	632	632
SCP food imports (2007 $million)														
Breakfast cereal	410	411	411	411	411	411	410	410	409	409	409	409	409	409
Chocolate and confectionery	2,058	2,062	2,102	2,144	2,160	2,305	1,057	574	387	314	286	275	270	268
Non-chocolate confectionery	1,496	1,501	1,538	1,574	1,586	1,717	764	425	303	260	244	238	236	235
Frozen food	2,350	2,429	2,492	2,530	2,539	2,630	2,478	2,402	2,364	2,345	2,335	2,330	2,327	2,326
Fruits and Vegetables canned	4,833	4,868	4,904	4,936	4,964	5,003	5,003	5,003	5,003	5,003	5,003	5,003	5,003	5,003
Ice cream	40	41	41	41	42	42	42	42	42	42	42	42	42	42
Bread and Bakery	2,222	2,258	2,287	2,310	2,327	2,342	2,351	2,358	2,364	2,368	2,372	2,374	2,376	2,378
Cookies, crackers	595	628	647	657	661	672	658	650	647	645	644	644	643	643
Snack food manufacturing	341	342	346	351	353	370	350	334	320	308	298	289	282	275
Flavoring syrup	175	188	197	202	203	213	198	190	186	184	183	183	183	183
Soft drinks	2,167	2,200	2,229	2,253	2,271	2,298	2,288	2,281	2,275	2,270	2,266	2,263	2,261	2,259
Total estimated refined sugar from imports SCP (1000 mt)	1,211	1,175	1,091	1,151	1,159	1,224	777	611	549	525	516	513	511	511

Appendix Table 2.1B. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Food production														
Breakfast cereal	9853	10180	10772	10884	10989	11067	11396	11523	11662	11798	11925	12057	12187	12323
Chocolate and confectionery	4430	3756	3728	3753	3789	3652	5145	5690	5941	6075	6161	6233	6296	6357
Confectionery manufacturing	9777	8575	8791	8879	8951	9080	9284	9394	9506	9614	9714	9820	9922	10027
Non-chocolate confectionery	5662	5754	5792	5833	5883	5777	6999	7415	7613	7732	7818	7898	7971	8044
Frozen food	24870	23964	24652	24890	25134	25467	26523	27001	27492	27953	28353	28775	29183	29622
Fruits and Vegetables canned	36126	36046	35738	36013	36120	37071	39143	39831	40591	41300	41859	42507	43099	43758
Ice cream	8851	7320	7249	7329	7390	7526	7791	7906	8027	8143	8245	8356	8462	8573
Bread and Bakery	34299	33829	32932	33288	33635	34098	34977	35450	35970	36483	36958	37454	37945	38461
Cookies, crackers	18691	18875	19156	19354	19548	19760	20304	20565	20847	21122	21376	21640	21901	22175
Snack food manufacturing	24249	24701	24655	24908	25153	25434	26089	26425	26790	27147	27476	27817	28153	28505
Flavoring syrup	9090	8619	8422	8522	8615	8707	9116	9261	9420	9573	9708	9851	9990	10139
Soft drinks	47188	44580	41841	42216	42421	43067	44663	45231	45780	46297	46741	47240	47694	48162
Employment														
Breakfast cereal	13704	13269	12958	13113	13259	13367	13826	14002	14195	14385	14561	14744	14925	15114
Sugar	13392	12381	12803	13336	13466	13800	13877	13672	13791	13993	14284	14548	14771	14931
Chocolate and confectionery	7733	7329	7464	7508	7571	7331	9948	10903	11342	11577	11728	11854	11964	12071
Confectionery manufacturing	30355	25718	24283	24556	24779	25178	25813	26156	26501	26837	27148	27478	27795	28120
Non-chocolate confectionery	17916	16653	16532	16663	16820	16484	20363	21681	22312	22689	22961	23214	23447	23679
Frozen food	87269	85615	86801	87638	88494	89665	93371	95050	96776	98392	99798	101278	102714	104253
Fruits and Vegetables canned	84424	81975	80357	80999	81249	83473	88319	89928	91706	93364	94670	96184	97570	99109
Ice cream	18481	18190	18389	18556	18682	18968	19520	19761	20013	20255	20469	20701	20921	21154
Bread and Bakery	218412	206854	195224	197488	199700	202649	208252	211267	214580	217848	220872	224034	227158	230450
Cookies, crackers	50488	49081	47801	48335	48860	49432	50904	51608	52369	53114	53800	54514	55219	55959
Snack food manufacturing	46125	44096	42724	43205	43671	44205	45450	46090	46783	47462	48089	48738	49377	50047
Flavoring syrup	6789	6173	6385	6460	6529	6598	6904	7012	7130	7245	7345	7452	7556	7668
Soft drinks	70244	69795	66666	67225	67530	68493	70869	71714	72533	73302	73964	74706	75383	76079
Total employment including sugar	665332	637129	618387	625081	630611	639643	667415	678843	690031	700463	709687	719447	728798	738633
Total employment without sugar	651940	624748	605584	611745	617145	625843	653538	665171	676240	686469	695403	704899	714027	723703

