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THE U.S. AND MICHIGAN SUGAR INDUSTRY:
A PRELIMINARY EVALUATION OF
MARKET CONDITIONS AND POLICY

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Summary

Sugar markets and policy are of importance not only to domestic growers and processors (of both beet and cane sugar) but also to producers of substitute sweeteners, to importers of foreign sugar, to consumers and through these to government. In the last two decades, changes have occurred that impact directly on all these groups but in different ways. Since 1960 per capita consumption of caloric sweeteners has increased 12 percent and reached 125.6 pounds per year in 1981. The proportion of this demand met by domestic beet producers has remained relatively stable while that met by domestic cane producers has fallen by more than 20 percent and that met by imports has fallen by about 30 percent. On the other hand, consumption of corn sweeteners has quadrupled during the same time period.

Widely fluctuating sugar prices during the 1970s prompted government response. Following a series of purchase and loan programs early in the decade, the U.S. was party to negotiations of a five-year International Sugar Agreement which became effective in 1978. However, subsequent events led the U.S. administration to enact further domestic price support programs both in 1977 and in 1981. The 1981 legislation provided support through the 1985-86 crop year. Domestic programs are backed by tariffs, fees and quotas on sugar imports.

This paper is a review of some of the significant changes in sugar and sweetener production, consumption and policy. Production and processing costs are also examined by region in the U.S., with an emphasis on beet sugar. Throughout the analysis, questions are raised to which only more detailed information and analysis can potentially provide answers.

Such questions relate to:

- a. The potential of corn sweeteners as a replacement for sugar in the U.S. diets, both in manufactured products and for table use. Related to this question are the questions of technical change in HFCS production and adoption by industry.
- b. The extent to which HFCS displaces imports vis-a-vis domestic sugar.
- c. The apparent inconsistency between regional price supports and regional costs of production data; i.e., these do not move concurrently between regions.
- d. What are regional processing costs for beet sugar.
- e. What are regional opportunity costs under various crop production costs and prices.
- f. What impact prospective changes such as deregulation of natural gas will have on processing costs--particularly the relation between beet and cane.

In a broader view a good deal more insight will be needed into the organization of the sugar industry, the nature of vertical linkages, buying and selling relationships and how the U.S. system operates before conclusive statements can be made about the prospective future position of the Michigan industry. It will also be necessary to evaluate the foreign policy component in terms of possible future trade-offs between domestic and foreign supplies as further inroads are made by corn sweeteners into the sugar market. To do this a study that assesses various forces that will influence the industry in the future and integrates these into a composite picture will be required.

THE U.S. AND MICHIGAN SUGAR INDUSTRY:
MARKET CONDITIONS AND POLICIES

Introduction

The sugar market and sugar policy are complex for a number of reasons. First, sugar is produced from two entirely different crops, sugar beets and sugarcane. Sugar beets are produced in temperate regions and are an important crop in most developed countries, including the U.S., the U.S.S.R. and the European Economic Community. Sugarcane is produced largely in tropical areas and is an important export crop for many less developed countries. International sugar policy, therefore, must coordinate the interests of a large number of nations with disparate goals and power.

In the U.S., sugarcane is grown on monocrop "plantations" in Hawaii, Florida, Texas, and Louisiana. Sugar beets are grown in fifteen states, usually as part of a diversified farming operation. In addition, about 30 percent of the nation's sugar needs are met by import from foreign sources each year. The U.S. is the world's largest sugar importer, and thus our sugar policy must address both domestic and international issues.

To complicate matters further, a serious competitor to sugar has been developed in recent years. High-fructose corn syrup (HFCS), the result of technological advance in recent decades, has become an increasingly important substitute for sugar in the commercial sweetener markets which have expanded steadily with the growth of the processed food and beverage industries. HFCS producers have a direct interest in sugar prices and policy that will affect their competitive position in the sweetener market.

Last but not least are the obvious interests of the U.S. consumer in policies that affect the price of sugar and products that contain sugar. U.S. consumers use about 125 pounds of caloric sweetener per capita each year. Broadbased concern about inflation adds a final area of concern to be considered in any formulation of sugar and sweetener policies and programs at the national level.

Legislation concerning sugar policies and programs must thus consider the probable impact on a large number of groups with different interests and concerns: included are sugarcane and sugar beet producers, processors, refiners, sweetener producers, commercial users, consumers, and exporting countries.

