Sugar
Background for 1995 Farm Legislation

Ron Lord

Introduction

The U.S. sugar and sweetener industry is the largest in the world, with annual consumption of caloric sweeteners approaching 20 million tons a year. The United States ranks among the top five world sugar producers and consumers, and produces about 75 percent of the world's high-fructose corn syrup (HFCS). While U.S. sugar imports have fallen in the last decade, import levels of over 1.5 million tons place the United States among the top five sugar importers.

Sugar beets are grown in 14 States, and sugarcane is grown in 4 States. While sugar beets are processed directly into refined sugar, sugarcane is processed into raw cane sugar, which must be refined by a cane refinery before final sale. Since sugar beets and sugarcane deteriorate rapidly, they can be grown only in proximity to a processor and generally only under contract.

Since 1982, the U.S. sugar price has been largely unaffected by movements in the lower world price, as the U.S. price was supported through a restrictive import quota (now a tariff-rate quota). Under the 1990 Farm Act, domestic marketing allotments are also available to support price, if supply restriction is still needed after import levels are reduced to the minimum level of 1.25 million tons.

U.S. sugar prices, as supported under the farm acts of 1981, 1985, and 1990, have stimulated production. By providing a price umbrella, the higher sugar prices stimulated production of alternative sweeteners, such as HFCS, and lowered sugar consumption. Beet sugar production has expanded in most areas except California, where alternative crops and higher input costs constrain production. Cane sugar output has declined in Hawaii, where input prices are high, but expanded in Florida, Louisiana, and Texas.

Technological progress continues to improve efficiency on sugar beet and sugarcane farms and in sugar processing facilities. The cost of producing U.S. sugar is falling both in absolute terms and relative to other countries. Beet processors are extracting record levels of sugar from sugar beets. Beet processors have also invested in new facilities to extract sugar from beet molasses, which has added about 235,000 tons to U.S. supplies. New breakthroughs, such as the ability to commercially extract sugar from cane molasses and seed improvements through DNA-splicing, are possible.

Refined sugar is processed and sold in the United States by 11 companies; the 3 largest have over half the market. Industry concentration has increased dramatically over the last 3 decades.

Characteristics of the Sugar Sector

Sugar consumed in the United States is derived from sugarcane or sugar beets.[1] About 83 percent of sugar consumed in the United States was produced domestically during fiscal years 1992-94,[2] 38 percent from domestic sugarcane and 45 percent from domestic sugar beets.

Structure of the U.S. Sugar Industry

There are three major stages in the production of refined sugar: (1) production and harvest of sugarcane and sugar beets, (2) extraction of raw sugar from sugarcane, and (3) refining of raw cane sugar and processing of sugar beets (see Box, "Sugar Beets and Sugarcane: Similarities and Differences") into commercial refined grades of sugar.

[1] USDA uses data on deliveries from cane refineries and beet processors to first users as a proxy for consumption of sugar.

[2] The fiscal year is October-September: for example, fiscal 1994 is the year beginning October 1.1993. In contrast, the crop year for sugar is most closely associated with the year beginning September: for example, the 1993 crop year is the year beginning September 1993.

Sugar Beets and Sugarcane: Similarities and Differences

Where the crops are grown: Sugar beets are a temperate crop in most of the United States, although they can be grown in warmer areas such as the Imperial Valley of California. Sugar beets are grown in 14 States.

Sugarcane, a tall perennial grass, is grown in tropical and semitropical climates. U.S. production is in four States: Florida, Louisiana, Hawaii, and Texas. Puerto Rico also grows some sugarcane.

Since sugar beets and sugarcane deteriorate rapidly once harvested, they can only be grown in proximity to a processor and are almost always grown under contract.

How they are grown: Most growers plant sugar beets in 3- to 5-year crop rotations. The rotation results in higher yields and fewer problems with diseases. Independent farmer/operators are the most efficient type of enterprise for managing such multicrop farms. Virtually all sugar beets are grown on "family-sized farms." Farmers generally harvest their own sugar beets.

Sugarcane production generally occurs on plantation-style operations that harvest only sugarcane (monoculture). After planting cane stalk cuttings, the plant matures in 12 months or less, except in Hawaii where climate allows a 24-month growing period. Two to four crops (ratoon or stubble crops) are usually harvested from the original plantings. In some cases, farmers harvest and deliver the sugarcane, but more often the factory does the harvest.

How they are processed: Processor transform sugar beets directly into refined sugar. There are two main byproducts, beet molasses and beet pulp. All sugar beet processors rely on independent growers or members of grower cooperatives for their supply of sugar beets.

Beginning in 1988, some beet sugar processors have built facilities that can extract crystalline sugar from beet molasses, a process called "desugarization of molasses." Desugarization results in 10 percent more sugar from the same acreage. Desugarization of cane molasses is technically more difficult, although trials are underway in Hawaii.

Sugarcane is not processed directly into refined sugar, but rather into raw sugar, with two main byproducts, cane molasses and bagasse. The bagasse is usually burned to provide energy to run the sugarcane mill, and some mills sell surplus electricity, particularly in Hawaii. The molasses is mostly used in animal feed.

Raw sugar is not consumed directly, but must be further refined. Cane sugar refineries buy raw sugar from both domestic and foreign sources and process it into the usable product, refined sugar. Cane refiners refine sugar throughout the year and are not restricted to any seasonal production patterns.

While in some countries such as Mexico and Brazil refineries are attached to the sugarcane processing mill, in the United States they are generally separate facilities, except for one combined mill/refinery in Florida.

Most U.S. sugarcane refining facilities are located at ports of entry near densely populated areas. This gives refiners easy access to offshore raw sugar. In 1993, cane refiners accounted for 54 percent of U.S. domestic sugar deliveries; the balance was beet sugar.

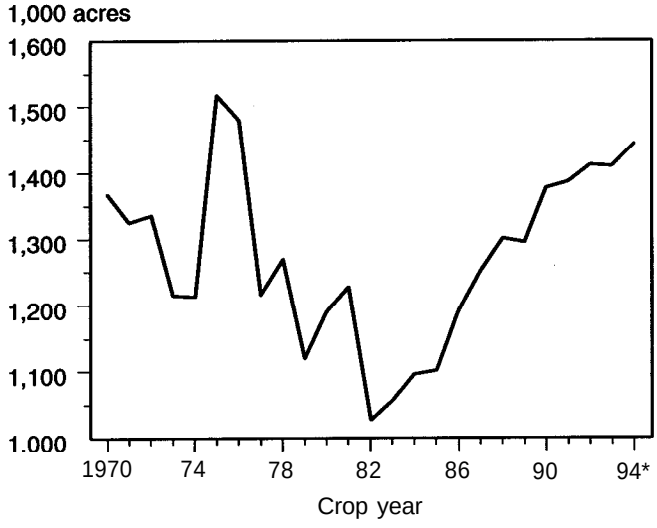
Sugar Beet Production and Harvesting

Sugar beet harvested area peaked at over 1.5 million acres in 1975 when world sugar prices skyrocketed, then fell to a low of 1.03 million acres in 1982 (fig. 1). In the last 12 years, harvested acres have risen steadily to a forecast 1.44 million in 1994. According to the Census of Agriculture, the number of U.S. sugar beet farms rose from 8,360 in 1987/88 to 8,810 in 1992/93, while the average acreage harvested per farm rose from 149 to 164 acres (table 1). Sugar beet yields per acre have shown no trend since 1970, but vary widely from year to year due to weather (fig. 2). In contrast, sugar per acre has been rising steadily as farmers adopt practices that yield more sugar (fig. 3). It is more efficient to increase the percentage of sugar in, rather than the weight and size of, sugar beets.

Sugar beet production occurs in five regions: Michigan/Ohio; Minnesota/eastern North Dakota; Great Plains; Pacific Northwest; and California. All sugar beets are irrigated except in Michigan/Ohio and Minnesota/eastern North Dakota.

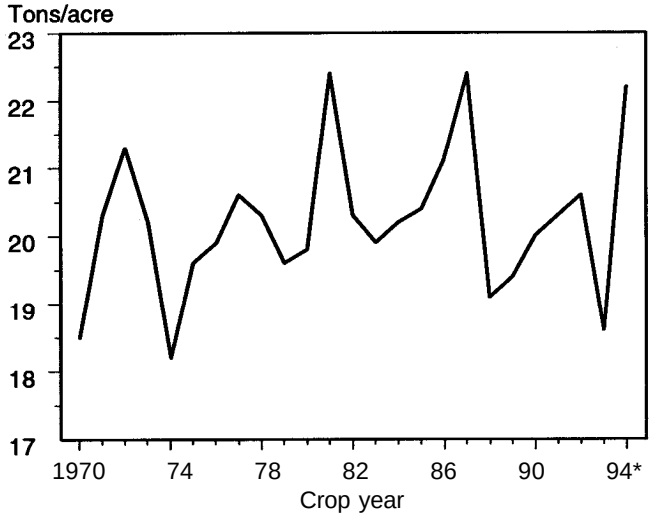
Sugar beet acreage per farm in Ohio and Michigan, at 115 and 88 acres in 1992, is lower than the national average (table 1). Total sugar beet harvested area in Ohio has not exceeded 21,000 acres since the mid-1970's (app. table l), while Michigan harvested

Figure 1
U.S. sugar beet acreage harvested



*Forecast.
Source: USDA.

Figure 2
Sugar beet yield per acre



*Forecast.
Source: USDA.

Table 1—US. sugar beet farms and average acreage harvested, by area, 1987/88, 1992/93 crop years

Region	1987/88		1992/93	
	Farms	Average area harvested per farm	Farms	Average area harvested per farm
	Number	*Acres*	*Number*	*Acres*
Region 1:				
Michigan	1,435	97	1,518	115
Ohio	222	62	227	88
Region 2:				
Minnesota	1,340	229	1,501	247
North Dakota	816	200	849	237
Region 3:				
Colorado	451	84	488	90
Kansas	0	0	1	NA
Montana	429	113	476	120
Nebraska	524	118	615	140
New Mexico	0	0	2	NA
Texas	254	118	357	107
Wyoming	400	142	497	146
Region 4:				
Idaho	1,397	121	1,406	144
Oregon	166	78	148	136
Washington	1	NA	2	NA
Region 5:				
California	924	228	723	212
Total	8,360	149	8,810	164

NA = Not available.
Source: 1992 Census of Agriculture.

acreage has doubled since the mid-1970's to a forecast 187,000 acres in 1994.

Sugar beet production in Minnesota and eastern North Dakota is concentrated in the Red River Valley along the North Dakota-Minnesota border, and in west-central Minnesota. About 12,000 acres of sugar beets are grown in far western North Dakota and delivered to a factory in Montana. The area harvested in Minnesota and eastern North Dakota has almost doubled since the mid-1970's to 600,000 acres in 1995 (app. table 1). Both the number of sugar beet farms and average size increased between 1987/88 and 1992/93. Climate in the northern part of the region limits the number of alternative crops.

The Great Plains region includes the Panhandle of Texas and eastern New Mexico; southeastern, central, and north central Wyoming; western Nebraska; northeastern Colorado; eastern and south central Montana; and far western North Dakota. Harvested sugar beet area has varied from 200,000 to 300,000 acres since the mid-1970's. Prospective area harvested in 1994 is up from a decade before in all Plains States except Texas. Harvested area in Texas for 1995, at 25,000 acres, was down 30 percent from the previous year, as growers cut back their sugar beet acreage due to low returns compared to alternative crops, such as cotton.