Appendix Table 2.1C. Comparison between the baseline and scenario

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Aggregate Sweetener measures														
Refined sugar final demand	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.8%	3.8%	3.7%	3.4%	3.1%	2.9%	2.7%	2.6%
Total estimated refined sugar from exports SCP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.9%	18.0%	17.2%	15.9%	14.0%	12.7%	11.8%	11.5%
Total estimated refined sugar from imports SCP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-37.4%	-51.3%	-56.4%	-58.2%	-58.6%	-58.4%	-58.0%	-57.6%
Intermediate demand refined sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	27.9%	30.4%	30.7%	29.9%	28.1%	26.6%	25.4%	24.6%
Total final + intermediate demand sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.2%	16.3%	16.5%	16.0%	15.0%	14.2%	13.5%	13.2%
Total SCP net imports (imports-exports)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-79%	-102%	-111%	-115%	-117%	-118%	-119%	-119%
HFCS demand	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.7%	-1.7%	-1.6%	-1.5%	-1.3%	-1.2%	-1.1%	-1.1%
Real food prices														
Breakfast cereal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.44%	-1.44%	-1.38%	-1.29%	-1.17%	-1.09%	-1.02%	-0.98%
Sugar (refined)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-32.4%	-33.1%	-32.6%	-31.3%	-29.3%	-27.9%	-26.8%	-26.3%
Chocolate and confectionery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.66%	-2.62%	-2.54%	-2.39%	-2.17%	-2.01%	-1.89%	-1.82%
Confectionery manufacturing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.61%	-1.58%	-1.53%	-1.44%	-1.30%	-1.21%	-1.13%	-1.09%
Non-chocolate confectionery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.29%	-2.22%	-2.16%	-2.03%	-1.84%	-1.70%	-1.60%	-1.55%
Frozen food	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.13%	-0.13%	-0.12%	-0.11%	-0.10%	-0.10%	-0.09%	-0.09%
Fruits and Vegetables canning	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.08%	-0.07%	-0.07%	-0.06%	-0.06%	-0.05%	-0.05%	-0.05%
Ice cream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.54%	-0.52%	-0.50%	-0.47%	-0.42%	-0.39%	-0.37%	-0.35%
Bread and Bakery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.71%	-0.70%	-0.67%	-0.63%	-0.57%	-0.53%	-0.50%	-0.48%
Cookies, crackers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.41%	-1.39%	-1.35%	-1.27%	-1.15%	-1.06%	-1.00%	-0.96%
Snack food manufacturing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.05%	-0.04%	-0.04%	-0.04%	-0.04%	-0.03%	-0.03%	-0.03%
Flavoring syrup	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.34%	-0.24%	-0.22%	-0.20%	-0.18%	-0.17%	-0.16%	-0.16%
Soft drinks	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.13%	-0.09%	-0.08%	-0.07%	-0.06%	-0.06%	-0.06%	-0.06%

Appendix Table 2.1C. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Per capita demands from LINQUAD														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Sugar (refined)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.82%	3.81%	3.68%	3.45%	3.14%	2.91%	2.72%	2.60%
Chocolate and confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Confectionery manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Non-chocolate confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Fruit and Vegetable canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.24%	3.20%	3.03%	2.81%	2.54%	2.33%	2.17%	2.08%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%	1.29%	1.23%	1.15%	1.04%	0.96%	0.90%	0.86%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%	1.45%	1.38%	1.29%	1.18%	1.09%	1.02%	0.98%
Total final demand														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Sugar (refined)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.82%	3.81%	3.68%	3.45%	3.14%	2.91%	2.72%	2.60%
Chocolate and confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Confectionery manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Non-chocolate confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77%	0.76%	0.73%	0.68%	0.62%	0.58%	0.54%	0.52%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Fruits and Vegetables canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.24%	3.20%	3.03%	2.81%	2.54%	2.33%	2.17%	2.08%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%	1.29%	1.23%	1.15%	1.04%	0.96%	0.90%	0.86%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.73%	0.72%	0.69%	0.64%	0.58%	0.54%	0.50%	0.48%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%	1.32%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%	1.45%	1.38%	1.29%	1.18%	1.09%	1.02%	0.98%