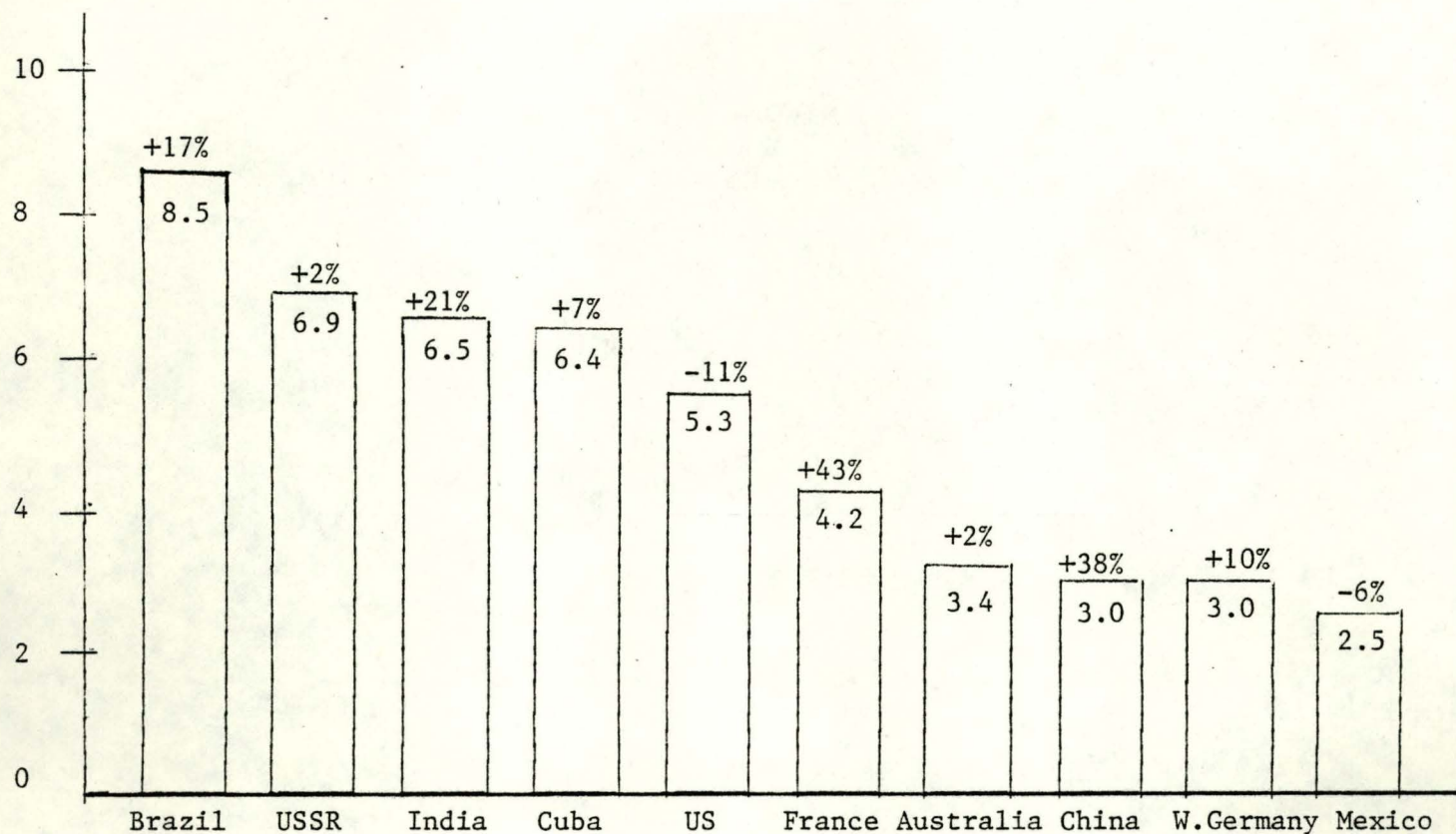
This report attempts to clarify some of the market considerations and policies that influence the economic position of the Michigan sugar industry. A review of production, consumption, and price trends, and of the growing place of HFCS in the U.S. sweetener market serve as background materials for subsequent discussion of policies and programs that impact on the industry. This is followed by evaluation of available production cost relationships in Michigan and other areas. Finally an effort will be made to tentatively evaluate the emerging economic position of the Michigan sugar industry.

World Sugar Trends

During the last five years production in some countries has increased dramatically while that of others has declined (Figure 1). Between 1976-1977 and 1980-1981 aggregate production by the ten leading countries increased substantially.^{1/} The largest increase was 43 percent in France. China and India

^{1/} Percentages calculated from Foreign Production Estimates Division, FAS, USDA as the change in each year over the previous years level.

Figure 1. World Sugar Production: 10 Leading Countries; 1980/81

Million
Metric Tons^{1/}

^{1/} Figures within the bars are production in 1980/81. Those above the bar are the percentage total increase or decrease in production during the five year period 1976/77-1980/81.

Source: Compiled from data published by the Foreign Production Estimates Division, FAS, USDA.

sustained relatively high rates of growth, at 38 percent and 21 percent respectively over the five year period. Brazil's production grew 17 percent, Cuba's at a more moderate 7 percent and the U.S.S.R. and Australia each increased production 2 percent over the five years. Both the U.S. and Mexico experienced declines in production over the five years, the U.S. by 11 percent and Mexico by 6 percent. However, much of the U.S. decline occurred earlier in the period and production is expected to increase slightly in 1981-82.