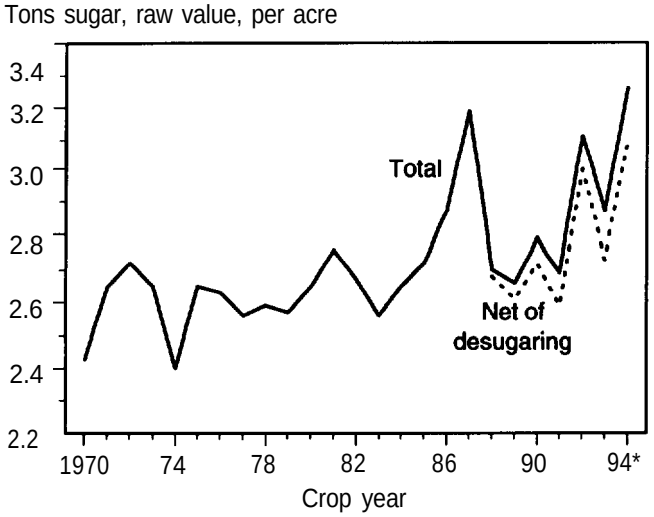
The Pacific Northwest region includes Idaho, Oregon, and Washington. Sugar beet production in eastern Idaho is in the high-elevation, low-rainfall area between the Rocky Mountain and Cascade-Sierra ranges. Only a few thousand acres of sugar beets were grown in Washington for delivery to factories in Idaho after the last processing facility in Washington closed in 1979. A few years ago, however, production started again in the Moses Lake region of Washington, which is well suited to sugar beet agriculture. Farmers in the Moses Lake area, who grow about 10,000 acres of sugar beets which are delivered both to Idaho and California, are attempting to finance a sugar beet processing facility in the region. Sugar beet farmers in Idaho and eastern Oregon are forming a cooperative and hope to purchase the processing company in the area.

California has four distinct production regions: the north central (Sacramento Valley), the south central (San Joaquin Valley), the coastal, and the Imperial Valley. The California climate is highly beneficial to crop production, and more than 30 different crops are grown on farms producing beets. Harvested beet area in the State has fallen to 141,000 acres in 1995, less than half of the peak during the mid-1970's, as diseases and drought have raised costs and driven farmers to alternative crops.

Sugar Beet Processing

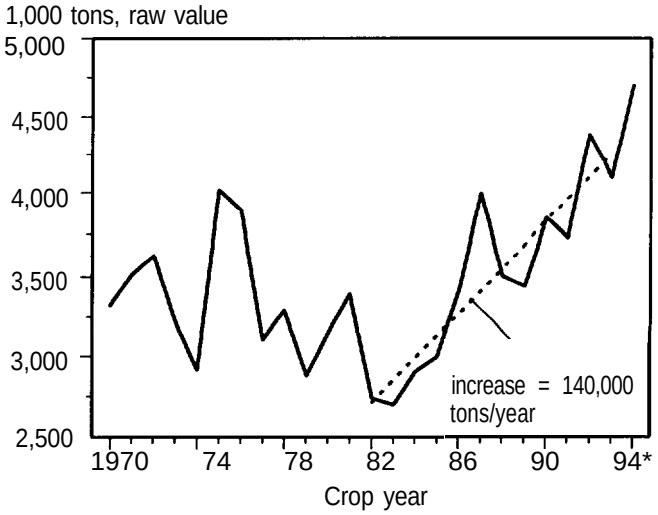
Technological changes between 1975 and 1993 contributed to the production of 9 percent more beet sugar from 7 percent fewer sugar beet acres. Harvested area in 1992 was about 100,000 acres less than the 1975 peak, while beet sugar production was up 400,000 tons to 4.4 million short tons (fig. 4).

Figure 3
Beet sugar per acre



*Forecast.
Source: USDA.

Figure 4
U.S. beet sugar production



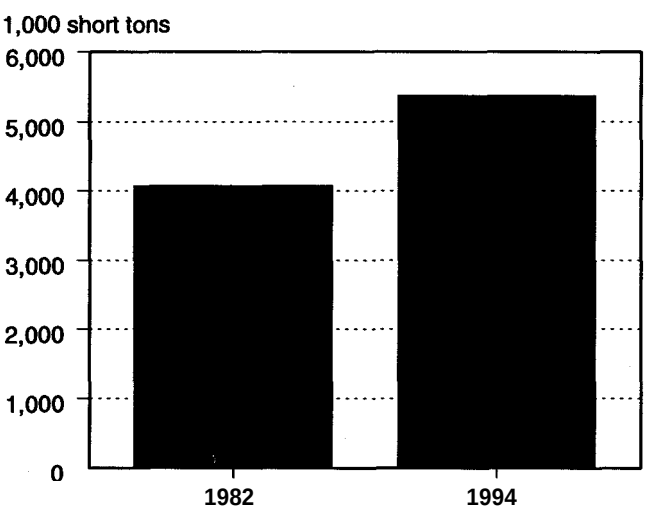
*Forecast.
Source: USDA.

Table 2—U.S. sugar beet processing companies

Location/company	Factories, 1994	Desugaring facilities	Daily slicing capacity	
			1988	1994
	--------Number--------		--------Tons--------	
Michigan/Ohio:				
Michigan Sugar Co.[1]	4	0	13,300	15,300
Great Lakes Sugar Co.[1]	1	1	3,800	3,800
Monitor Sugar Co.	1	0	8,000	8,000
Minnesota/North Dakota:[2]				
American Crystal Sugar Company	5	1	25,500	28,600
Southern Minnesota Beet Sugar Cooperative	1	1	7,200	10,000
Minn-Dak Farmers Cooperative	1	0	5,500	5,900
Plains:				
Western Sugar Co.[3]	7	1	20,200	23,000
Northwest:				
Amalgamated Sugar Co.	4	1	29,000	37,000
California:				
Spreckels	3	0[4]	12,000	12,000
Delta	0[5]	0	3,000	0
California and Plains:				
Holly Sugar Corporation[6]	7	1	41,400	39,100
U.S. total[7]	34	6	168,700	182,700

[1]Subsidiary of Savannah Foods & Industries, Inc.
[2]The three companies, all cooperatives, formed a joint marketing company in 1994, United Sugars Corporation.
[3]Owned by Tate & Lyle, based in London, UK. Tate & Lyle also owns Domino Sugar Corporation, a cane sugar refiner,
[4]Spreckels is planning to build a desugaring facility, which would be the seventh.
[5]Delta closed in 1993.
[6]Part of Imperial Holly Co., which includes cane refiner Imperial Sugar Co. Closed one California factory in 1993.
[7]In 1994, there were 10 beet sugar companies. Due to joint ownership or marketing arrangements, there are seven separate beet sugar marketing companies.
Source: USDA.

Figure 7
U.S. sugar beet factories daily average slicing capacity



Source: United States Beet Sugar Association.

longer in the sheds and are shielded from the sun and weather.

Sugarcane Production and Harvesting

U.S. cane sugar production, including Puerto Rico, is forecast at a record 3.59 million tons in fiscal 1995 (fig. 8). Since 1982, cane sugar production has trended up 1.5 percent, or 42,000 tons, a year. Sugarcane acreage harvested for sugar rose from 739,000 acres in 1970 to a record 927,000 acres in 1993 (fig. 9). An additional 55,000 acres of cane was grown for seed.

Florida's sugarcane production has expanded significantly since the United States ceased importing Cuban sugar in 1960. In 1980, Florida surpassed Hawaii as the largest cane sugar producing State and now accounts for over half of all U.S. cane sugar. In 1995, Florida is forecast to produce a record 1.84 million tons of sugar from 428,000 acres (figs. 10 and 11).

Changes in the field and factory have improved the U.S. sugar beet factory recovery rate, which measures sugar output as a percentage of sugar beet input, from 13 percent in the early 1970's to a record 15 percent in 1992 and 1993 (fig. 5).

Improved beet seed genetics contributed to greater production by increasing disease resistance, improving sucrose content, and enhancing other desirable attributes. Conventional industry wisdom states that "sugar is made in the field, not the factory," and factory managers increasingly work with farmers to tailor production practices to maximize sucrose production. Nitrogen management has become more important, since the sugar beet plant produces more sucrose at the end of the season if it is nitrogen-starved. Computers have become an important tool in testing alternative production practices and providing faster feedback. At the same time, contracts between processors and growers provide stronger incentives to "grow sugar." For example, some contracts prohibit the application of nitrogen after a certain date.

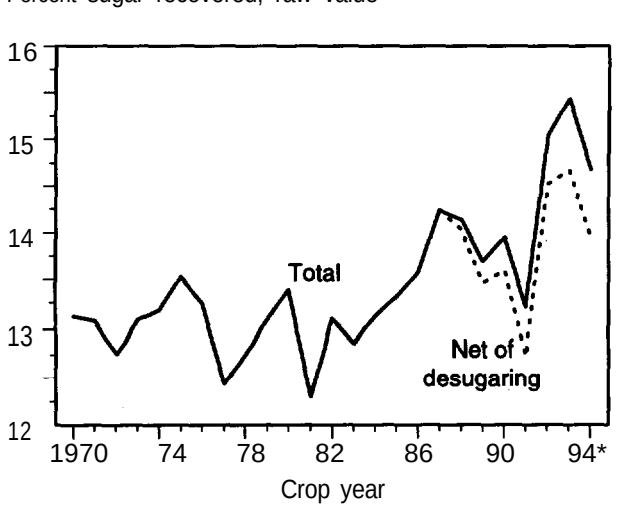
Installation of facilities for the desugarization of molasses began in 1988 (see box, Sugar Beets and Sugarcane: Similarities and Differences). By 1994, six such facilities were operating, with plans for at least two more. In some cases, the desugaring facilities replaced older, similar technologies, such as the Steffen process. USDA estimates that the amount of sugar produced in the desugaring facilities, net of that which would have been produced in terminated Steffen facilities, was 235,000 tons in fiscal 1994 (fig. 6).

There were 34 U.S. sugar beet processing factories in 1994, down from 43 in 1981 (table 2). Ten beet processing companies own the plants. Three are grower cooperatives which jointly market their sugar, while two are subsidiaries of two cane refining companies. The four largest beet sugar companies operated 23 facilities and accounted for about 70 percent of the beet sugar produced in the United States in 1994.

U.S. beet sugar production in fiscal 1995 is forecast at a record 4.7 million tons, and has risen at 4 percent or about 140,000 tons a year since 1982. Production is limited by the industry's capacity to slice sugar beets and extract sugar from beet molasses. Industry slicing capacity rose from 168,700 tons a day in 1988 to 182,700 tons in 1994 (table 2). Average factory slicing capacity per factory has risen from 4,100 tons a day in 1982 to 5,400 tons in 1994 (fig. 7).