Appendix Table 2.1C. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Exports of SCP food products														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.36%	11.41%	10.95%	10.17%	8.99%	8.21%	7.64%	7.43%
Confectionery manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.12%	10.16%	9.76%	9.07%	8.02%	7.33%	6.83%	6.65%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	24.02%	24.15%	23.06%	21.24%	18.52%	16.77%	15.53%	15.07%
Fruits and Vegetables canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.01%	7.04%	6.77%	6.31%	5.60%	5.13%	4.79%	4.66%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.04%	0.04%	0.03%	0.03%	0.03%	0.03%	0.02%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.87%	16.96%	16.24%	15.03%	13.20%	12.01%	11.15%	10.84%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.13%	13.20%	12.65%	11.74%	10.35%	9.44%	8.79%	8.54%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	25.59%	25.74%	24.55%	22.59%	19.67%	17.80%	16.46%	15.98%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.20%	13.27%	12.72%	11.80%	10.41%	9.49%	8.83%	8.59%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	22.02%	22.14%	21.15%	19.51%	17.05%	15.46%	14.32%	13.91%
Total estimated refined sugar from exports from SCP	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.61%	19.71%	18.85%	17.41%	15.26%	13.86%	12.85%	12.48%
SCP food imports														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.23%	-0.35%	-0.40%	-0.41%	-0.40%	-0.37%	-0.35%	-0.33%
Chocolate and confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-55.0%	-75.9%	-83.9%	-86.9%	-88.0%	-88.3%	-88.3%	-88.3%
Non-chocolate confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-56.2%	-76.0%	-82.9%	-85.3%	-86.0%	-86.1%	-86.0%	-85.8%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-5.80%	-8.71%	-10.0%	-10.4%	-10.1%	-9.59%	-9.10%	-8.76%
Fruits and Vegetables canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.54%	-1.01%	-1.42%	-1.74%	-1.98%	-2.16%	-2.30%	-2.41%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.63%	-1.17%	-1.62%	-1.98%	-2.23%	-2.40%	-2.53%	-2.63%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.10%	-0.18%	-0.24%	-0.28%	-0.30%	-0.32%	-0.32%	-0.32%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-2.27%	-3.40%	-3.91%	-4.03%	-3.90%	-3.70%	-3.50%	-3.35%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-6.89%	-12.6%	-17.1%	-20.6%	-23.1%	-24.9%	-26.2%	-27.2%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-7.16%	-10.8%	-12.4%	-12.8%	-12.5%	-11.9%	-11.3%	-10.9%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.03%	-1.83%	-2.43%	-2.83%	-3.06%	-3.17%	-3.22%	-3.23%
Total estimated refined sugar from imports SCP	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-37.4%	-51.3%	-56.4%	-58.2%	-58.6%	-58.4%	-58.0%	-57.6%

Appendix Table 2.1C. (continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Food production														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.50%	1.49%	1.42%	1.32%	1.18%	1.08%	1.01%	0.97%
Chocolate and confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	38.6%	52.2%	56.8%	57.5%	56.1%	54.0%	51.8%	49.9%
Confectionery manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.85%	0.84%	0.80%	0.75%	0.68%	0.63%	0.59%	0.57%
Non-chocolate confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.30%	25.25%	27.02%	27.09%	26.26%	25.23%	24.21%	23.39%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.32%	2.58%	2.60%	2.50%	2.30%	2.12%	1.97%	1.87%
Fruits and Vegetables canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.25%	3.28%	3.16%	2.98%	2.75%	2.56%	2.42%	2.34%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.66%	1.64%	1.56%	1.46%	1.32%	1.22%	1.14%	1.09%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.06%	1.06%	1.01%	0.94%	0.85%	0.78%	0.73%	0.70%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.27%	1.29%	1.25%	1.17%	1.06%	0.97%	0.91%	0.87%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	1.25%	1.26%	1.24%	1.17%	1.12%	1.08%	1.06%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.61%	2.66%	2.57%	2.40%	2.16%	1.98%	1.84%	1.76%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.92%	1.95%	1.90%	1.80%	1.65%	1.54%	1.45%	1.40%
Employment														
Breakfast cereal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.72%	1.71%	1.63%	1.51%	1.35%	1.23%	1.15%	1.10%
Sugar	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.99%	-0.48%	-0.19%	0.85%	2.54%	3.93%	4.97%	5.44%
Chocolate and confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.76%	45.69%	49.84%	50.55%	49.41%	47.70%	45.89%	44.32%
Confectionery manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.95%	0.94%	0.89%	0.83%	0.76%	0.70%	0.65%	0.63%
Non-chocolate confectionery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.42%	28.00%	29.93%	29.95%	28.98%	27.79%	26.63%	25.68%
Frozen food	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.31%	2.57%	2.60%	2.49%	2.29%	2.11%	1.96%	1.87%
Fruits and Vegetables canned	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.37%	3.40%	3.27%	3.09%	2.84%	2.65%	2.50%	2.41%
Ice cream	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.38%	1.37%	1.31%	1.22%	1.11%	1.02%	0.96%	0.92%
Bread and Bakery	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.14%	1.13%	1.08%	1.01%	0.91%	0.84%	0.78%	0.75%
Cookies, crackers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.37%	1.39%	1.35%	1.26%	1.14%	1.05%	0.97%	0.93%
Snack food manufacturing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.28%	1.36%	1.37%	1.35%	1.28%	1.22%	1.17%	1.15%
Flavoring syrup	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.57%	2.63%	2.54%	2.37%	2.13%	1.95%	1.81%	1.73%
Soft drinks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.80%	1.83%	1.78%	1.69%	1.55%	1.45%	1.36%	1.32%
Total employment including sugar	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.61%	2.93%	2.99%	2.93%	2.80%	2.68%	2.58%	2.50%
Total employment without sugar	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.65%	3.01%	3.06%	2.98%	2.81%	2.66%	2.53%	2.44%

