U.S. and World Sugar and HFCS Production Costs, 1989/90-1994/95

Stephen L. Haley[1]

Abstract: LMC International periodically publishes its estimates of world sugar and high fructose corn syrup (HFCS) costs of production. The data go back to 1979/80 and presently extends through 1994/95. This article reports on yearly trends in costs for various categories of raw cane and beet producers. The categories include low- and high-cost producers, and major exporters. World HFCS cost trends are also traced out. Several diagrams directly compare regional U.S. costs of production with those of other countries, for both beet and cane sugar. Components of these costs show where certain U.S. advantages may lie, vis-a-vis other countries. The same procedure is applied to HFCS costs.

Keywords: beet sugar, cane sugar, costs of production, high fructose corn syrup.

Introduction

LMC International periodically publishes its estimates of world sugar and high fructose corn syrup (HFCS) costs of production.[2] The data go back to 1979/80 and presently extend through 1994/95. Field, factory, and administrative costs are detailed for 36 beet producing countries and for 61 cane producing countries. HFCS production costs are presented for 15 countries. Articles in previous *Sugar and Sweetener Situation and Outlook* reports have described data through 1986/87. This article updates the earlier articles and focuses a bit more on comparisons of U.S. costs of production with those from other countries.

There are many limitations in the use of production cost estimates. For instance, the LMC data refer to averaged costs within individual countries. Economists generally argue that marginal costs are more relevant in predicting supply response changes due to changes in output prices, government support, input prices, and the like. Knowledge of industry structures and specific production technologies in use are also necessary for predicting supply response changes when underlying price and cost variables change.

Nonetheless, costs of production provide very useful information. They typically form the basis for comparing competitiveness in production across regions and countries. They aid in the calculation of government support to sugar/sweetener industries in many countries. In addition, trends in production costs can be compared with long-term trends in world prices to evaluate the viability of production in markets that may be liberalized. Finally, the LMC data would be useful in predicting which countries would be successful bidders if the assignment of tariff-rate quotas (TRQ's) were determined by auction rather than based on historical trade shares (see below and special article entitled "Auctioning Tariff Quotas for U.S. Sugar Imports").

U.S. cane and beet sugar producers argue that they are cost-efficient even though their production costs usually exceed the world price of sugar. They say the world market for sugar is sufficiently distorted by other producing and consuming countries' policies; that the world price is a biased measure against which to compare domestic costs. Therefore, the producers claim other producing countries' costs of production relative to their own provide a more valid comparison of cost efficiency.

This article reports on yearly trends in costs for various categories of raw cane and beet producers. The categories include low- and high-cost producers, and major exporters. World HFCS cost trends are also traced out. Several diagrams directly compare regional U.S. costs of production with those of other countries, for both beet and cane sugar. Components of these costs show where certain U.S. advantages may lie, vis-a-vis other countries. The same procedure is applied to HFCS costs. The article also briefly describes the LMC approach to estimating production costs for beet and cane sugar and HFCS (see box).

[1]Agricultural economist with the Market and Trade Economics Division, Economic Research Service.

[2]The study is copyrighted and the results for specific countries or regions may not be quoted or published without the prior approval of LMC International. For more detailed information regarding the LMC study, contact: Andrea Kavaler, LMC International, 1841 Broadway, New York, NY, 10023. Tel: (212) 586-2427.

Cost Estimating Procedures

LMC bases its estimates on an engineering cost approach. Its computations account for the physical inputs of labor, machinery, fuel, chemicals, and fertilizers used in alternative technologies employed in field and processing operations. The data, therefore, represent actual average costs and do not necessarily reflect minimum attainable costs.

Cane and beet sugar costs are presented at three different stages. The first comprises field costs. It covers land preparation before planting to the delivery of beets or cane to the processing mill. Estimates are made for labor, capital, and all fuel, chemicals, and fertilizers used in the field. The second stage is the factory stage. For cane, this covers all costs from the initial arrival to the delivery of raw sugar into bulk storage at the mill. For beets, these costs account for everything through the delivery of refined white sugar into storage at the factory. For both cane and beets, all byproduct credits are applied against factory costs. As with the field costs, estimates are divided into their labor, capital, and fuel and chemical components. The third stage represents administrative and overhead costs that cannot be adequately included solely as a field or factory expense.