World Prices

As is visually apparent from Figure 2, the international free market in sugar has been characterized by cyclical prices. Table 1 reveals the imbalances of production to consumption that underlie these cyclical price movements. Sugar cycles result mainly from (1) an inelastic demand for sugar which results in wide fluctuations with relatively small shifts in supply, (2) a lagged industry supply response because of the high fixed investment needed to develop processing capacity and the fixed nature of the investment once capacity is developed,^{1/} and (3) a lagged industry supply response because sugarcane is a perennial and once planted is not harvested until the second year, but continues to be harvested three to six years thereafter.

The magnitude of price variation through the sugar cycle is aggravated by the residual nature of the world free market in sugar. For example, in 1974 less than 30 percent of world sugar production was traded. Of the 21.7 million tons traded, the free market accounted for only 10.7 million tons; the remainder moved under various bilateral agreements.^{2/} Only production

^{1/}Robert Bohall, et al. The Sugar Industry's Structure, Pricing and Performance, ERS/USDA Agricultural Economic Report No. 364, p. 33.

^{2/}Gordon Gemmill, "An Equilibrium Analysis of U.S. Sugar Policy." American Journal of Agricultural Economics, November 1977, p. 609.

Price
(cents)

Figure 2. World Sugar Price 1960-82
(U.S. Cost Per Raw Pound)