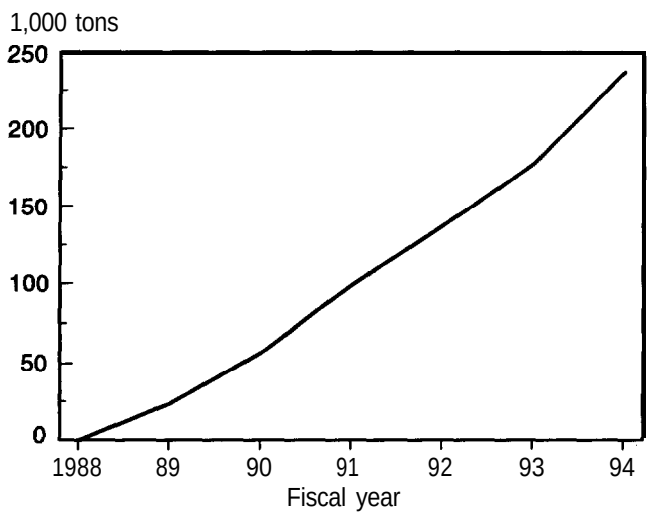
The number of days that a factory can slice beets, called a campaign, along with per-day slicing capacity determines annual sugar production capacity. Climate is the major factor affecting each region's potential campaign length. Once harvested and put into piles, beets are at risk of deteriorating rapidly. Colder temperatures reduce the risk, and rate, of deterioration. In California, some campaigns last less than 100 days. In the Great Plains, the campaign is generally 150-180 days, compared with over 200 days in the Minnesota/eastern North Dakota region. One cooperative in the Red River Valley has built insulated sheds, which aerate beets with ambient air at 20-30 degrees below zero and then are sealed. Beets stay frozen

Figure 5
Beet sugar recovery per ton sugar beets



*Forecast.
Source: USDA.

Figure 5
U.S. production of sugar from beet molasses desugarization



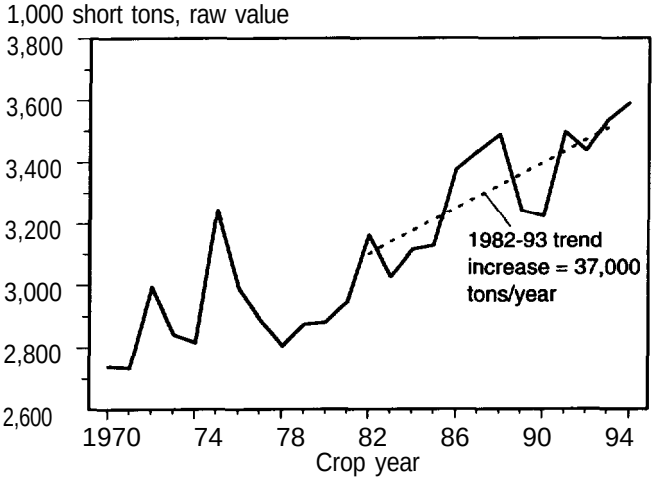
Source: USDA.

The Florida sugar industry is highly vertically integrated. The two largest processing companies each owns over 130,000 acres of sugarcane, and over two-thirds of the sugarcane is grown by processing companies. The average farm size was 3,106 acres in 1992, up slightly from 1987 (table 3).

Two major changes have affected Florida's sugar industry recently. Technological improvements in machine harvesters and in the ability of factories to accommodate more trash coming in with the cane have allowed most cane companies to switch from hand to mechanical harvesting. As a result, the number of Caribbean "guest worker" cutters, who work for a few months a year under special work permits, has declined from 10,000 in the mid-1980's to an estimated 1,200 in 1995.

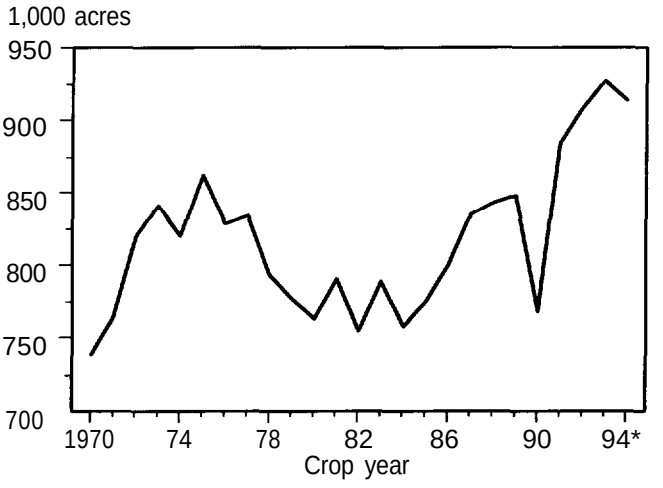
At the same time, the Florida sugar industry has been involved in debates over the causes and extent of ecological deterioration of the Everglades. Water flows south from sugarcane fields to conservation areas and

Figure 8
U.S. cane sugar production 1/



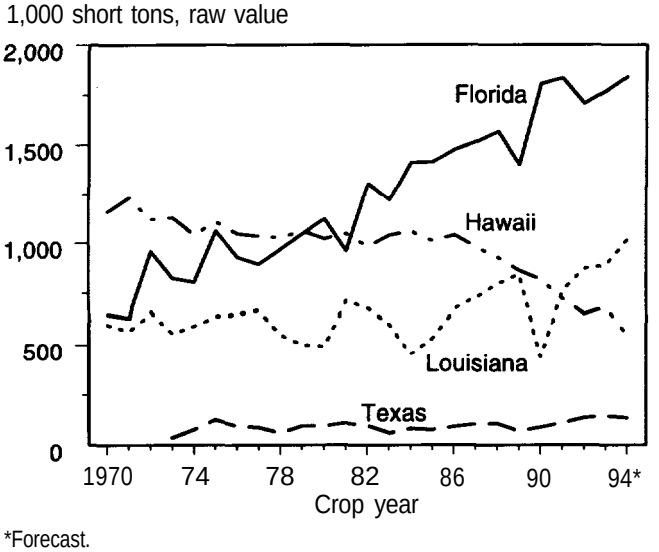
*Forecast.
1/ Includes Puerto Rico.
Source: USDA.

Figure 9
U.S. sugarcane area harvested for sugar 1/



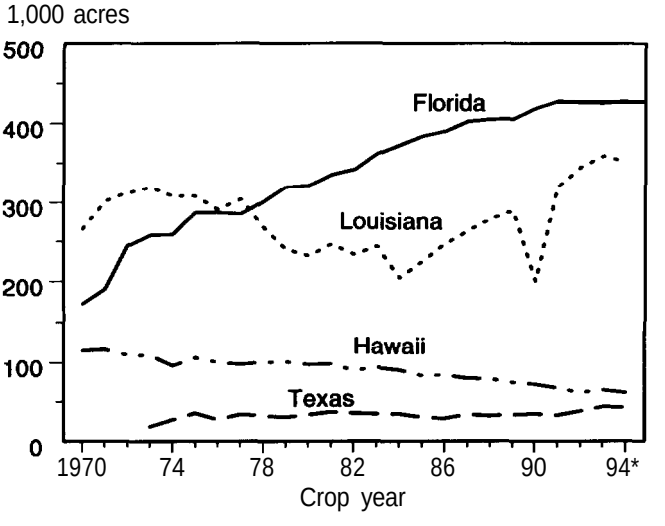
1/ Includes Puerto Rico.
*Forecast.
Source: USDA.

Figure 10
U.S. cane sugar production, by State



*Forecast.
Source: USDA.

Figure 11
Sugarcane acreage harvested for sugar, by State



*Forecast.
Source: USDA.

Table 3—U.S. sugarcane farms and average acreage harvested, by State

Location	1987/88		1992/93	
	Farms	Average area harvested per farm	Farms	Average area harvested per farm
	Number	*Acres*	*Number*	*Acres*
Florida	138	2,920	139	3,106
Hawaii[1]	79	1,003	31[1]	2,030
Louisiana	687	385	755	472
Texas	85	383	106	311
U.S. total	989	788	1,031	857

[1]By September 1994, all independent growers had ceased operations. All cane is now grown by the five processing companies. After 1996, all cane will be grown by only three remaining companies.
Source: 1992, 1987 Census of Agriculture.

eventually to the Everglades National Park. Federal and State agencies have determined that phosphorus exported via canals from the Everglades Agricultural Area (mostly sugarcane land) has impaired the ecological integrity of the Loxahatchee National Refuge and is threatening the Everglades National Park.

In May 1994, the Florida State legislature passed the Everglades Forever Act, which calls for a multimillion-dollar environmental restoration plan spanning several decades. About 40,000 acres of filtration marshes are to be constructed to reduce the level of phosphorus in water flowing into the conservation area. Some of the acreage could be taken from sugarcane production areas. According to the Act, the sugar industry will pay about $12 million annually for the next 20 years, which is about one-third of the estimated cost of the project.

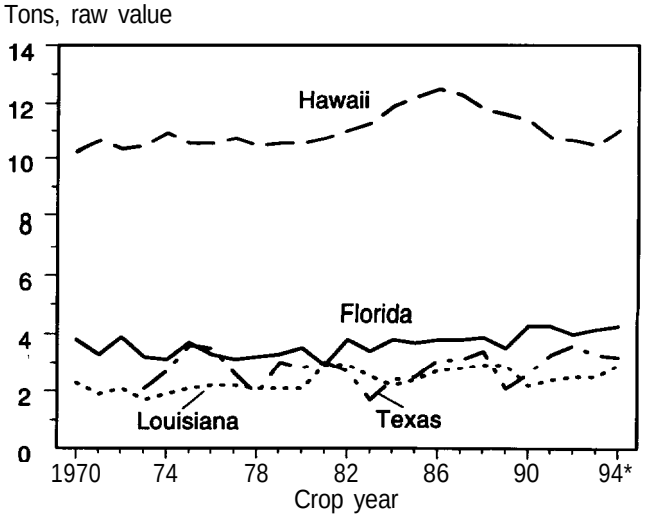
Like Florida, Louisiana's sugar industry is expanding, with acreage harvested for sugar in 1994 at 352,000 acres, up almost 50 percent from 1983 (fig. 11). Sugar production was a record 1.020 million tons in 1994 (fig. 10). Some of the expansion in sugarcane acreage in recent years occurred as returns for competing crops, such as rice and soybeans, declined. Further increases in sugarcane acreage will be limited because of the cost of hauling sugarcane from production areas that are not close to a mill.

There were 755 cane farmers in Louisiana with an average of 472 acres of sugarcane harvested in 1992/93, up from 687 farms and 385 acres in 1987/88 (table 3). In Louisiana, the northernmost cane-growing State, most sugarcane production has been confined to the Mississippi Delta's fertile soils and warm climate. However, freezing weather makes the growing season shorter than in other States, and yields are lower because the cane is generally harvested before fully maturing.

In contrast, Hawaii's unique year-round growing season, ideal climate, and biennial harvest pattern result in the highest cane sugar yields per acre in the world. Yield of sugar per acre peaked at 12.5 tons in 1986, but fell to 10.4 tons in 1993 because of poor weather, disease, and lack of recapitalizing by companies preparing to cease production (fig. 12). This yield is based on a 2-year growing season. However, even if the yield were annualized by dividing by two, the resulting yield of 5-6 tons of sugar per acre per year would be among the world's highest.

Hawaii's sugar production has declined from over 1 million tons as recently as 1986 to a forecast 540,000 tons in 1995. Sugarcane area harvested in Hawaii has decreased from over 100,000 acres in 1979 to a forecast 50,000 acres for 1995 (fig. 11). The State's

Figure 12
Cane sugar yield per acre, by State



*Forecast.
Source: USDA.

higher land, labor, and transportation costs have contributed to the industry's decline. In addition, it has been costly to comply with water and air effluent standards and with restrictions on the pre-harvest burning of fields.