HFCS costs are calculated somewhat differently. Unlike for sugar, the purchase of the raw agricultural product (i.e. corn) is represented as a factory cost. The close links between growers and processors that typify the sugar industry are largely absent in relations between grain farmers and corn wet-millers. For that reason the cost of producing corn is not included in the analysis as is the cost of growing beets and cane.

The process by which HFCS is produced provides several additional products, including ethanol, corn oil, feed products, starches, related sweeteners, and other chemicals. Because of the joint product nature of the production process, LMC tracks HFCS production costs at two stages. The first is the processing of corn into a starch slurry. This process is common to all starch-based products. The second stage is the conversion of the starch slurry into HFCS. Byproduct credits are separated out from the costs of processing and applied against corn costs, thereby reducing the net cost of the raw material. Administrative costs are implicitly included in the processing costs, and therefore are not separated out as with sugar.

The data are reported in terms of U.S. dollars using official exchange rates. It is possible, therefore, for a country to become a low-cost producer by a depreciation of its currency, and the opposite when its currency appreciates. (Although not reported here, LMC uses various deflators when reporting country estimates in order to give a clearer picture of changing costs.) Capital costs are estimated on the basis of replacement costs. Real interest rates are used in the valuation of capital, and capital gains are excluded from revenue calculations.

Because the benefits of capital goods investment flow over a number of years, using current exchange rates may bias depreciation charges. LMC instead links the cost of capital to the U.S. index of capital goods prices, denominated in U.S. dollars. The ideal case for tracking land costs is to attach value to the land in its next alternative use, i.e. opportunity cost. This procedure is more easily followed for beets, where there are almost always returns from the cultivation of cereals and other crops. Information from land rental systems can be used to attach a value to land use. Where this procedure may prove difficult, costs associated with getting land suitable for cane cultivation is treated as a separate production process.

Cost of Production Estimates

Raw Cane Sugar

Results of the LMC study are shown in two tables. Table A-1 shows production cost estimates for various groupings of sugar and HFCS producing countries from 1989/90 to 1994/95. Table A-2 compares ranges for the same groupings plus the United States and a production-weighted world estimate range.

The lowest cost cane producers were Brazil (central, south), Colombia, Guatemala, Malawi, and Zambia. As a group they accounted for about 9 percent of world sugar production. Their total costs per pound remained steady over the period, with a low of 8.04 cents and a high of 9.91 cents. A weak negative trend in unit costs of 0.16 cents per year is statistically insignificant.

The highest cane producers were Barbados, Congo, Guadeloupe, Japan, Puerto Rico, Reunion, and Sri Lanka. Collectively they produced less than 1 percent of the world's sugar. Unit costs ranged between 43 and 52 cents a pound over the period. A yearly upward trend of 1.61 cents per pound is statistically significant, indicating a worsening of already weak competitiveness in sugar production.

Table A-1--Costs of producing raw cane sugar, beet sugar, and high fructose corn syrup, by select categories of world producers, 1989/90 - 1994/95

Category	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
			Cents/pound 1/			
Raw cane sugar						
Low-cost producers 2/	9.91	9.29	8.04	8.71	8.89	8.93
High-cost producers 3/	43.08	44.22	45.21	43.64	48.98	51.78
Major exporters 4/	11.31	11.32	11.15	13.98	14.93	15.17
Cane sugar, white value equivalent						
Low-cost producers 2/	13.73	13.05	11.69	12.41	12.61	12.66
High-cost producers 3/	49.77	51.01	52.09	50.39	56.19	59.23
Major exporters 4/	15.24	15.25	15.07	18.14	19.18	19.44
Beet sugar, refined value						
Low-cost producers 5/	20.15	21.50	21.74	20.24	19.69	20.40
High-cost producers 6/	35.87	42.63	47.92	50.08	47.66	55.36
Major exporters 7/	25.65	30.34	31.57	32.34	28.97	32.19
High fructose corn syrup 8/						
Major producers 9/	12.61	11.31	13.49	12.51	13.10	12.67