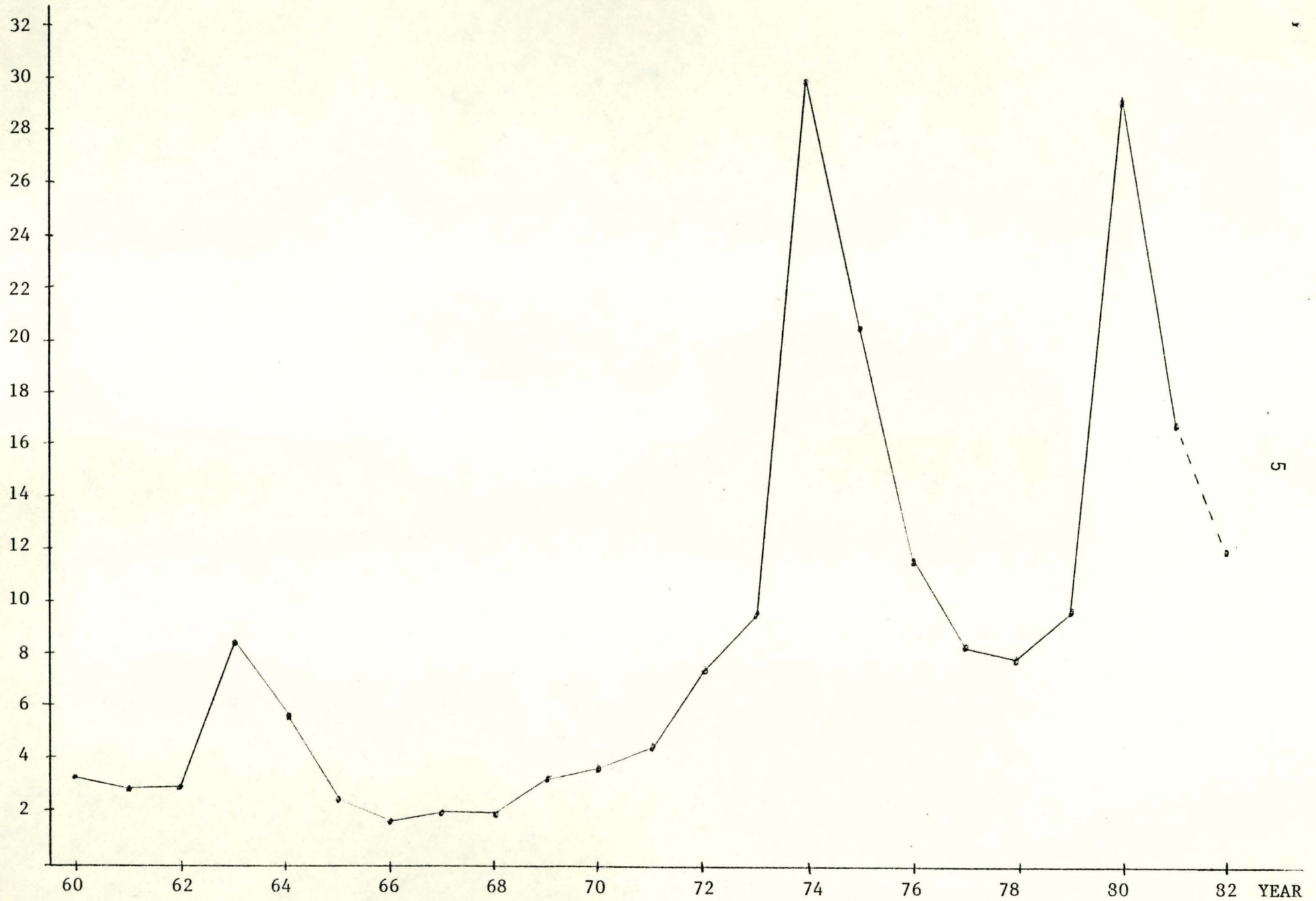


TABLE 1

WORLD SUGAR: PRICE, PRODUCTION, AND CONSUMPTION, 1960-1981

Year	Price ¹ Cents per Pound	Production ² Million metric tons	Consumption ² million metric tons, raw value	Ending Stocks ² As A Percentage of Consumption
1960	3.14	54.6	50.5	36.57
61	2.91	51.8	52.4	34.18
62	2.98	49.8	53.9	25.63
63	8.50	54.4	55.8	22.15
64	5.87	65.8	58.8	32.98
65	2.12	62.9	61.0	34.85
66	1.86	64.6	63.3	35.59
67	1.99	66.2	65.9	34.74
68	1.98	67.6	68.5	32.10
69	3.37	71.9	70.8	32.58
1970	3.75	70.5	72.8	28.59
71	4.52	70.6	74.9	22.00
72	7.43	75.1	76.7	22.10
73	9.61	80.0	80.0	21.60
74	29.99	78.5	77.1	24.51
75	20.49	81.7	79.2	26.52
76	11.58	86.3	81.9	30.28
77	8.11	92.5	86.2	34.57
78	7.82	91.1	89.6	34.15
79	9.66	84.4	89.5	26.37
80	29.02	87.0	88.4	24.10
81	16.93	96.3	91.0	28.96
82 (est.)				

^{1/}At the Coffee, Sugar and Cocoa Exchange--raw sugar stowed at Greater Caribbean ports, including Brazil. Sugar Statistics and Related Data, ASCS/USDA, Statistical Bulletin No. 293; Sugar and Sweetener Report, USDA.

^{2/}Years 1960-1974 are on a May/April crop year basis. Robert Bohall, et al., The Sugar Industry's Structure, Pricing, and Performance, ERS/USDA, Agricultural Economics Report No. 363; Sugar and Sweetener Report, USDA, May 1979. Years 1974-81 are on a September/August crop year; Sugar and Sweetener Report, USDA, May 1982.

which is in excess of the domestic requirements and bilateral commitments of producing nations is traded in the free market. This market thereby bears the brunt of production shortages and excesses.

Attempts to stabilize the free market through an International Sugar Agreement began as early as 1931. International Sugar Agreements of 1937, 1953, 1958, and 1969 attempted to maintain prices for sugar exports to the free market at a "reasonable" level by controlling the volume of exports through quotas. The success of these agreements was rather limited. A USDA report concludes:

It is doubtful that world sugar prices, except those of a temporary and seasonal nature, were increased much. Greater stability of prices does seem to have been maintained in certain years. . .^{1/}

The International Sugar Agreement of 1968 (to which neither the U.S. nor the EEC were party) was not renegotiated when it expired in 1974. Producing countries were essentially uninterested in a new agreement because 1974 prices were at a record high.

U.S. Trends and Regional Production

Tables II and III provide information concerning sugar production and consumption and price trends in the U.S. since 1960. U.S. sugarcane is grown in four states: Florida, Louisiana, Texas and Hawaii. Florida and Hawaii account for over 70 percent of total cane production^{2/} (36.4 percent and 34.9 percent respectively of the 1981 cane crop), followed by Louisiana (24.6%) and Texas (4%). Sugar beets are grown in 15 states, down from 20 states only a few years ago.^{3/} Two states, California and Minnesota, account for close to

^{1/}Roy A. Ballinger, A History of Sugar Marketing Through 1974, ERS/USDA Agricultural Economics Report #382, p. 66.

^{2/}Percentages given here are taken from the Sugar and Sweetener Report, USDA, September 1981, p. 30.

^{3/}Ref. Jill Mirowsky and V. Sorenson, "U.S. Sugar Policy: A Current Perspective", Staff Paper No. 79-30, 1979.

TABLE II

U.S. SUGAR: PRICE, PRODUCTION, AND CONSUMPTION, 1960-1981

Year	Price ¹ Cents per Pound raw sugar	Production ² 1000 Short Tons, raw value	Consumption Per Capita, pounds refined
1960	6.30	4823	97.6
61	6.30	5218	97.8
62	6.45	5278	97.3
63	8.18	5693	96.7
64	6.90	6329	96.7
65	6.75	6123	96.8
66	6.99	5964	97.2
67	7.28	6061	98.3
68	7.52	6094	99.0
69	7.75	5802	100.7
1970	8.07	6212	101.9
71	8.52	5816	102.3
72	9.09	6015	102.3
73	10.29	6061	100.8
74	29.50	5662	95.6
75	22.47	6300	89.1
76	13.31	6798	93.4
77	11.00	6089	94.2
78	13.93	5602	91.4
79	15.56	5793	89.3
80	30.11	5736	83.6
81	19.72	6206	79.5
82 (est)			

^{1/}New York Spot, bulk raw sugar price.