Texas sugarcane farmers formed a cooperative in 1973. The co-op is forecast to harvest 42,500 acres and produce 145,000 tons of sugar in 1994 (figs. 10, 11). Texas sugarcane is produced in the lower Rio Grande Valley in the southern tip of the State. This area has a subtropical climate of long hot summers and short mild winters. Killing freezes are a recurrent threat. Hurricanes and drought have significantly reduced production in some years, and excessive rainfall periodically delays harvest and processing. Disease and insects also have affected yields.

Sugarcane Processing

Sugarcane processing takes two stages. First, sugarcane is converted into raw sugar by extracting juice from the stalk. The juice is then clarified, boiled, and crystallized. The raw sugar, usually 96-99 percent pure, is shipped to a refinery for further processing into refined sugar. Technically, it is possible to combine the cane processing and refining operations, as is done in one location in Florida; however, it has usually been the practice to transport raw sugar to refineries close to major use areas, so the refined product does not need to be shipped as far. Refineries also receive imported raw cane sugar, and must be situated in port cities.

Sugarcane mills are located near the cane fields to minimize transportation costs and postharvest losses. Many sugarcane processors grow their own sugarcane (producer/processor) and supplement their production with sugarcane purchased from independent growers. Others are either cooperatives that process members' cane or producer/processors that process only their own production.

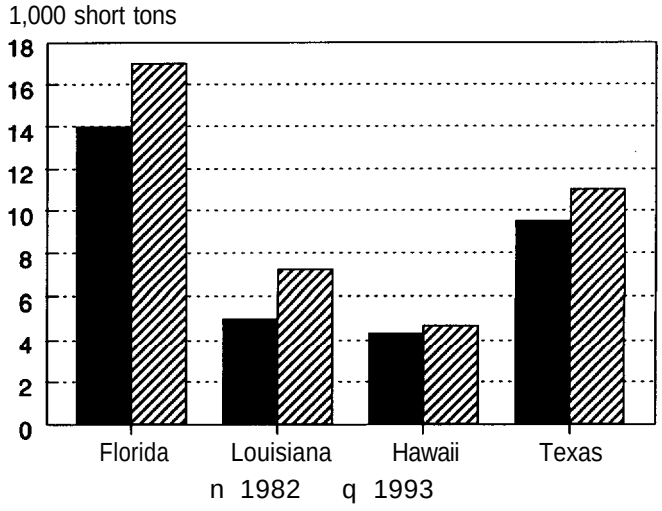
The seven Florida mills producing raw cane sugar, for example, are owned by a cooperative, an independent mill, a company with two mills, and another with three mills. The average daily grinding capacity of the seven mills rose from about 14,000 tons a day in 1982 to 17,000 tons a day in 1993 (fig. 13 and app. table 9). The large size of the Florida mills is in part due to the plantation-style farms near the mills, which allow the cane to be transported efficiently over relatively short distances, level roads, and in some cases by rail. Recent investments to better handle machine-cut cane and to upgrade capacity, coupled with the continued development of better cane varieties, increased Florida sugar yields from 3.4 tons per acre in 1979-83 to 4.1 tons in 1989-93. Yields reached a record 4.3 tons per acre in 1991 (fig. 12).

Louisiana ran 20 mills in 1994, down from 24 in 1982. The average mill can grind about 7,250 tons of sugarcane a day, compared with under 5,000 tons in 1982 (fig. 13). Smaller mills are not as efficient as larger mills and the industry continues to consolidate, closing some mills while increasing the capacity of remaining mills. Louisiana has averaged 2.5 tons of sugar per acre in recent years (fig. 12).

Hawaiian factories are much smaller than their mainland counterparts, with an average capacity to grind about 4,700 tons of sugarcane daily (fig. 13). However, the 12-month grinding season means the average Hawaiian factory produces almost as much sugar annually as the average mainland factory, which runs only 3-6 months of the year.

Two Hawaiian factories closed in 1994, one of which was the last to process cane from independent growers. As a result, all of the small, independent growers have stopped growing sugarcane, and all sugarcane is now grown by the companies which own the mills. A factory on Oahu is scheduled to close in April 1995, as are two more in 1996 including the last factory on the island of Hawaii. If these three factories close as scheduled, the State would contain seven factories, owned by three companies.

Figure 13
U.S. sugarcane mills: Average daily grinding capacity



Source: USDA.

Texas cane is refined in a mill owned by a 100-member cooperative. The mill can grind about 10,000 tons of sugarcane per day (fig. 13), up from 9,500 in 1982. While the average campaign runs about 170 days from mid-October to April, rain delays have forced much longer campaigns. Texas has been averaging above 3 tons of sugar per acre in recent years.

Cane Sugar Refining

Cane refiners process virtually all domestic and imported raw cane sugar, except for very small quantities sold for direct consumption in niche markets. In fiscal year 1994, domestic deliveries of refined cane sugar were about 54 percent of total deliveries, or just under 5 million short tons, raw value. In fiscal 1982, cane sugar deliveries, 6.2 million tons, were 67 percent of the total.

The number of refineries shrunk from 21 in 1982 to 12 in 1994 (table 4). In the 1970's, over 4 million tons of imported sugar were annually refined, providing over half of the raw sugar supplies for refiners. By 1994, imports for consumption had fallen to about 1.3 million tons annually and provided only about 30 percent of refiners' raw sugar supplies. The industry's daily melting capacity fell from 31,000 to 23,000 tons from 1982 to 1994 (fig. 14). The refining industry decline was due to the U.S. sugar program's stimulus of the HFCS industry, the subsequent decline in U.S. sugar consumption, and the reduced sugar import quota. Under optimal conditions for efficient plant operations of 260 days per year, the industry could refine about 5.7 million tons of raw sugar, down from over 8.1 million tons in 1982.

Table 4—U.S. cane sugar refiners: Company, factory location, and capacity

Company	Factory location	Daily melting capacity			
		1982	1988	1992	1994
		Short tons, raw value			
Domino Sugar Corp.	Baltimore, MD	2,600	2,600	2,950	3,000
	Boston, MA[1]	1,000	1,000	—	—
	Brooklyn, NY	2,100	2,100	2,000	2,000
	Chalmette, LA	3,250	3,250	2,850	3,000
	Philadelphia, PA[2]	2,100			
California and Hawaiian Sugar Co.	Aiea, HI[3]	200	200	200	142
	Crockett, CA	3,000	3,000	3,000	3,000
Florida Sugar	Belle Glade, FL[4]	390	—	—	—
Godchaux-Henderson	Reserve, LA[5]	1,900	—	—	—
Imperial Holly Corp.	Sugar Land, TX	1,650	1,650	1,950	1,950
Industrial	St. Louis, MO[6]	300	—	—	—
Louisiana Sugar Cane	Mathews, LA[5]	600		—	—
Florida Crystals Refinery	South Bay, FL	500	500	725	725
Refined Sugars, Inc.	Yonkers, NY	1,800	1,800	1,800	2,000
Revere	Boston, MA[7]	1,200	—	—	—
	Brooklyn, NY[5]	1,120	—	—	—
	Chicago, IL[7]	850	—	—	—
Savannah Foods and Industries, Inc.	Port Wentworth, GA	3,000	3,000	3,000	3,100
Everglades Sugar Refinery, Inc.	Clewiston, FL	750	750	800	850
Colonial Sugars, Inc.	Gramercy, LA	1,750	1,750	2,000	2,150
Supreme Sugar Co., Inc.	Supreme, LA	700	800	800	850
Total capacity		30,760	22,400	22,075	22,767
Average capacity		1,465	1,723	1,840	1,897
				Number	
Total plants		21	13	12	12

—- = Factory closed. [1]Closed 1988. [2]Closed 1982. [3]Aiea stopped producing crystalline sugar in 1994 and is now producing only liquid sugar. [4]Closed 1988. [5]Closed 1985. [6]Closed 1987. [7]Closed 1984.
Source: USDA, Economic Research Service.

In 1994, 11 cane sugar refineries operated in the continental United States, and a small refinery in Hawaii was being converted to liquid sugar production (table 4). All but two of the refineries were located on or near the east and gulf coasts. Of seven refining companies, the four largest account for 85 percent of total refining capacity.

To allow U.S. refiners to be competitive on the world refined sugar market, USDA operates a Refined Sugar Re-Export Program under which refiners may import world-priced raw sugar and re-export world-priced refined sugar. In recent years, this program has provided refiners with additional annual volume of about 600,000 tons. U.S. refiners are most competitive in nearby refined sugar markets, such as Canada, Mexico, and the Caribbean.

Production and Processing Costs and Returns

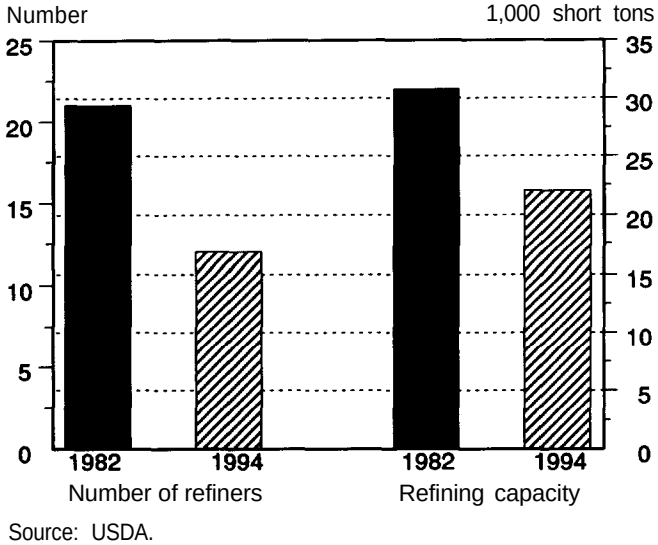
Refined Beet Sugar

Sugar beet production costs (farm level) rose from 11.5 cents a pound in 198 1 to 14 cents in 1992 (fig. 15). In part, this rise reflects adjustments made in the survey in 1988, which incorporated new cost items such as the cost of owning a cooperative share for the first time. Sugar beet growers, like processors, are adopting new technologies and methods that reduce costs. While the "family farm" is still the most efficient unit for growing sugar beets, slow growth in the average sugar beet farm size likely reflects some room for additional economies of size. Average returns (cents-per-pound of refined sugar) to sugar beet growers have been higher than both total and variable costs over 1981-92.

In crop year 1992, the latest crop year for which data are available, total sugar beet production costs averaged $823 per acre for the Nation. Costs varied from $627 per acre in Michigan and Ohio to $1,152 in California (app. table 19). Costs are higher in the West due to more extensive irrigation, more disease problems, and higher labor and land costs. Sugar beet farmers received an average of $41.40 per net ton, ranging from $35.90 in California to $47.20 in Minnesota and eastern North Dakota. Receipts averaged $850 per acre, and the national average market value of sugar beets sold exceeded the estimated average total economic cost of production by $27 per acre.