1/ Measured in current U.S. cents per pound, ex-mill/factory basis. 2/ Average of 5 countries (Brazil, Colombia, Guatemala, Malawi, and Zambia). 3/ Average of 7 countries (Barbados, Congo, Guadaloupe, Japan, Puerto Rico, Reunion, Sri Lanka). 4/ Average of 8 countries (Australia, Brazil, (central, south), Colombia, Cuba, Guatemala, Mauritius, South Africa, and Thailand). 5/ Average of 6 countries (Belgium, Chile, the Netherlands, Turkey, United Kingdom and United States). 6/ Average of 7 countries (Bulgaria, Japan, Kazakstan, Moldova, Romania, Russia, Ukraine). 7/Average of 3 exporters (European Union, Turkey, Ukraine). 8/ Cents per pound, HFCS-42, dry weight. 9/ Average of 15 countries (Argentina, Belgium, Canada, Finland, France, Germany, Hungary, Italy, Japan, Netherlands, South Korea, Spain, Taiwan, United Kingdom, and United States).

Source: LMC, International.

Major cane sugar exporters were Australia, Brazil, Colombia, Cuba, Guatemala, Mauritius, South Africa, and Thailand. Together they produced about 23 percent of the world's sugar. Unit costs ranged from 11.15 to 15.17 cents a pound. These costs were low but still 3 to 5 cents higher than the lowest cost producers. Analysis of the yearly data indicates an upward trend in costs of about 0.94 cents per pound.

The LMC data show unit costs for U.S. cane producers ranged from 14 to 22 cents a pound. This range was about twice as high as that of the lowest cost producers, and 3 to 7 cents higher than the major exporters. Nonetheless, U.S. costs were far below those of the highest cost producers. The range of U.S. cane costs would also appear to compare favorably with the weighted world average range of 14.53 to 16.52 cents per pound.

Beet Sugar

Low-cost beet sugar producing countries were Belgium, Chile, the Netherlands, Turkey, the United Kingdom, and the United States. Together they accounted for 8 percent of the period's beet sugar production. Unit costs per pound ranged between 19.69 and 21.74 cents. There was no significant trend over the period for the low-cost producing group.

It is interesting to compare the low beet sugar costs to the lowest cane costs. To make the numbers comparable, the raw cane sugar costs were converted into their refined equivalent using a method used by LMC. These numbers appear in tables 1 and 2 beneath the results for raw cane sugar. As can be seen, the lowest cost cane producers have a cost advantage over the like-defined beet producing group. The range averages differ by about 8 cents a pound.

The high-cost beet producers are Bulgaria, Japan, Kazakstan, Moldova, Romania, Russia, and the Ukraine. They produced about 6 percent of the world's sugar over the period. Their unit costs ranged between 36 and 55 cents. The costs trended upward over the period at about 3.3 cents a pound per year. Most of these countries were formerly command economies that faced major changes with the collapse of the old order. It appears that their sugar producing sectors have not had an easy adjustment.

Major beet sugar exporters were the European Union, Turkey, and the Ukraine. They produced about 19 percent of the world's sugar. Their units costs ranged between 25 and 33 cents per pound, and showed a slight, relatively insignificant upward trend during the period. These cost estimates are biased upward due to the inclusion of Ukraine, which is a high-cost producer but still exports a large share of its production, typically to Russia and other countries in the region.