Appendix Table 2.1D. Impact of removal of U.S. sugar program on consumer welfare and profits

Year	2013	2014	2015	2016	2017	2018	2019	2020
Increase in total number of jobs	17005	19346	20031	19960	19355	18802	18304	18014
Increase in 12 food sector number of jobs	16868	19411	20057	19842	19001	18252	17605	17244
Welfare of individual consumer current ($/person)	10.80	10.84	10.71	10.29	9.58	9.08	8.71	8.56
Welfare of individual consumer (2007 $/person)	9.73	9.57	9.26	8.71	7.95	7.39	6.95	6.71
Total welfare of consumers (2007 $billion)	3.11	3.09	3.02	2.87	2.64	2.48	2.36	2.29
Total welfare of consumers (nominal $billion)	3.45	3.50	3.49	3.39	3.18	3.05	2.95	2.93
Food production margins (2007 $million)								
Breakfast cereal	16.81	16.93	16.36	15.41	13.95	12.92	12.15	11.83
Chocolate and confectionery	143.31	195.15	215.30	221.86	221.35	218.49	214.79	211.57
Confectionery manufacturing	7.79	7.83	7.56	7.15	6.57	6.14	5.81	5.65
Non-chocolate confectionery	113.22	149.47	161.96	164.80	162.58	159.10	155.38	152.47
Frozen food	60.04	67.92	69.74	68.13	63.62	59.61	56.24	54.40
Fruits & Vegetables canned	123.29	126.33	124.24	119.66	111.93	106.15	101.70	99.90
Ice cream	12.69	12.77	12.36	11.71	10.75	10.05	9.51	9.26
Bread and Bakery	36.80	37.16	36.03	34.14	31.26	29.17	27.57	26.87
Cookies, crackers	25.39	26.26	25.77	24.51	22.43	20.88	19.67	19.12
Snack food manufacturing	30.18	32.52	33.35	33.21	31.88	30.90	30.10	29.89
Flavoring syrup	23.16	24.03	23.61	22.47	20.55	19.12	18.01	17.50
Soft drinks	84.30	86.59	85.15	81.75	75.98	71.59	68.14	66.58
Change in return margins food processor except sugar sector (2007 $million)	676.97	782.96	811.43	804.80	772.87	744.12	719.07	705.04
Changes in return margins food processor except sugar sector (current $million)	770.14	909.47	962.41	974.65	956.33	940.73	928.57	929.32
Gains to sugar users (food processors + consumers) (current $billion)	4.225	4.411	4.456	4.362	4.140	3.988	3.880	3.858
Gains to sugar users (2007 $billion)	3.790	3.873	3.831	3.674	3.417	3.223	3.074	2.999
Gains to sugar retailers (current $billion)	56.34	31.82	34.31	38.48	35.39	31.50	30.13	30.11

Appendix Table 2.2A. Baseline: U.S. sugar and HFCS sectors

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sugar beets														
Harvested area (1,000 a.)	1,304	1,247	1,005	1,149	1,156	1,134	1,107	1,099	1,095	1,087	1,083	1,079	1,076	1,075
Yield (tons/a.)	26	26	27	26	28	28	28	29	29	29	30	30	30	31
Production (1,000 tons)	34,064	31,834	26,881	29,783	31,901	31,677	31,265	31,388	31,642	31,772	31,981	32,231	32,494	32,820
Sugarcane														
Harvested area (1,000 a.)	847	828	822	817	825	871	860	836	828	821	810	800	792	784
Yield (tons/a.)	33.0	34.2	31.8	34.9	31.1	31.4	31.6	31.9	32.2	32.4	32.7	32.9	33.2	33.5
Production (1,000 tons)	27,962	28,273	26,131	28,484	25,663	27,346	27,209	26,660	26,624	26,612	26,465	26,360	26,283	26,239
Raw sugar							(Thousand short tons, raw value)							
Supply	11,801	12,368	12,141	12,606	12,980	13,515	13,528	13,574	13,668	13,736	13,801	13,883	13,973	14,075
Beginning stocks	1,698	1,799	1,664	1,534	1,498	1,745	1,776	1,818	1,824	1,831	1,843	1,860	1,876	1,891
Production	8,445	8,152	7,531	7,963	7,946	8,396	8,352	8,343	8,418	8,477	8,532	8,599	8,673	8,761
Beet sugar	5,008	4,721	4,214	4,575	4,800	5,032	4,998	5,050	5,123	5,177	5,244	5,317	5,394	5,481
Cane sugar	3,438	3,431	3,317	3,387	3,146	3,364	3,354	3,293	3,295	3,300	3,288	3,282	3,279	3,280
Refined Production from Cane (in refined value)	4,730	5,127	5,693	5,838	6,011	5,848	5,824	5,820	5,821	5,816	5,809	5,802	5,796	5,790
Net imports	1,658	2,417	2,946	3,109	3,536	3,374	3,401	3,413	3,426	3,428	3,426	3,424	3,423	3,423
Net raw imports for refining	1,202	1,852	2,638	2,649	3,036	2,894	2,878	2,934	2,933	2,924	2,927	2,926	2,923	2,916
Refined imports	456	565	308	460	500	481	523	479	493	505	499	498	501	508
Disappearance														
Domestic deliveries	10,135	10,704	10,607	11,152	11,235	11,739	11,710	11,750	11,837	11,893	11,941	12,006	12,082	12,169
Ending stocks	1,799	1,664	1,534	1,498	1,745	1,776	1,818	1,824	1,831	1,843	1,860	1,876	1,891	1,907
Sugar-containing products														
Net imports	809	746	678	705	701	854	834	849	851	841	817	792	769	752
High fructose corn syrup								(Thousand short tons)						
Production	9,204	9,074	8,491	8,999	9,133	9,438	9,413	9,462	9,503	9,576	9,657	9,735	9,808	9,885
Domestic use	8,789	8,504	8,098	7,896	7,887	7,971	7,942	7,957	7,971	7,996	8,019	8,039	8,057	8,077
Net exports	415	570	393	1,103	1,246	1,467	1,471	1,504	1,532	1,580	1,638	1,696	1,751	1,808