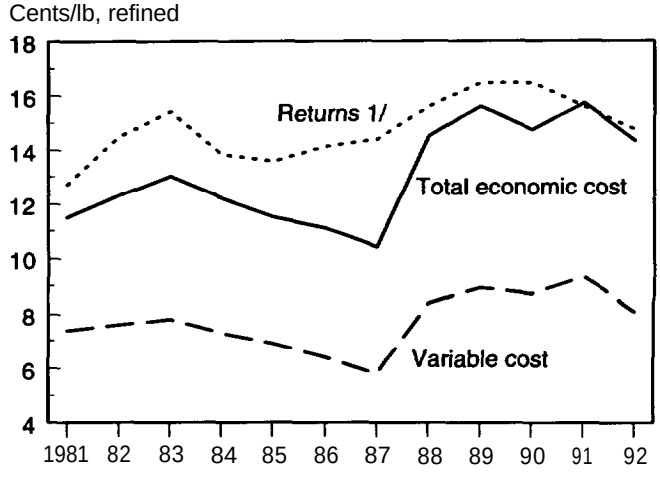
Sugar beet processor costs, net of byproduct credits, fell from 12.2 cents a pound in 1981 to 7.7 cents a pound in 1992 (fig. 16). Lower unit costs because of increased production accounted for part of the decline. Processors cut their energy and labor requirements and took advantage of computer technology to reduce costs at the factory. Processors have instructed growers to use sugar beet management practices that yield more extractable sucrose, and factories have improved their ability to test beets for "extractable sugar." Better field management of nutrients, especially nitrogen, helps raise sugar recovery and thus lower costs. Processor returns, estimated as the refined sugar price

Figure 14
U.S. cane sugar refinery numbers and daily capacity



Source: USDA.

Figure 15
Costs and returns for sugar beet growers



1/ U.S. average sugar beet price adjusted to a cents-per-pound-sugar basis (refined sugar).
Source: USDA.

minus payments for sugar beets, were above total and variable costs in all years except 1982 and 1984.

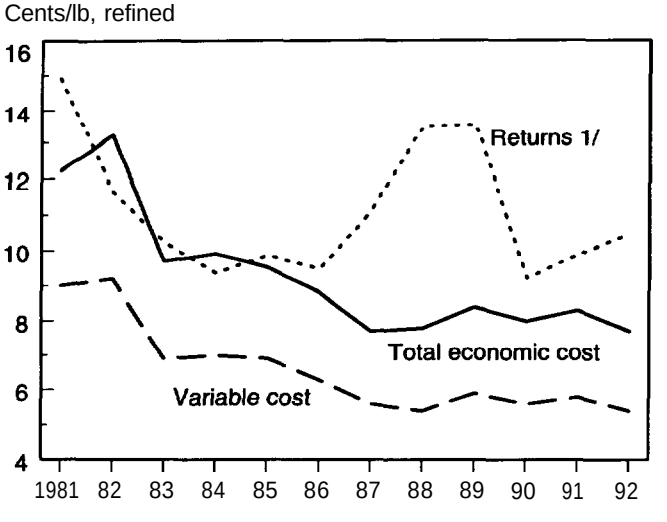
The national average total economic cost of producing beet sugar (combining grower and processor costs) fell from 23.7 cents a pound in 1981 to 22.0 cents a pound in 1992, the latest crop for which data are available (fig. 17, app. table 21). Total costs were less than the Midwest refined beet sugar price. Variable costs accounted for about 60 percent of total costs of beet sugar.

Costs of beet sugar production are generally lower in the East than in the West (fig. 18). Irrigation is not used in the East, where climate allows a longer processing season, which can lower fixed costs per unit of sugar produced. The lack of irrigation, however, also raises the variability of yields and returns in the East.

Over three-fourths of sugar in the East is produced by the three cooperatives in Minnesota and eastern North Dakota, and the cooperative structure appears to be very efficient for beet sugar production. Farmers also get all returns from cooperative factory operations, so they have a stronger incentive to tailor their farm practices to maximize recovery of sugar. A typical beet sugar factory risks uncertainty over the supply of sugar beets; for example, higher prices for alternative crops could cause farms to reduce sugar beet acreage. A cooperative virtually eliminates this risk. The farmer-member is considering not just the returns from sugar beets, but from the combined farm and factory operations. A lower supply risk enhances the factory's ability to make investments. Eastern producers also have lower transportation costs to the Nation's largest sugar market, which centers around Chicago.

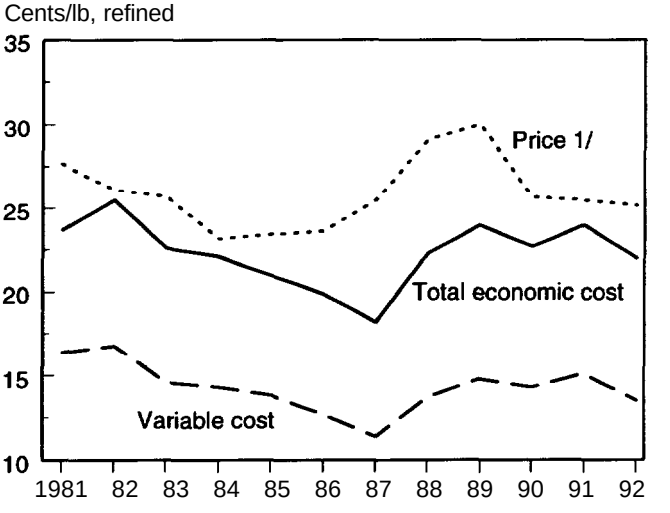
Landell Mills Commodities Studies indicated that the U.S. beet sugar industry had the 2nd-lowest cost of production out of 32 beet-sugar-producing countries in 1987/88-1991/92. In 1979/80-1983/84, the United States beet sector ranked 9th of 31 countries.

Figure 16
Costs and returns for beet processors



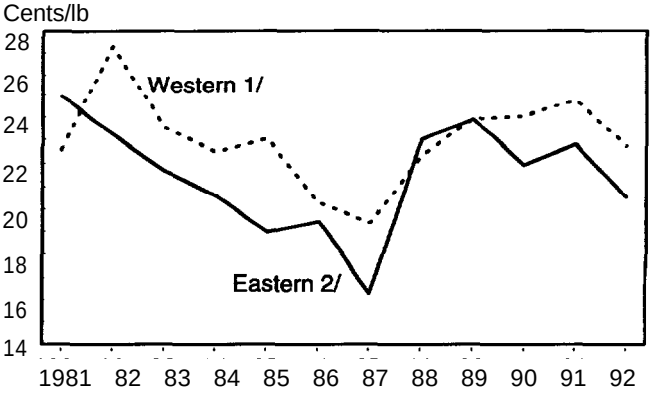
1/ Midwest wholesale beet sugar price minus payments to growers.
Source: USDA.

Figure 17
Costs and returns for beet sugar



1/ Midwest wholesale beet sugar.
Source: USDA.

Figure 18
Total economic cost of beet sugar, Eastern and Western United States



1/ Western is irrigated and includes Colorado, Nebraska, Wyoming, Texas, Montana, western North Dakota, Idaho, Oregon, and California.
2/ Eastern is largely nonirrigated and includes Michigan, Ohio, Minnesota, and eastern North Dakota.
Source: USDA.

Raw Cane Sugar

Sugarcane growers' costs fell from 14.1 cents a pound in 1981 to 12.7 cents in 1992 (fig. 19 and app. table 22). Variable costs accounted for about two-thirds of total grower costs. Returns, as measured by the national average sugarcane price converted to cents per pound of raw sugar, were generally above total costs and well above variable costs. Production costs for the 1992 crop ranged from 11 cents a pound in Louisiana to 14.7 cents a pound in Hawaii (app. table 22).

Cane processor total economic costs, net of byproduct credits, declined from 7.7 cents a pound in 1981 to 7.1 cents in 1992 (fig. 20). Returns, estimated as the raw sugar price minus payments to sugarcane growers, were above total and variable costs during the period.

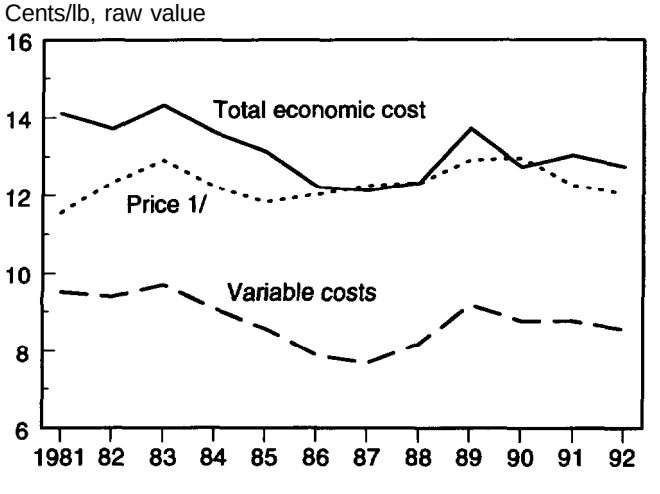
In 1992, total processing costs (including byproduct credits) averaged 8.2 cents a pound of raw sugar. Processing costs were lowest in Florida at 6.36 cents a pound and highest in Hawaii at 14.1 cents. Some of the recent structural changes in Hawaii may not be reflected in the 1992 costs, which are based on a 1988 survey. For example, some of the higher cost producing areas of Hawaii have reduced or even ceased production.

The combined return for sugarcane growers and processors is the key variable when the grower and processor are the same economic unit. The mill in Texas, for example, is a cooperative, and the sugarcane grower-members receive returns from growing and processing. In Hawaii, all sugarcane is now grown by the processing companies, for which the separate costs of growing and processing sugarcane are not as important as the overall combined cost of producing raw cane sugar. Over half of the sugarcane in Florida is grown either by the company that also owns the processing mill, or by members of a cooperative mill. In Louisiana, about half the mills are cooperatives.

The combined grower and processor average total economic cost of producing cane sugar, net of byproduct credits, fell from 21.9 cents a pound, raw value, in 1981 to 19.9 cents in 1992 (fig. 21 and app. table 24). The 20-percent increase in production volume over the period helped lower unit costs. Growers and processors also were able to maintain investment programs to improve efficiency. Returns have exceeded total economic costs in most years and in every year since 1986 (fig. 21).

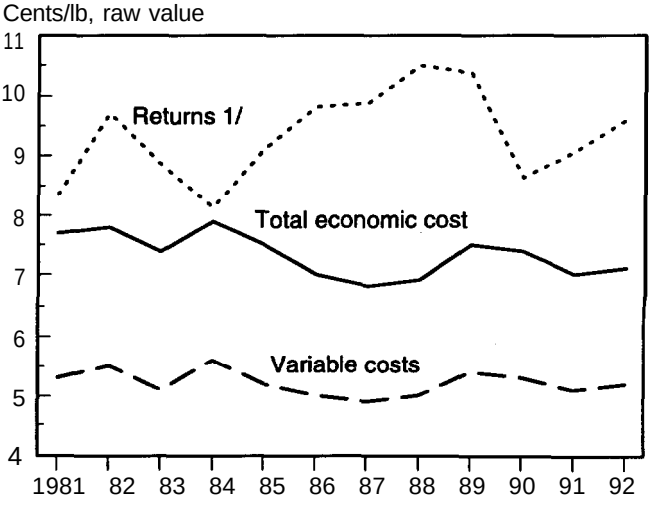
Prices paid for sugarcane are based on the returns that processors receive from the sale of raw sugar and molasses. The grower generally receives about 60 percent and the processor 40 percent from the sale of raw sugar. The grower also receives a share of the value of the molasses in the sugarcane. The average price for 1992 sugarcane was $25.40 per net ton in Louisiana and Texas, and up to $29.80 in Florida (app. table 22). No return is given for Hawaii, because integrated producer/processor operations do not impute a value to their cane before processing. A net

Figure 19
Costs and returns for sugarcane growers



1/ U.S. average sugarcane price adjusted to a cents-per-pound-sugar basis (raw value).
Source: USDA.