The United States emerges as a relatively low-cost producer of beet sugar. Its costs ranged between 15.6 and 20.6 cents a pound during 1989/90 to 1994/95, or about 40 percent less than the weighted world average. Over the period U.S. unit costs trended downward at a significant 0.81 cents per year. Also, within the United States, unit costs of beet sugar

Table A-2--Costs of producing raw cane sugar, beet sugar, and high fructose corn syrup, United States and select categories of world producers, 1989/90-1994/95

Category	Cents/pound 1/		
Raw cane sugar			
U.S. producing regions 2/	14.15	-	22.09
Low-cost producers 3/	8.04	-	9.91
High-cost producers 4/	43.08	-	51.78
Major exporters /5	11.15	-	15.17
World	14.53		16.52
Cane sugar, white value equivalent			
U.S. producing regions 2/	18.33	-	26.96
Low-cost producers 3/	11.69	-	13.73
High-cost producers 4/	49.77	-	59.23
Major exporters /5	15.07	-	19.44
World	18.74		20.91
Beet sugar, refined value			
United States 6/	15.64	-	20.59
Low-cost producers /7	19.69	-	21.74
High-cost producers /8	35.87	-	55.36
Major exporters /9	25.65	-	32.34
World	27.77		33.45
High fructose corn syrup /10			
United States	9.55	-	10.60
Major producers 11/	12.51	-	13.61

Note: Weighted averages except for the United States.
1/ Measured in current U.S. cents/pound, ex-mill/factory basis. 2/ U.S. producing regions comprise Florida, Hawaii, and Louisiana/Texas. 3/ Average of five countries (Brazil, Colombia, Guatemala, Malawi, Zambia). 4/ Average of seven countries (Barbados, Congo, Guadaloupe, Japan, Puerto Rico, Reunion, Sri Lanka). 5/ Average of eight countries (Australia, Brazil (central, south), Colombia, Cuba, Guatemala, Mauritius, South Africa, and Thailand). 6/ Weighted average of U.S. producing regions of Great Lakes, Red River Valley, Great Plains, Northwest, and Southwest. 7/ Average of six countries (Belgium, Chile, the Netherlands, Turkey, United Kingdom, United States). 8/ Average of seven countries (Bulgaria, Japan, Kazakhstan, Moldova, Romania, Russia, Ukraine). 9/Average of three exports (European Union, Turkey, Ukraine. 10/ Cents per pound, HFCS-42, dry weight. 11/ Average of 15 countries (Argentina, Belgium, Canada, Finland, France, Germany, Hungary, Italy, Japan, Netherlands, South Korea, Spain, Taiwan, United Kingdom, and United States).
Source: LMC, International.

appeared to be less than the comparable cane sugar unit costs of 21.4 to 22.2 cents a pound. The beet sector appeared more competitive at the end of the period than at the beginning.

High Fructose Corn Syrup

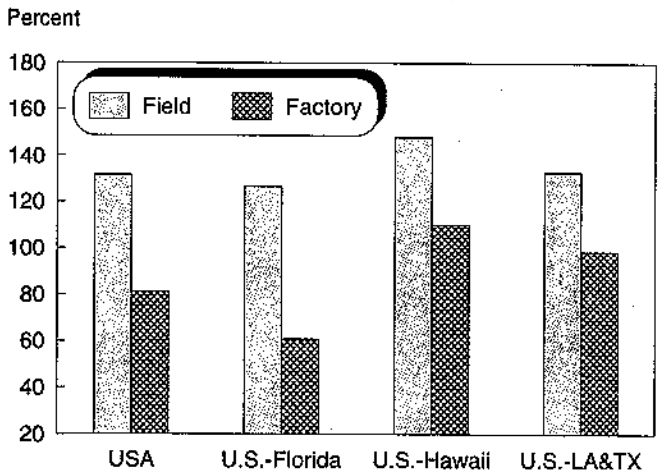
HFCS (42 percent, dry weight) costs ranged from 12.5 to 13.6 cents a pound during the period and showed no significant trend. The United States was clearly a low-cost producer, with unit costs ranging from 9.6 to 10.6 cents per pound. HFCS costs in the United States were lower than comparable ranges for either cane sugar, white value equivalent, or beet sugar, regardless of where produced.