Appendix Table 2.2A. (continued)

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Per-capita use*							(Pounds per capita, raw value)							
Sugar deliveries	67.0	70.1	68.9	71.8	71.6	74.1	73.2	72.7	72.6	72.2	71.8	71.5	71.3	71.2
Sugar-containing net imp.	5.3	4.9	4.4	4.5	4.5	5.4	5.2	5.3	5.2	5.1	4.9	4.7	4.5	4.4
HFCS domestic use	58.1	55.7	52.6	50.8	50.3	50.3	49.6	49.3	48.9	48.6	48.2	47.9	47.6	47.2
Sum of above	130.5	130.8	125.9	127.1	126.3	129.8	128.1	127.3	126.7	125.9	125.0	124.2	123.4	122.8
Prices							(Cents per pound)							
N.Y. spot raw sugar	20.87	21.27	22.07	34.23	37.69	38.86	37.37	37.28	37.54	37.44	37.09	36.79	36.60	36.39
Refined beet sugar	25.73	29.86	35.90	50.29	55.38	56.94	54.81	54.63	54.92	54.73	54.18	53.71	53.38	53.03
Retail refined sugar	51.52	52.07	55.99	61.55	66.09	68.06	66.46	66.25	66.60	66.57	66.19	65.84	65.62	65.40
Cane sugar loan rate	18.00	18.00	18.00	18.25	18.50	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75
Beet sugar loan rate	22.90	22.90	22.90	23.45	23.77	24.09	24.09	24.09	24.09	24.09	24.09	24.09	24.09	24.09
HFCS, 42% Midwest	20.05	24.38	25.56	22.87	25.24	23.39	24.41	24.66	25.37	25.40	25.20	25.09	25.15	25.14
World sugar price	11.67	13.67	15.94	24.12	28.18	21.78	24.03	23.86	24.43	25.09	26.06	26.71	27.23	27.30

* Per capita consumption is the sum of sugar deliveries and sugar-containing net imports.

Table 2.2B. Scenario: Impact of removal of the U.S. sugar program on the U.S. sugar and HFCS sectors

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sugar beets														
Harvested area (1,000 a.)	1,304	1,247	1,005	1,149	1,156	1,134	993	978	983	993	1,019	1,037	1,051	1,057
Yield (tons/a.)	26	26	27	26	28	28	28	29	29	29	30	30	30	31
Production (1,000 tons)	34,064	31,834	26,881	29,783	31,901	31,677	27,998	27,913	28,366	29,000	30,078	30,975	31,738	32,269
Sugarcane														
Harvested area (1,000 a.)	847	828	822	817	825	871	807	736	731	742	755	769	777	778
Yield (tons/a.)	33.0	34.2	31.8	34.9	31.1	31.4	31.6	31.9	32.2	32.5	32.7	33.0	33.2	33.5
Production (1,000 tons)	27,962	28,273	26,131	28,484	25,663	27,346	25,537	23,480	23,544	24,070	24,695	25,334	25,796	26,042
Raw sugar							(Thousand short tons, raw value)							
Supply	11,801	12,368	12,141	12,606	12,980	13,515	15,485	15,676	15,800	15,827	15,791	15,795	15,824	15,897
Beginning stocks	1,698	1,799	1,664	1,534	1,498	1,745	1,776	2,018	2,003	2,003	2,009	2,021	2,035	2,048
Production	8,445	8,152	7,531	7,963	7,946	8,396	7,624	7,391	7,507	7,710	8,000	8,264	8,487	8,645
Beet sugar	5,008	4,721	4,214	4,575	4,800	5,032	4,476	4,491	4,593	4,725	4,931	5,110	5,268	5,389
Cane sugar	3,438	3,431	3,317	3,387	3,146	3,364	3,148	2,900	2,914	2,985	3,069	3,154	3,218	3,255
Refined Production from Cane (in refined value)	4,730	5,127	5,693	5,838	6,011	5,848	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200
Net imports	1,658	2,417	2,946	3,109	3,536	3,374	6,086	6,267	6,291	6,114	5,781	5,510	5,302	5,204
Net raw imports for refining	1,202	1,852	2,638	2,649	3,036	2,894	4,556	4,804	4,790	4,719	4,635	4,550	4,486	4,449
Refined imports	456	565	308	460	500	481	1,530	1,463	1,500	1,395	1,146	960	816	755
Disappearance														
Domestic deliveries	10,135	10,704	10,607	11,152	11,235	11,739	13,468	13,673	13,797	13,817	13,770	13,760	13,776	13,834
Ending stocks	1,799	1,664	1,534	1,498	1,745	1,776	2,018	2,003	2,003	2,009	2,021	2,035	2,048	2,063
Sugar-containing products														
Net imports	809	746	678	705	701	854	174	-21	-95	-123	-135	-140	-142	-143
High fructose corn syrup								(Thousand short tons)						
Production	9,204	9,074	8,491	8,999	9,133	9,438	9,105	9,112	9,151	9,239	9,350	9,449	9,537	9,619
Domestic use	8,789	8,504	8,098	7,896	7,887	7,971	7,649	7,629	7,640	7,680	7,732	7,773	7,804	7,828
Net exports	415	570	393	1,103	1,246	1,467	1,456	1,484	1,510	1,559	1,618	1,676	1,733	1,791