Figure 20
Costs and returns for cane processors



1/ Raw sugar price (New York) minus payments to growers.
Source: USDA.

ton is gross weight less dirt, leaves, trash, debris, and other extraneous materials.

According to Landell Mills Commodities Studies, the U.S. cane sugar cost of production ranked 31st out of 62 cane sugar-producing nations or regions in 1987/88-1991/92. In 1979/80-1983/84, the U.S. cane sector ranked 39th.

Comparison of Beet and Cane Sugar Costs of Production

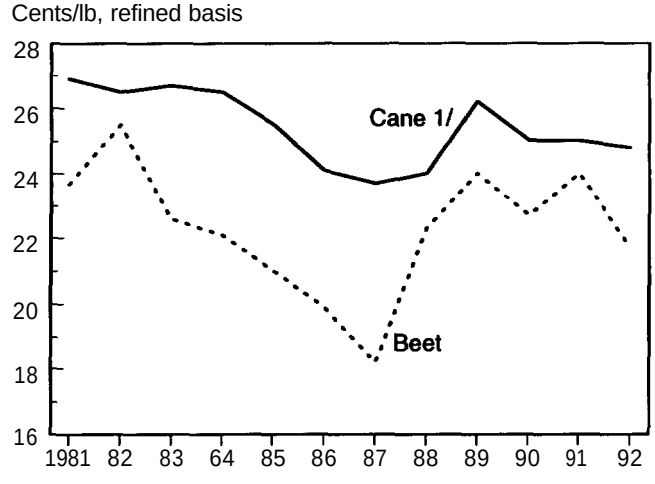
To compare the cost of producing refined cane and beet sugar, it is necessary to add to the raw cane sugar costs the cost of refining, which some analysts estimate at about 3.5 cents a pound in recent years. Since the volume of refined cane sugar is always less than the amount of raw sugar produced, an estimated refining loss of 7 percent is added. With these two adjustments, the cost of growing, processing, and refining cane sugar in the United States has consistently been higher than for beet sugar (fig. 22): in 1992, about 3 cents higher.

U.S. Sugar Prices and Consumption

U.S. sugar prices have been well above world prices since 1982 (fig. 23). The main mechanisms for maintaining U.S. sugar prices have been a restrictive import quota and more recently, domestic marketing allotments. The two key sugar prices in the United States are the raw cane sugar price and the refined beet sugar price (fig. 24). The raw cane sugar price is based on sugar delivered to New York, and is quoted on the (New York) Coffee, Sugar & Cocoa Exchange. There is no futures market for U.S. refined sugar, but a price for wholesale Midwest refined beet sugar, f.o.b. factory, is quoted each week in *Milling and Baking News.*

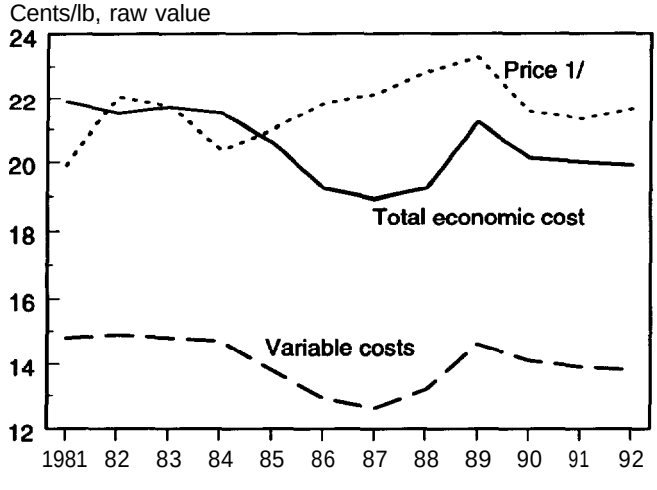
From 1982 to 1993, the U.S. raw sugar price averaged 21.6 cents a pound, ranging from 19.9 cents in 1982 to 23.3 cents in 1990. The monthly average raw

Figure 22
Cost of production of U.S. beet and cane sugar



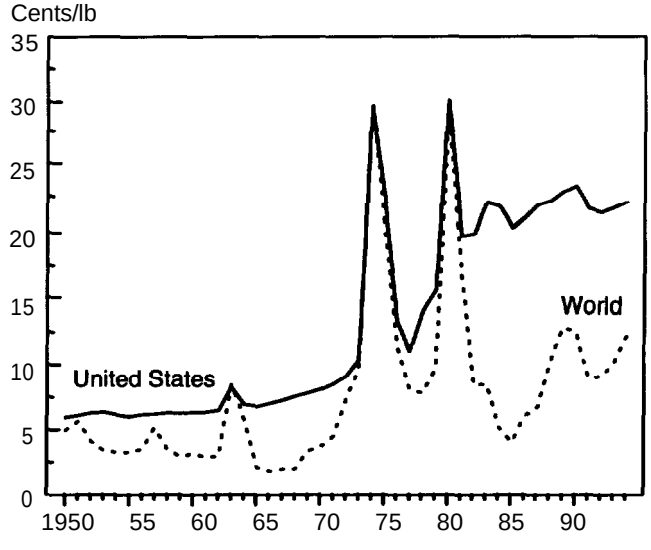
1/ Cane sugar cost, raw value, adjusted to refined basis by multiplying by 1.07 and adding 3.5 cents as a refining margin.
Source: USDA.

Figure 21
Costs and returns for cane sugar



1/ Raw sugar price, New York Coffee, Sugar, and Cocoa Exchange, No. 14 Contract.
Source: USDA.

Figure 23
World and U.S. raw sugar prices, 1950-94



Source: USDA, Economic Research Service.

sugar price ranged from 18.7 cents in October 1985 to 23.8 cents in April 1990 (app. table 10).

In contrast to raw sugar, refined sugar prices have been more variable. Refined sugar prices tend to drop when there is a large beet sugar crop, and rise when beet sugar production declines. Drought and other weather problems reduced the beet crops in 1988 and 1989, contributing to high refined sugar prices in those years. Monthly refined beet sugar prices since 1982 have ranged from 22.5 cents a pound in late 1987 to 31.5 cents a pound for most of 1990 (fig. 24). Refined beet sugar prices averaged 26.8 cents a pound in 1989-94, up 10 percent from 24.3 cents during 1984-88 (app. table 11). Weather has much less influence on raw cane sugar prices, since weather-induced shocks to domestic supply can be accommodated by changing the import quota.

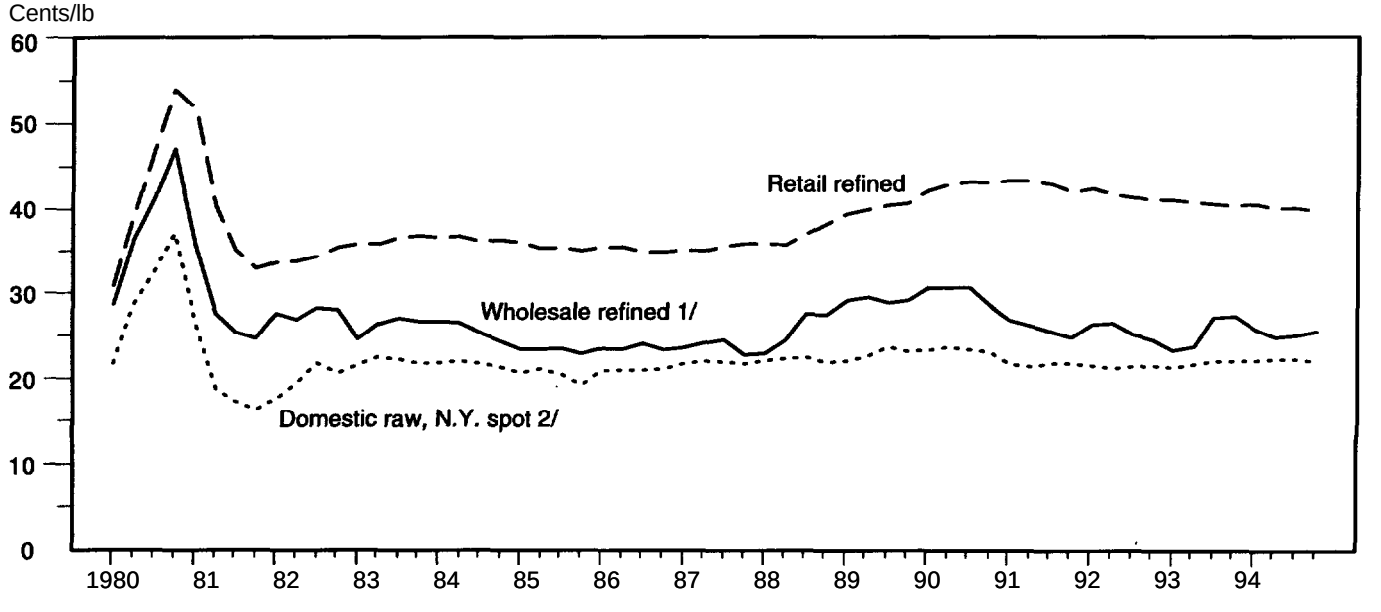
The margin between refined and raw sugar prices has varied from about 10 cents a pound in the early 1980's to less than 1 cent in 1988 (fig. 25). When this margin is low, cane refiners pay almost as much for raw sugar as they charge for refined sugar and are not able to cover their costs.

The HFCS product that is most substitutable for sugar, HFCS-55 (55-percent fructose, a liquid), is typically priced about 10 percent below the price of refined sugar. As a result, HFCS rapidly replaced sugar in a wide range of products, particularly soft drinks. HFCS consumption climbed an average of 560,000 tons or nearly 5 pounds per capita annually between 1980 and 1986, while U.S. consumption of sugar fell by 394,000 tons per year (fig. 26). Consumption of domestic sugar was not constrained, however, as imports were forced to absorb the decline in sugar consumption (fig. 27).

After capturing most of the market for liquid sweeteners by 1986, HFCS growth slowed to an increase of about 240,000 tons, dry basis, a year, compared to an increase in sugar of 169,000 tons, raw value. The estimated HFCS use of 7.4 million tons in 1994 represents an annual growth rate of about 4 percent since 1986. Estimated sugar consumption for food and beverage use in calendar 1994 of 8.4 million tons (refined basis) represents an annual growth rate since 1986 of 2 percent a year (table 5).

Most of the growth in HFCS has been at the expense of sugar, but HFCS also generated new uses and was the primary impetus in raising overall caloric sweetener consumption from 124 pounds per capita annually during 1975-79 to 150 pounds in 1994. Refined sugar comprised 44 percent of caloric sweeteners consumed in 1994, and 54 percent of the sugar/HFCS market.