Implications for the United States

While tables A-1 and A-2 show U.S. costs of production were marginally above the world average for cane sugar but below it for beet sugar and HFCS, figures 1-3 examine the situation more closely. Figure A-1 shows cane sugar costs separated into field and factory components. The United States is presented as a whole and in its regional cane producing areas of Florida, Hawaii, and Louisiana/Texas. The competitiveness of the U.S. cane sector is enhanced by relatively low factory costs, which were about 80 percent of the non-U.S. average, with Florida's percentage at about 60 percent. The Louisiana/Texas percentage was about the same as the non-U.S. average, while Hawaii's share was somewhat higher. In all U.S. producing areas, factory costs were lower than were similarly defined field shares. U.S. costs were made higher by relatively high field costs. Even in relatively efficient Florida, field costs were 25 percent higher than the non-U.S. average.

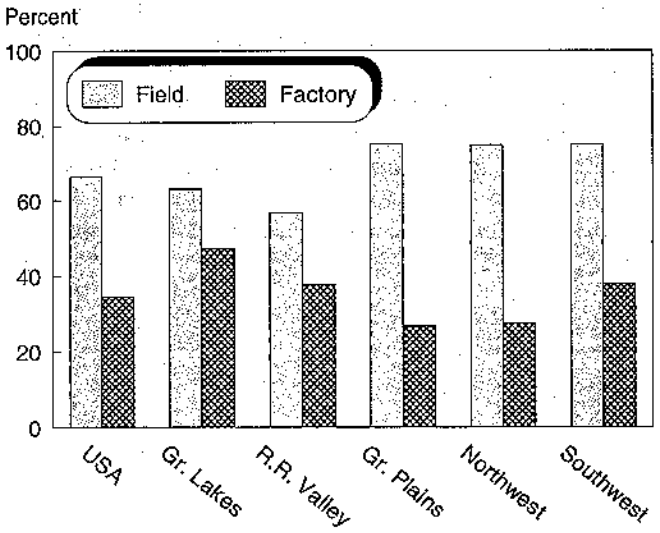
U.S. beet producing regions include the Great Lakes region, Red River Valley, Great Plains, Northwest, and the Southwest. Unlike cane sugar costs, all U.S. regions produced at less cost than non-U.S. beet countries (figure A-2) . In terms of total costs, the Red River Valley was the lowest cost producer, while costs in the Southwest (mainly California) were the highest. As with cane, the United States had a relative advantage in factory costs, which appeared especially low in the Great Plains and Northwest. Nowhere were they above 50 percent of the non-U.S. factory amount. Also as with cane sugar, the U.S. had high field costs relative to factory costs. The Western growing areas had markedly higher field costs than the Eastern regions. Still, all field costs were below comparable non-U.S. levels.

Figure A-1
U.S. Cane Sugar Costs Relative to Non-U.S. Costs



Source: LMC, International.

Figure A-2
U.S. Beet Costs Relative to Non-U.S. Costs



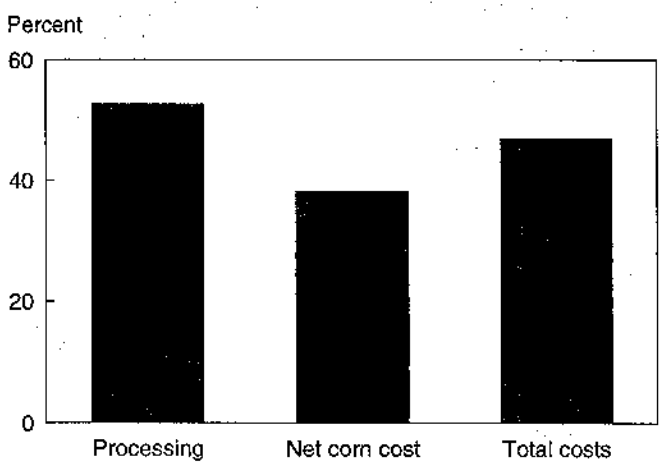
Source: LMC, International.

Figure A-3 shows HFCS costs broken out into processing and net corn cost (i.e. after deducting byproduct credits) and the total. U.S. HFCS costs were far below similarly defined costs for non-U.S. producers. The U.S. net corn cost was less than 40 percent of the non-U.S. average. This advantage stemmed from abundant corn supplies and efficient production and marketing of non-HFCS starch, oil, and feed products.