Appendix Table 2.2B. (continued)

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Per-capita use*	(Pounds per capita, raw value)													
Sugar deliveries	67.0	70.1	68.9	71.8	71.6	74.1	84.2	84.7	84.6	83.9	82.8	82.0	81.3	80.9
Sugar-containing net imp.	5.3	4.9	4.4	4.5	4.5	5.4	1.1	-0.1	-0.6	-0.7	-0.8	-0.8	-0.8	-0.8
HFCS domestic use	58.1	55.7	52.6	50.8	50.3	50.3	47.8	47.2	46.9	46.6	46.5	46.3	46.1	45.8
Sum of above	130.5	130.8	125.9	127.1	126.3	129.8	133.1	131.8	130.9	129.8	128.5	127.5	126.5	125.8
Prices	(Cents per pound)													
N.Y. spot raw sugar	20.87	21.27	22.07	34.23	37.69	38.86	25.10	24.74	25.27	25.88	26.73	27.32	27.78	27.82
Refined beet sugar	25.73	29.86	35.90	50.29	55.38	56.94	33.10	32.74	33.27	33.88	34.73	35.32	35.78	35.82
Retail refined sugar	51.52	52.07	55.99	61.55	66.09	68.06	44.96	44.29	44.92	45.76	46.77	47.45	48.02	48.20
Cane sugar loan rate	18.00	18.00	18.00	18.25	18.50	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75
Beet sugar loan rate	22.90	22.90	22.90	23.45	23.77	24.09	24.09	24.09	24.09	24.09	24.09	24.09	24.09	24.09
HFCS, 42% Midwest	20.05	24.38	25.56	22.87	25.24	23.39	23.03	23.78	24.55	24.65	24.54	24.45	24.53	24.50
World sugar price	11.67	13.67	15.94	24.12	28.18	21.78	25.10	24.74	25.27	25.88	26.73	27.32	27.78	27.82

* Per capita consumption is the sum of sugar deliveries and sugar-containing net imports.

Appendix Table 2.2C. Comparison between scenario and baseline

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Sugar beets														
Harvested area (1,000 a.)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-10.3%	-11.0%	-10.3%	-8.7%	-5.9%	-3.9%	-2.3%	-1.7%
Yield (tons/a.)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%
Production (1,000 tons)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-10.4%	-11.1%	-10.4%	-8.7%	-6.0%	-3.9%	-2.3%	-1.7%
Sugarcane														
Harvested area (1,000 a.)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-6.2%	-12.0%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.8%
Yield (tons/a.)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
Production (1,000 tons)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-6.1%	-11.9%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.7%
Raw sugar														
Supply	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.5%	15.5%	15.6%	15.2%	14.4%	13.8%	13.3%	12.9%
Beginning stocks	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.0%	9.8%	9.4%	9.0%	8.6%	8.5%	8.3%
Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-8.7%	-11.4%	-10.8%	-9.0%	-6.2%	-3.9%	-2.1%	-1.3%
Beet sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-10.4%	-11.1%	-10.4%	-8.7%	-6.0%	-3.9%	-2.3%	-1.7%
Cane sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-6.1%	-11.9%	-11.6%	-9.6%	-6.7%	-3.9%	-1.9%	-0.7%
Refined Production from Cane (in refined value)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	23.6%	23.7%	23.7%	23.8%	24.0%	24.1%	24.2%	24.3%
Net imports	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	79.0%	83.6%	83.6%	78.3%	68.8%	60.9%	54.9%	52.0%
Net raw imports for refining	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	58.3%	63.7%	63.3%	61.4%	58.4%	55.5%	53.5%	52.6%
Refined imports	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	192.5%	205.4%	204.5%	176.3%	129.6%	92.8%	63.1%	48.8%
Disappearance														
Domestic deliveries	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.0%	16.4%	16.6%	16.2%	15.3%	14.6%	14.0%	13.7%
Ending stocks	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.0%	9.8%	9.4%	9.0%	8.6%	8.5%	8.3%	8.2%
Sugar-containing products														
Net imports	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-79.1%	-102.5%	-111.2%	-114.7%	-116.5%	-117.7%	-118.5%	-119.0%
High fructose corn syrup														
Production	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-3.3%	-3.7%	-3.7%	-3.5%	-3.2%	-2.9%	-2.8%	-2.7%
Domestic use	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-3.7%	-4.1%	-4.2%	-3.9%	-3.6%	-3.3%	-3.1%	-3.1%
Net exports	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.0%	-1.4%	-1.4%	-1.3%	-1.3%	-1.2%	-1.0%	-1.0%