Figure 24
U.S. raw, wholesale and retail refined sugar prices, quarterly



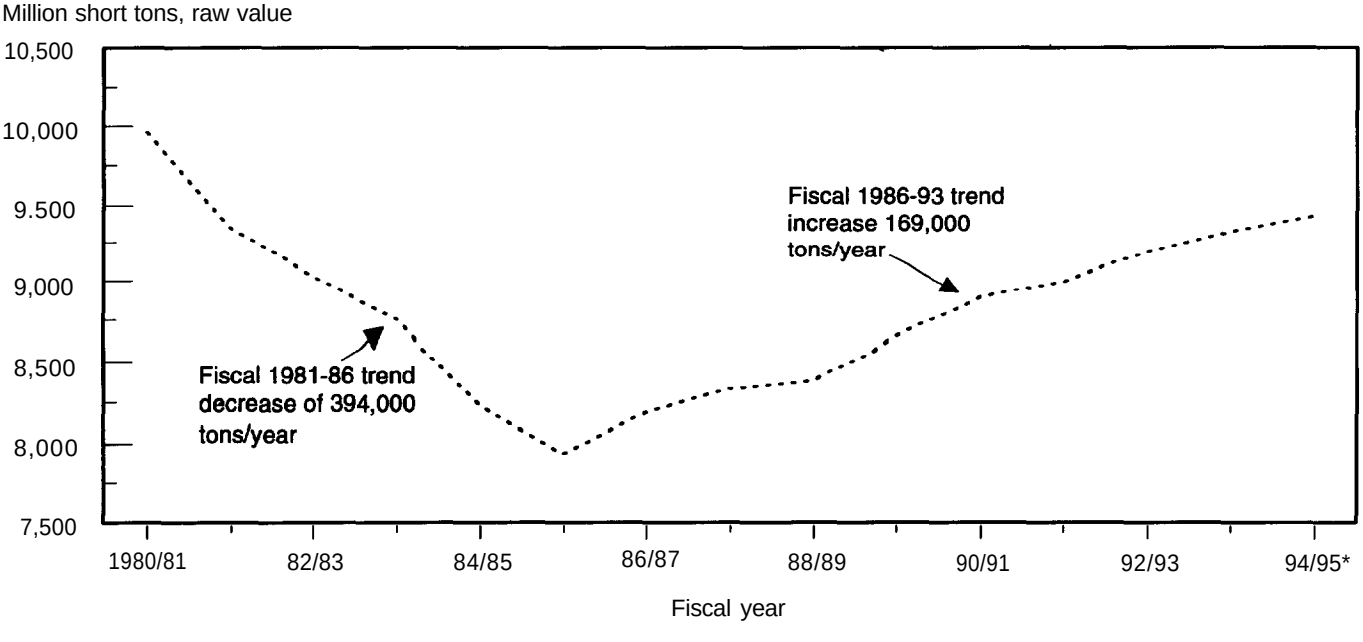
1/ Midwest.
2/ Starting June 1985, prices are for nearby futures.
Source: U.S. Department of Labor, Bureau of Labor Statistics, *Mining and Baking News,* and New York Coffee Sugar & Cocoa Exchange, Inc.

The 0.9 percent U.S. population growth rate has helped lift consumption of sugar. In addition, higher incomes, greater consumption of processed food and meals away from home, an increased immigrant population whose diets traditionally are high in sugar, and a growing awareness of the nutritional benefits of a high-carbohydrate diet, have raised per capita sugar consumption. A sugar industry campaign

Figure 25
Margin between refined and raw sugar prices

1/ Difference between Midwest wholesale refined beet sugar price and New York raw sugar price. Not adjusted for refining loss of approximately 7 percent.
Source: USDA.

Figure 26
U.S. sugar consumption

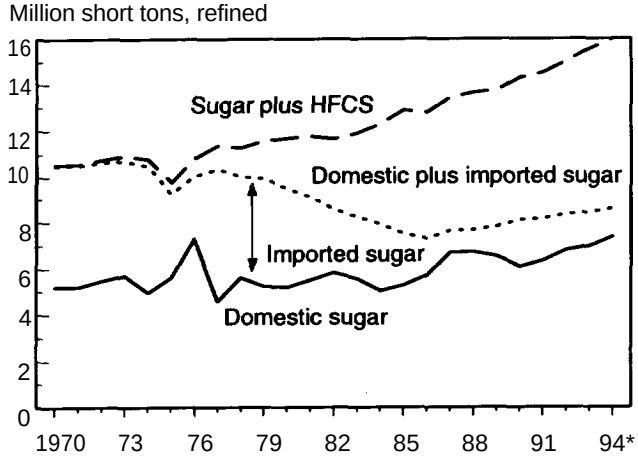


*Forecast.
Source: USDA.

to promote sugar as a natural product also helped boost consumption.

The future of U.S. sugar consumption will depend on the development of other alternative sweeteners. Crystalline fructose, a corn sweetener that is almost 100 percent fructose and sweeter than sugar, has until recently been more expensive than sugar and found very limited markets. When blended with other sweeteners, crystalline fructose can have a synergistic (complementary) effect, intensifying the sweetness that would not exist with either sweetener alone. Because it has different sweetness characteristics and "mouthfeel," crystalline fructose is not a direct substitute for sugar in many commercial products. Though no published data are available on the price or volume of crystalline fructose, its price is apparently falling and use is growing, and these trends are likely to continue.

Figure 27
U.S. consumption of domestic and imported sugar and HFCS



*Forecast.
Source: USDA.

U.S. consumption of low-calorie (or high-intensity) sweeteners, such as saccharine and aspartame, also has grown rapidly. Increased use of diet soft drinks, the largest market for low-calorie sweeteners, pushed annual consumption of these alternate sweeteners from 6 pounds per capita in 1970 to 24 pounds in 1991, the latest year for which estimates are available.

Low-calorie sweeteners are not expected to significantly affect consumption of caloric sweeteners in the near future. It is difficult to substitute low-calorie for caloric sweeteners in many food products, since the bulk or body of the caloric sweetener is critical to the

Table 5—U.S. total consumption of caloric sweeteners, 1980-94[1]

Calendar year	Sugar[2]		Corn sweeteners				Pure honey	Edible syrups	Total caloric sweeteners[3]
	Raw value	Refined basis	HFCS	Glucose syrup	Dextrose	Total			
				1,000 short tons, dry basis					
1980	10,189	9,522	2,159	1,908	433	4,500	94	50	14,166
1981	9,769	9,130	2,625	1,940	442	5,007	96	50	14,283
1982	9,153	8,554	3,090	2,011	459	5,560	104	50	14,268
1983	8,812	8,236	3,657	2,066	474	6,197	111	50	14,594
1984	8,428	7,877	4,404	2,110	487	7,001	104	50	15,032
1965	8,003	7,479	5,396	2,157	497	8,050	107	50	15,686
1986	7,731	7,225	5,508	2,197	508	8,213	117	50	15,605
1987	8,103	7,573	5,808	2,240	517	8,565	133	50	16,321
1988	8,136	7,604	6,015	2,287	525	8,827	115	50	16,596
1989	6,304	7,761	5,986	2,346	536	8,872	124	50	16,807
1990	8,615	8,051	6,227	2,433	557	9,217	126	50	17,444
1991	8,815	8,051	6,401	2,558	570	9,529	128	50	17,758
1992	8,827	6,250	6,682	2,700	573	9,955	124	50	18,379
1993	8,873	8,293	7,114	2,811	584	10,509	126	50	18,978
1994[4]	9,015	8,425	7,418	2,900	600	10,918	125	50	19,518

[1]Totals may not add due to rounding.
[2]Does not include Puerto Rico, or sugar imported in blends and mixtures.
[3]Total includes sugar, refined basis.
[4]Forecast
Source: USDA, Economic Research Service.

consumer's taste for the product. Development of a suitable and cheap bulking agent could expand the market for low-calorie sweeteners and erode caloric sweeteners' share. Furthermore, if the blending of caloric and low-calorie sweeteners gains consumer acceptance, soft drinks are likely to be the first major category to use blended sweeteners. If so, HFCS would face more competition from low-calorie sweeteners than would sugar, since virtually all caloric soft drinks are sweetened with HFCS.

The World Sugar Market

The world sugar market has undergone profound changes in recent decades. The world sugar price, since recovering from very low prices in the mid-1980's, in recent years has not exhibited the volatility of previous decades. Policy reforms and the privatization of some industries have reduced regulatory constraints within many countries, and a number of countries have lowered barriers to trade. Gradually, world price changes are being transmitted to the producers and consumers in more countries.

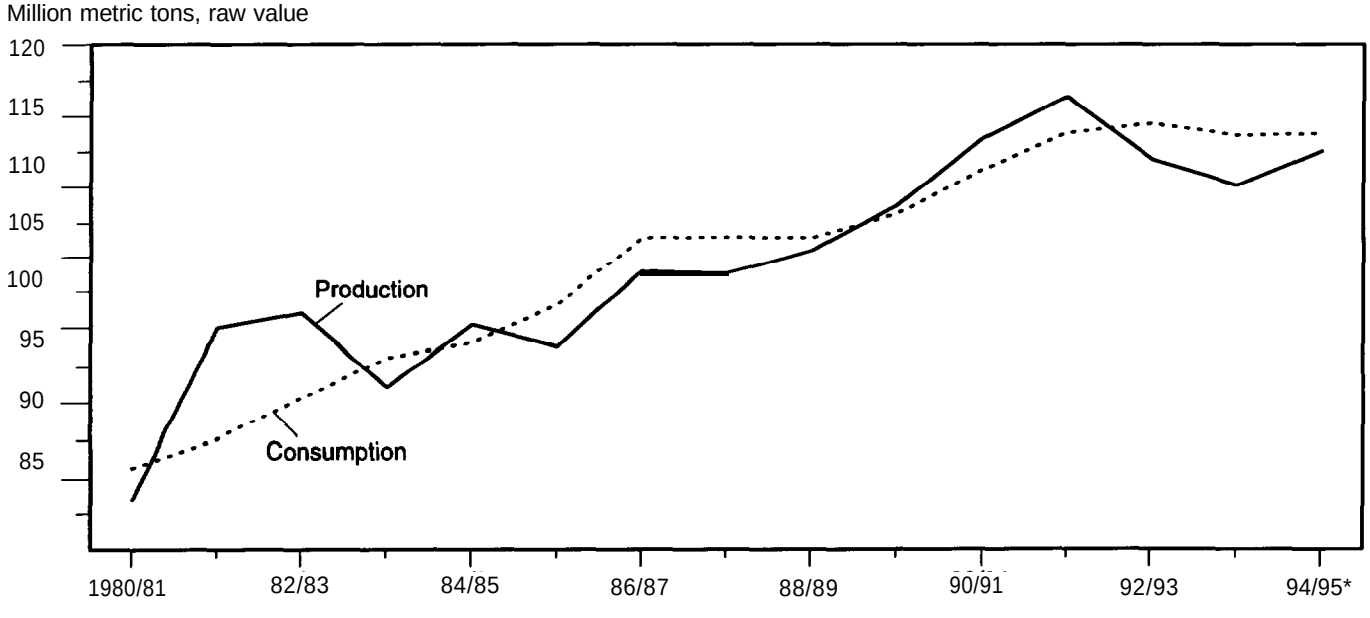
World Consumption, Production, and U.S. Share

World sugar consumption has risen about 2 percent, or 2 million metric tons, a year over recent decades (fig. 28). However, world consumption in 1993/94 fell about 800,000 metric tons from the year before, to about 113.7 million metric tons (table 6), in part due to the economic turmoil in eastern Europe and the former Soviet Union. As those economies stabilize, world sugar consumption is likely to resume its growth trend of l-2 percent a year. For 1994/95, USDA forecasts world consumption to be unchanged.