^{2/}Domestic production plus receipts from domestic offshore areas.

SOURCE: 1960-71: Sugar Statistics and Related Data, ASCS/USDA, Statistical Bulletin No. 293; 1972-81: Sugar and Sweetener Report, USDA, May 1982.

TABLE III

U.S. Sugar Crops: Production, Price Per Ton & Value of Production 1979-81¹

State and Area	Production			Price per Ton			Value of Production		
	1979	1980	1981	1979	1980	1981 ²	1979	1980	1981 ²
	(1000 tons)			(\$s)			(\$1000)		
Cane for Sugar									
Florida	9,975	9,985	9,696	30.30	39.40	--	302,243	393,409	--
Louisiana	4,950	5,414	6,669	24.20	33.20	--	119,790	179,745	--
Texas	853	969	1,146	25.20	27.10	--	21,496	26,260	--
Hawaii	9,632	9,214	9,535	22.60	41.80	--	217,683	385,145	--
Total U.S.	25,410	25,582	27,046	26.00	38.50	--	661,212	984,559	--
Beet									
Great Lakes	1,816	2,231	2,304	38.00	41.50	--	69,020	92,666	--
(Michigan	1,550	1,892	2,030	38.90	40.70	--	60,295	77,004	--)
(Ohio	266	339	274	32.80	46.20	--	8,725	15,662	--)
Red River Valley ³	6,086	5,638	7,072	32.70	44.90	--	198,834	253,073	--
Great Plains ⁴	5,130	6,032	6,526	35.20	48.00	--	180,434	289,522	--
Northwest ⁵	3,028	3,508	4,049	37.30	46.00	--	113,070	161,315	--
Southwest ⁶	5,936	6,093	7,320	31.00	51.30	--	183,915	312,398	--
Total U.S.	21,996	23,502	27,271	33.90	47.20	--	745,273	1,108,974	--

^{1/} Crop year September/August.

^{2/} Not available.

^{3/} Minnesota, North Dakota

^{4/} Colorado, Kansas, Montana, Nebraska, New Mexico, Texas, Wyoming

^{5/} Idaho, Oregon, Utah, Washington

^{6/} Arizona, California

Source: "Crop Production" and "Crop Values", SRS, USDA; Sugar and Sweetener Report, USDA, May 1982, p. 22.

50 percent of total U.S. sugar beet production (27.5 percent and 17.6 percent respectively) and together with three others--Idaho (13.0%), North Dakota (10.0%) and Michigan (6.9%)--comprise 75 percent of total U.S. sugar beet production. Washington and Utah have recently ceased beet production. New Mexico currently produces only .2 percent of total U.S. sugar beets.