Appendix Table 2.2C. (continued)

October-September year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Fiscal year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Per-capita use*														
Sugar deliveries	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.0%	16.4%	16.6%	16.2%	15.3%	14.6%	14.0%	13.7%
Sugar-containing net imp.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-79.1%	-102.5%	-111.2%	-114.7%	-116.5%	-117.7%	-118.5%	-119.0%
HFCS domestic use	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-3.7%	-4.1%	-4.2%	-3.9%	-3.6%	-3.3%	-3.1%	-3.1%
Sum of above	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	3.5%	3.3%	3.1%	2.8%	2.7%	2.5%	2.5%
Prices														
N.Y. spot raw sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-32.8%	-33.7%	-32.7%	-30.9%	-27.9%	-25.8%	-24.1%	-23.5%
Refined beet sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-39.6%	-40.1%	-39.4%	-38.1%	-35.9%	-34.2%	-33.0%	-32.5%
Retail refined sugar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-32.4%	-33.1%	-32.6%	-31.3%	-29.3%	-27.9%	-26.8%	-26.3%
Cane sugar loan rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Beet sugar loan rate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HFCS, 42% Midwest	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-5.6%	-3.6%	-3.2%	-2.9%	-2.6%	-2.5%	-2.5%	-2.5%
World sugar price	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.5%	3.7%	3.5%	3.2%	2.6%	2.3%	2.0%	1.9%

* Per capita consumption is the sum of sugar deliveries and sugar-containing net imports.

Appendix Table 2.2D. Baseline: U.S. producer and refiner margins

Marketing year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Gross margin beet processors (1000 $)	903089	1297559	1536790	2799425	2999933	3326323	3186590	3208104	3269914	3291965	3301398	3319296	3346563	3378911
Beet processor margins ($/ton of beet)	34	40	52	96	101	104	101	101	102	103	102	102	102	102
Beet processor margins (c/lb of refined sugar)	10	15	19	33	34	35	34	34	34	34	34	33	33	33
Gross margin cane processors (c/lb)	7.64	8.31	9.16	19.03	19.52	20.02	19.37	19.32	19.43	19.38	19.22	19.08	18.99	18.90
Margin for cane processors (1000 $)	584539	628257	693319	1327956	1301495	1429922	1378074	1349762	1358269	1357030	1340808	1328614	1321071	1314695
Margin per unit (refined price - raw price in refined equivalence) (c/lb)	3	7	12	14	15	15	15	15	15	15	14	14	14	14
Gross margin cane refiners (1000 $)	322284	728068	1398587	1594901	1808519	1795958	1726490	1714928	1717653	1705944	1683526	1663626	1648016	1631834
Sugarcane returns														
Gross market revenue ($/acre)	1004	1004	938	1213	1297	1359	1312	1323	1348	1358	1357	1358	1363	1368
Variable expenses ($/acre)	761	896	1117	998	1057	1067	1101	1135	1157	1186	1206	1224	1243	1262
Net returns ($/acre)	243	108	-179	216	240	292	211	188	190	172	151	134	120	106
Sugar beet returns														
Gross market revenue ($/acre)	1155	1072	1285	1307	1703	1788	1747	1773	1817	1843	1855	1871	1892	1911
Variable expenses ($/acre)	521	560	698	624	661	667	688	709	723	741	754	765	777	789
Net returns ($/acre)	634	513	586	683	1043	1122	1059	1064	1093	1101	1101	1106	1114	1123
HFCS gross margin (total) (1000 $)	2140070	2365222	2355016	2292188	2037515	2112614	2144424	2213686	2273330	2325181	2304675	2303232	2319309	2364112
HFCS (per unit) (c/lb)	14.62	16.88	18.31	16.53	16.41	15.38	15.84	16.11	16.51	16.62	16.40	16.28	16.28	16.35

Appendix Table 2.2E. Scenario: Impact of removal of U.S. sugar program on U.S. sroducer and refiner margins