World sugar production was 110 million metric tons in 1993/94, and is forecast to rise to 112.6 million in 1994/95, the third year in a row below consumption. Cane sugar production accounts for about 65 percent of world output, compared with 61 percent in the late 1970's. World sugar production has not been very responsive to world prices since many countries insulate their producers, especially from low prices. As an annual crop, beet sugar can generally respond more quickly than cane. But world production rose about 7 million metric tons in the 2 years after the price rose to almost 14 cents in 1990, up from about 4 cents in 1985. In 1995, as the world price continues to rise from its recent low of 8.15 cents a pound in December 1992, world sugar production is rebounding along with the rising price.

U.S. sugar consumption in 1994/95 is forecast at about 7.6 percent of world consumption. In the European Union (EU), sugar consumption has grown very slowly in the last decade, and is estimated at 12.9 million metric tons, about 11.5 percent of world consumption. While sugar consumption growth in the

Figure 28
World sugar production and consumption



*Forecast.
Source: USDA.

industrial market economies has been lackluster over the last decade, sugar consumption has grown rapidly in developing countries, especially in Asia (fig. 29).

U.S. sugar production, about 6 percent of world production in 1993/94, ranked behind only the EU, India, and Brazil. The 12 countries of the EU jointly produce around 15-17 million metric tons, about 16 percent of world production, in line with quota levels and the usual surplus for export (fig. 30). India has increased production rapidly and now produces the most of any single country, 12-14 million metric tons. Cuba, once the world's largest producer, has seen its production fall to 4 million metric tons in 1993/94, and a forecast 3.2 million in 1994/95. The economic problems of Cuba are very severe, and will likely continue to hinder production for some time.

World Sugar Trade and U.S. Share

World sugar imports and exports are forecast at about 28 million metric tons in 1994/95, or about 25 percent of world production. World trade has been 27-32 million metric tons since 1980. The share of world production traded has declined slightly as production has grown.

U.S. sugar imports in 1994195, including almost half a million metric tons for re-export, are forecast at 1.67 million metric tons, 6 percent of world imports (table 7). Subtracting U.S. exports of 0.46 million metric tons, the U.S. is a net importer of 1.2 million metric tons. The Russian Federation and Japan are the only consistent larger net importers, with imports forecast at 3.1 and 1.6 million metric tons, respectively, and negligible exports.

The EU is forecast to import about 2 million metric tons in 1994/95, although it is also the world's largest exporter (fig. 31). U.S. and EU imports have declined significantly over the last few decades. For example, during 1974-76, U.S. net imports amounted to 18 percent of world trade, while during 1992-94,

Table 6—World sugar supply, use, stocks-to-consumption ratio, and price[1]

Marketing year	Beginning stocks	Production	Imports	Supply/ distribution	Exports	Domestic consumption	Ending stocks	stocks/ consumption ratio	World raw sugar price
	Million metric tons, raw value							*Percent*	*Cents/lb*
1980/81	19.46	88.47	27.66	135.59	27.66	90.69	17.24	19.01	24.80
1981/82	17.24	100.00	31.08	148.32	31.08	93.59	23.65	25.53	10.43
1982/83	23.65	100.99	30.01	154.65	30.01	95.41	29.23	30.64	7.58
1983/84	29.23	96.15	28.45	153.83	28.45	98.18	27.20	27.70	6.75
1984/85	27.20	100.28	28.97	156.45	28.97	99.09	28.39	28.65	3.68
1985/86	28.39	98.80	28.87	156.06	28.87	101.55	25.64	25.25	6.00
1986/87	25.64	103.95	27.46	157.05	27.46	106.47	23.12	21.17	6.19
1987/88	23.12	103.79	27.08	153.99	27.08	106.56	20.35	19.10	8.95
1988/89	20.35	105.56	28.67	154.58	28.67	106.52	19.40	18.26	11.58
1989/90	19.40	108.80	33.17	161.36	33.17	108.75	19.45	18.52	13.93
1990/91	19.45	113.49	32.54	165.49	32.54	111.92	21.03	19.92	9.39
1991/92	21.03	116.45	30.77	168.25	30.77	113.90	23.58	21.22	9.23
1992/93	23.58	112.01	29.55	165.14	29.55	114.55	21.04	18.22	9.56
1993/94[3]	21.04	110.24	29.73	161.01	29.73	113.72	17.56	15.85	10.67
1994/95[4]	17.56	112.60	27.87	158.02	27.87	113.84	16.31	14.33	NA

NA = Not available.

[1]The world production, supply, and distribution table covers all countries. Estimates are based on reports from USDA's agricultural counselors and attaches in 60 countries and analysts. The marketing year used by USDA varies by country because of differences in the timing of crop production. Stocks are measured at the end of the market year. Trade estimates exclude intra-EU trade. Unrecorded data have been introduced into the time series as a balancing mechanism to equalize exports and imports. It is assumed that a certain quantity of sugar imports go unrecorded by USDA each year, with the result that imports appear unrealistically low. It is also assumed that these imports of sugar are consumed. Therefore, the 'unrecorded' data have been introduced to rectify these inconsistencies.

[2]World raw sugar price, September-August year average. Contract No. 11, f.o.b. stowed Caribbean ports.

[3]Preliminary.

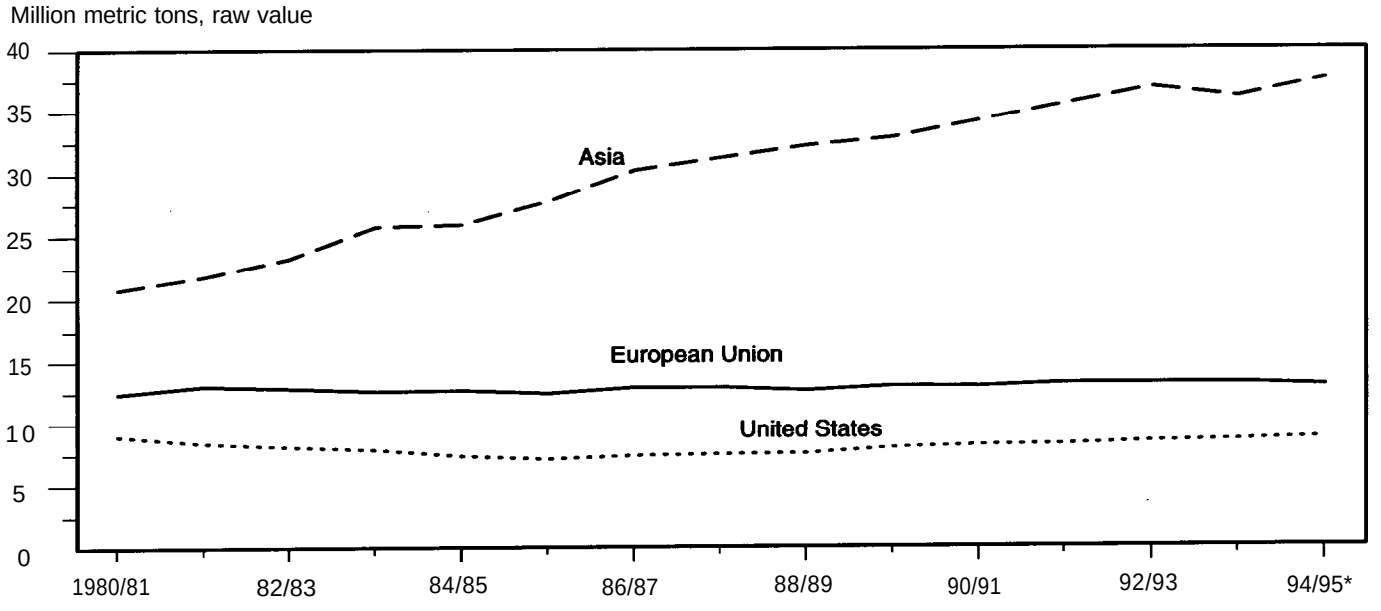
[4]Forecast.

Source: USDA, Foreign Agricultural Service.

U.S. net imports averaged 4 percent of world trade (fig. 32). Over the same period, the EU switched from net imports (7 percent of world trade) to net exports (13 percent of world trade).

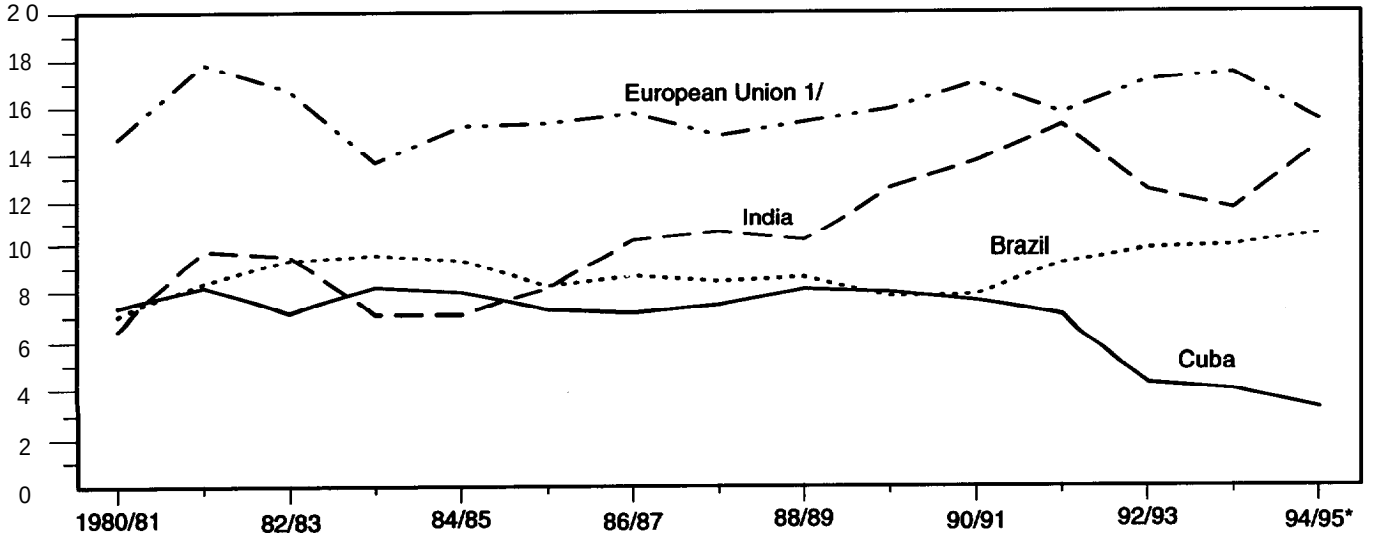
Other major importers include Japan, China, Canada, and the Republic of Korea. Although often a net exporter, India is forecast to import 500,000 metric tons in 1994/95.

Figure 29
Consumption in selected regions



*Forecast.
Source: USDA.

Figure 30
Production in selected countries



*Forecast.
1/ The EU is composed of 12 countries.
Source: USDA.