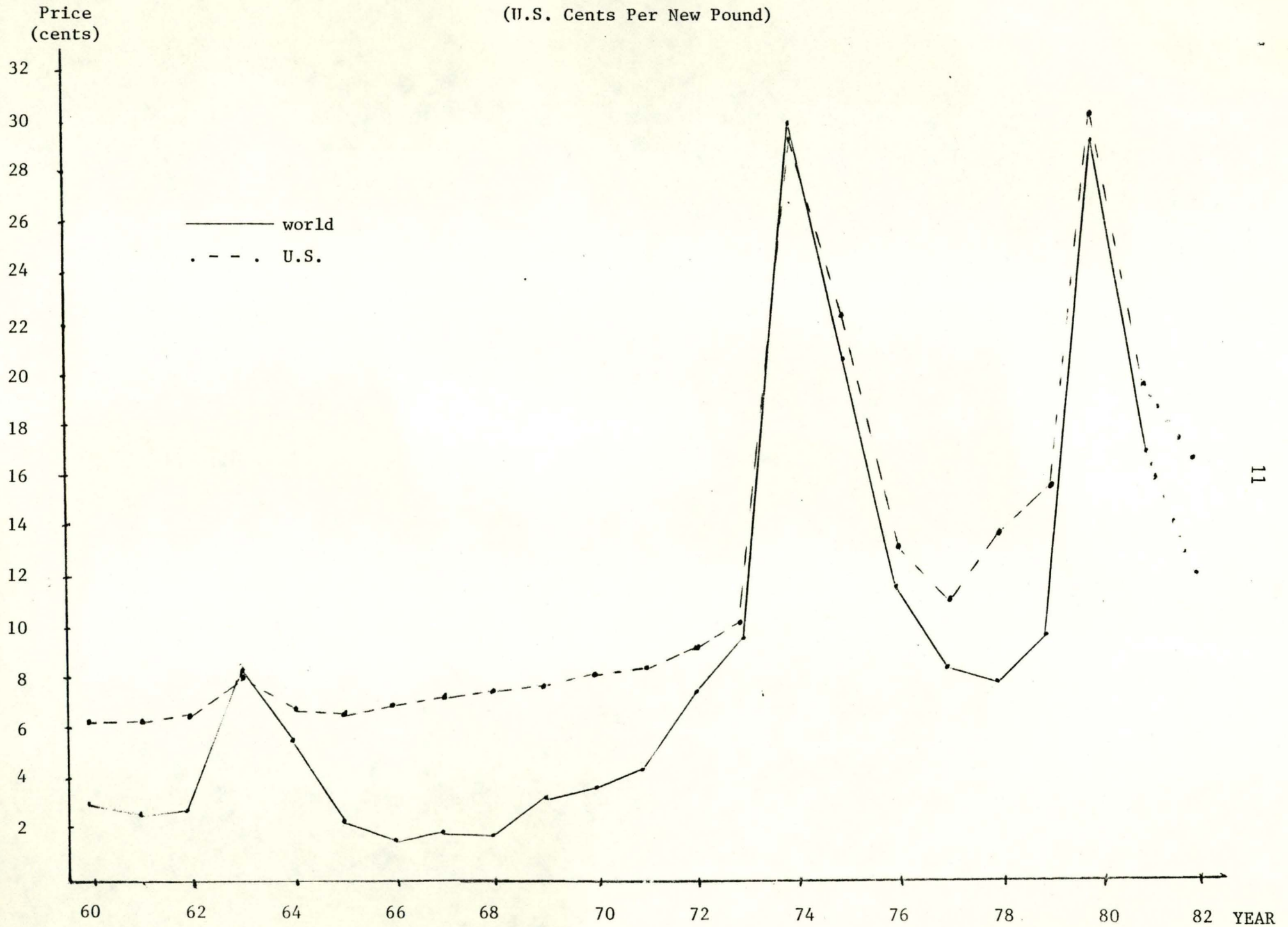
The price of sugar in the U.S. during most of the period has been a function of government support levels rather than of unregulated market forces. The structure of the sugar program through 1974 was established by the Sugar Act of 1934, also known as the Jones-Costigan Act. President Roosevelt spelled out three objectives of the Act: "of keeping down the price of sugar to consumers, of providing for the retention of beet and cane farming within our continental limits, and also to provide against expansion of this necessarily expensive industry."^{1/} Under this sugar program, the Secretary of Agriculture determined yearly consumption requirements. Total consumption requirements were then allocated among domestic producers and foreign countries. Import quotas controlled the supply of foreign sugar to the U.S. Benefit payments were made to domestic producers for abiding to the terms of the Sugar Act. U.S. sugar producers benefited from this program in two ways: (1) protection due to limitations on imports of low cost foreign sugar raised the price of sugar on the U.S. market and (2) producers received payments of from 10-15 percent of the prices received for sugar beets and sugar cane.^{2/}

Figure 3 demonstrates the effects of the sugar program on U.S. prices. The U.S. sugar price has generally exceeded the world free market price. It

^{1/}U.S. Congress, Senate, Committee on Finance, "To Include Sugar Beets and Sugarcane as Basic Agricultural Commodities Under the Agricultural Adjustment Act," Hearings, 73rd Congress, 2nd Session, 1934, p. 3.

^{2/}D. Gale Johnson, The Sugar Program: Large Costs and Small Benefits, American Enterprise Institute for Public Policy Research, Washington, D.C. 1974, p. 11.

Figure 3: U.S. and World Sugar Prices 1960-82
(U.S. Cents Per New Pound)



is apparent from the figure that the sugar program provided a considerable degree of stability to U.S. price relative to the world free market price until 1974.

In 1973, however, shortages of sugar on the world market began to drive up both U.S. and world prices. In June 1974 when the Sugar Act came up for renewal, U.S. retail sugar prices were above 25 cents per pound. It became evident to consumers and congressmen that the import quota system was successful only in placing a floor under prices; it was ineffective in placing a ceiling on rising prices. Congress did not extend the Sugar Act, and in January 1975, the U.S. became a participant in the world free market for sugar.^{1/}

Policy Since 1974

Predictably, the sugar price highs of 1974 soon fell as a new cycle of production overtook consumption requirements in the world market. As prices fell, interest in new sugar programs was revived on national and international levels.