U.S. TRQ Exporters

The other special article in this report examines the economics and implications of converting the assignment of TRQ's to potential sugar exporters into a system where the quotas would be auctioned. An important implication of the analysis is that, all other things constant, lower cost producers entitled to participate in such an auction would be expected to bid higher prices to obtain the right to export to the United States. Other factors besides fundamental costs of production (including marketing costs, transport facilities, and returns-to-scale) would be expected to be important as well.

Figure A-3
U.S. HFCS Costs Relative to Non-HFCS Costs



Source: LMC, International.

The countries currently entitled to export sugar to the United States are grouped below according to their relative costs of production (table A-3). The average costs of each group are shown in figure A-4. The left axis is scaled about 100, which represents the average cost of all TRQ exporters weighted by their TRQ shares.

The average TRQ cost is most closely approximated by Brazil (north, east). There are 16 countries or regions with costs lower than Brazil and 21 with higher costs.

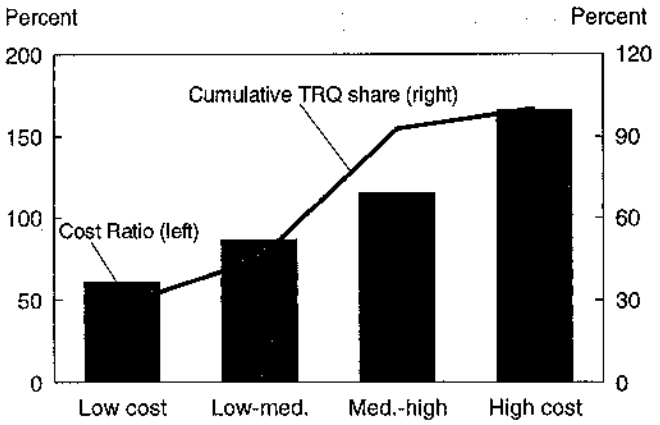
Also shown in figure A-4 are the groupings' cumulative TRQ share. The low-cost group members have costs that are 40 percent below the mean and contribute about 28 percent of the sugar exports to the United States. The second group's costs are about 13 percent below the mean and ship around 17 percent of the TRQ amount. The medium-high cost group averages over 15 percent above the mean and has an allocation of over 47 percent. The high-cost group has costs 65 percent higher than the mean, but its allocation share is less than 7 percent.

Table A-3-- Countries entitled to export sugar to the United States

Low-cost	Australia, Brazil (central, south), Colombia, Guatemala, Malawi, Swaziland, Zimbabwe
Low- to medium-cost	Bolivia, Brazil (north, east), Ecuador, El Salvador, Fiji, India, Mauritius, Mexico, South Africa, Thailand
Medium- to high-cost	Argentina, Belize, Costa Rica, Dominican Republic, Guyana, Honduras, Jamaica, Nicaragua, Paraguay, Peru, Philippines, St. Kitts, Uruguay
High-cost	Barbados, Congo, Ivory Coast, Madagascar, Panama, Papua New Guinea, Taiwan, Trinidad

Source: LMC, International.

Figure A-4
Relative Production Costs of U.S. TRQ Sugar Exports



Source: LMC, International.

Although costs of production can only partly determine optimal trade patterns, the listing in figure A-4 provides a valuable glimpse into what future U.S. import sourcing could be if the TRQ's were allocated differently than now.

References

Hoff, Frederick L., Luigi Angelo, James Fry. "World Raw Cane Sugar, Beet Sugar, and HFCS Production Costs, 1979/80-1984/85," *Sugar and Sweetener Situation and Outlook Report.* Econ. Res. Serv., U.S. Dept. of Agriculture, SSRV12N1, March 1987.

Lord, Ronald C., Robert D. Barry, and James Fry. "World Sugar and HFCS Production Costs, 1979/80-1986/87," *Sugar and Sweetener Situation and Outlook Report.* Econ. Res. Serv., U.S. Dept. of Agriculture, SSR14N2, June 1989.

LMC International. A World Survey of Sugar and HFCS Field, Factory, and Freight Costs: 1997 Report. Oxford, England, Sept. 1997.