Marketing year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Gross margin for beet processors (1000 $)	903089	1297559	1536790	2799425	2999933	3326497	1272545	1263469	1309483	1367856	1457940	1531952	1596538	1633899
Beet processor margins ($/ton of beet)	34	40	52	96	101	104	45	45	46	47	48	49	50	50
Beet processor margins (c/lb of refined sugar)	10	15	19	33	34	35	15	15	15	15	16	16	16	16
Gross margin for cane processors (c/lb)	7.64	8.31	9.16	19.03	19.52	20.02	9.76	9.66	9.80	9.96	10.18	10.33	10.45	10.45
Margin for cane processors (1000 $)	584539	628257	693319	1327956	1301495	1430008	677768	617439	629873	656496	691064	721620	745328	754488
Margin per unit (refined price - raw price in refined equivalence) (c/lb)	3	7	12	14	15	15	6	6	6	6	6	6	6	6
Gross margin for cane refiners (1000 $)	322284	728068	1398587	1594901	1808519	1796028	898990	902658	897272	891093	882513	876653	871982	871534
Sugarcane returns														
Gross market revenue ($/acre)	1004	1004	938	1213	1297	1359	1118	1111	1152	1198	1258	1303	1342	1358
Variable expenses ($/acre)	761	896	1117	998	1057	1067	1101	1135	1157	1186	1206	1224	1243	1262
Net returns ($/acre)	243	108	-179	216	240	293	17	-24	-5	12	52	79	99	96
Sugar beet net returns														
Gross market revenue ($/acre)	1155	1072	1285	1307	1703	1789	1507	1518	1574	1636	1712	1775	1833	1868
Variable expenses ($/acre)	521	560	698	624	661	667	688	709	723	741	754	765	777	789
Net returns ($/acre)	634	513	586	683	1043	1122	819	808	851	894	958	1010	1056	1080
HFCS gross margin (total) (1000 $)	2140070	2365222	2355016	2292188	2037515	2112487	1828819	1974739	2043364	2109014	2111964	2119060	2139870	2179908
HFCS (per unit) (c/lb)	14.62	16.88	18.31	16.53	16.41	15.38	14.49	15.24	15.71	15.89	15.76	15.65	15.67	15.71

Appendix Table 2.2F. Comparison between scenario and baseline for U.S. producer and refiner margins (in percent deviation from baseline)

Marketing year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Gross margin for beet processors	0.0%	-60.1%	-60.6%	-60.0%	-58.4%	-55.8%	-53.8%	-52.3%	-51.6%
Beet processor margins	0.0%	-55.6%	-55.9%	-55.5%	-54.6%	-53.2%	-52.2%	-51.3%	-51.0%
Beet processor margins	0.0%	-55.4%	-55.7%	-55.3%	-54.5%	-53.0%	-52.0%	-51.2%	-50.8%
Gross margin for cane processors	0.0%	-49.6%	-50.0%	-49.6%	-48.6%	-47.0%	-45.9%	-45.0%	-44.7%
Margin for cane processors	0.0%	-50.8%	-54.3%	-53.6%	-51.6%	-48.5%	-45.7%	-43.6%	-42.6%
Margin per unit (refined price - raw price in refined equivalence)	0.0%	-57.9%	-57.5%	-57.8%	-57.8%	-57.7%	-57.5%	-57.4%	-57.0%
Gross margin for cane refiners	0.0%	-47.9%	-47.4%	-47.8%	-47.8%	-47.6%	-47.3%	-47.1%	-46.6%
Sugarcane returns									
Gross market revenue	0.0%	-14.8%	-16.0%	-14.5%	-11.8%	-7.3%	-4.0%	-1.5%	-0.7%
Variable expenses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net returns	0.0%	-92.2%	-113.0%	-102.7%	-93.0%	-65.8%	-41.0%	-17.6%	-9.2%
Sugar beet returns									
Gross market revenue	0.0%	-13.7%	-14.4%	-13.4%	-11.2%	-7.7%	-5.1%	-3.1%	-2.3%
Variable expenses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net returns	0.0%	-22.6%	-24.0%	-22.2%	-18.8%	-13.0%	-8.6%	-5.2%	-3.8%
HFCS gross margin(total)	0.0%	-14.7%	-10.8%	-10.1%	-9.3%	-8.4%	-8.0%	-7.7%	-7.8%
HFCS (per unit)	0.0%	-8.6%	-5.4%	-4.9%	-4.4%	-3.9%	-3.8%	-3.7%	-3.9%

Appendix 3
Macro Assumptions

Appendix Table 3.1. Macroeconomic assumptions

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population (millions)	302	305	308	311	314	317	320	323	326	329	332	336	339	342
Real consumer expenditure in 2007 prices ($ billions)	10326	10299	10175	10337	10574	10800	10956	11185	11481	11782	12064	12346	12641	12964
CPI for food & beverage	204	215	219	220	225	228	232	236	241	247	252	257	263	268
CPI	207	215	215	218	221	226	230	235	240	245	250	255	260	265
CPI food rebased for 2007=1	100	106	107	108	110	112	114	116	119	121	124	126	129	132
CPI rebased 2007=1	100	104	103	105	107	109	111	113	116	118	120	123	125	128
U.S. income per capita $1000	34	34	33	33	34	34	34	35	35	36	36	37	37	38