In March 1977, the U.S. International Trade Commission (USITC) reported to President Carter that increased imports of sugar were a threat to the domestic sugar industry. The USITC recommended the imposition of an annual quota of 4,275 million short tons, raw value, for a five-year period beginning with calendar year 1977. President Carter responded to this request:

I have determined that import relief is not in the national economic interest. However, I believe that a strong and viable domestic sugar industry is vital to the economic wellbeing of the American

^{1/}U.S. policy from January 1, 1975 to September 21, 1976 was a non-restrictive global import quota and .625 cents per pound duty (raw). On September 21, 1976 the duty was raised to 1.875 cents per pound.

people, and that this can best be achieved by the negotiation and implementation of an International Sugar Agreement.^{1/}

On July 22, an amendment to the Food and Agricultural Act of 1977 (the Farm Bill) was put forward in the House of Representatives that would support sugar prices at 55 percent of parity (approximately 14 cents per pound, raw value). The amendment was adopted by the House, but met opposition from the Administration, consumer groups, industrial sugar-users, and sugar refiners.^{2/} The level of support was compromised in Conference to 52.5 percent of parity under Administration pressure.^{3/} The compromised amendment was passed into law on September 16, 1977 with the Farm Bill. Title IX of the Farm Bill added sugar beets and sugarcane to the list of commodities supported through loans or purchases with the minimum level of support being 52.5 percent of parity, but not less than 13.5 cents per pound; raw value. The support program was limited to two crop years, 1977 and 1978, and the Secretary of Agriculture was authorized to suspend the program upon completion of an international sugar agreement that was expected to maintain a 13.5 cent a pound price.^{4/}

On September 15, 1977, President Carter announced a temporary direct payment program to make up the difference between the 13.5 cents per pound minimum set by Congress and the market price. This program was replaced by the Congressionally mandated loan program on November 8, 1977. A similar loan program for the 1979 crop was operated under authority of the Agricultural

^{1/}Presidential Documents, Jimmy Carter, 1977, V. 13, No. 19, p. 657.

^{2/}Congressional Quarterly Weekly Report, July 30, 1977, p. 1600.

^{3/}Congressional Quarterly Weekly Report, August 6, 1977, p. 1651.

^{4/}Congressional Quarterly Weekly Report, September 24, 1977, p. 2031.

Act of 1949. The national average loan rate was 13.0 cents per pound for raw sugar (about 43 percent of parity). World sugar prices again rose and no price support program was instituted for the 1980 or 1981 crops.

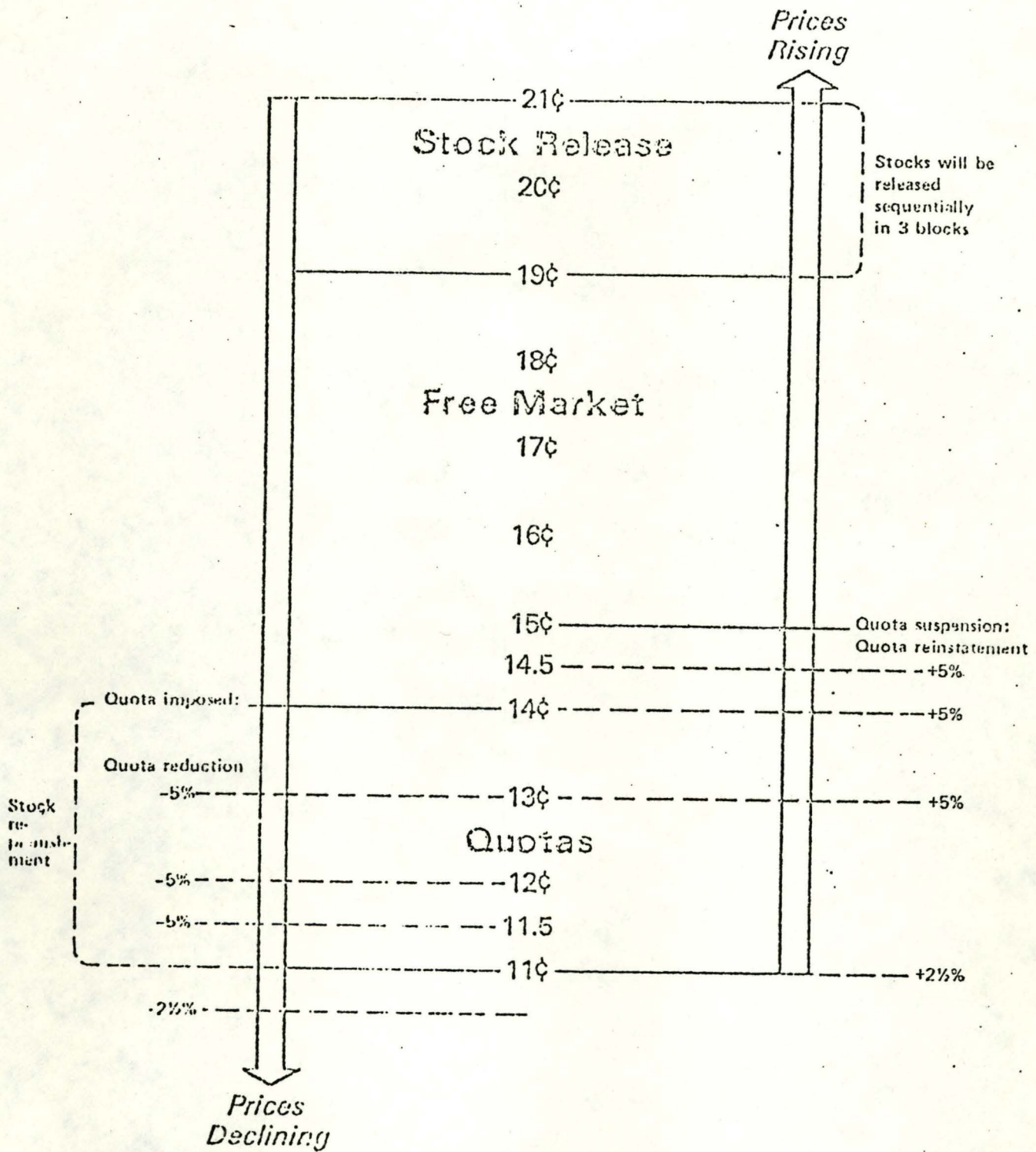
Meanwhile, on October 6, 1977, 74 nations concluded negotiations for an International Sugar Agreement. The five-year agreement provides for the stabilization of world sugar prices within a range of 11 to 21 cents per pound, raw value. The minimum price was to be supported by accumulation of stocks and through the use of export quotas. The ceiling price was to be defended by the release of reserve stocks. Figure 4 illustrates the price mechanism of the ISA. The agreement became provisionally effective on January 1, 1978.^{1/}

The Agriculture and Food Act of 1981 provides price support for domestically grown sugarcane and sugar beets from the date of its enactment through the 1985-86 crop year. Support is achieved through purchase and loan programs for cane and beet sugar. For sugar processed during the December 22, 1981 to March 31, 1982 a purchased program applied. The purchase price was 16.75 cents per pound for raw cane sugar. A non-recourse loan program will cover sugar produced during the remainder of the period at annually increasing minimum raw cane sugar loan rates of 17.0, 17.50, 17.75 and 18.0 cents per pound. Beet sugar purchases and loan rates are determined in relation to the support for cane.

The loan program becomes effective at the start of each fiscal year and loans mature on the last day of the sixth month following the date of the loan and, in any case, before the end of the fiscal year. Thus for the 1982 crop loans will be available October 1, 1982 and all loans must mature by September 30, 1983.

^{1/}The European Community did not sign the Agreement but agreed to honor its provisions.

Figure 4 INTERNATIONAL SUGAR AGREEMENT
PRICE MECHANISM



Source: Sugar and Sweetener Report, USDA.

The sugar loan program for the 1982 crop mandates a national average raw sugar support price of not less than 17 cents per pound. Refined beet sugar is supported at 113 percent of this level. Prices in turn are differentiated by region as shown in appendix I. To qualify for a loan processors must agree to pay growers prices for beets and cane as shown in appendix II.

With current world prices if sugar were imported freely imports would be substituted for domestic sugar and large CCC stocks would accumulate. To prevent this the domestic market price for sugar must be higher than the support price and a border protection system must be used to prevent large inflows of foreign sugar.

The U.S. Department of Agriculture has computed a market stabilization price (MSP) designed to insure commercial marketing of U.S. produced sugar rather than its sale to the CCC. For the 1982 program this value has been set at 21.32 cents per pound for raw cane sugar. The MSP includes the raw sugar support rate, freight, handling, interest and any other transportation costs associated with selling raw sugar in the high cost marketing area and an incentive to encourage processors to sell in the market. The current MSP calculations is as follows:

17.00¢/lb.	raw cane support price
2.93¢/lb. ^{1/}	freight costs
1.19¢/lb. ^{2/}	interest
0.20¢/lb.	incentive factor

^{1/}Transportation factor for Hawaiian to Gulf ports and ports north of Hatteras.

^{2/}Interest factor and used only if interest is not charged. Factor based on a 17 cent loan rate, 14 percent interest rate and a six month loan period.

The 21.32 cents MSP went into effect April 1, 1982. This is nearly triple current world sugar prices. To protect this price imports can be restricted under two pieces of legislation one of which empowers the President to impose quotas and a duty on imported sugar. The other allows quotas and import fees.

The extent of protection with duties and fees, however, is limited since each is subject to a legal maximum. The lowest world price at which the duties and fees can protect the 21.32 cents MSP is 11.34 cents per pound. When world prices are below this level the maximum duty of 2.8125 cents per pound and the maximum fee which is subject to a 50 percent advalorem limitation do not produce adequate border protection. The world price of sugar dropped below this level in April 1982. The remaining tool to insure a sufficient domestic market price is quotas. These became effective on May 11, 1982. For the period between May 11 and June 30, 1982 a quota of 220,000 short tons was established. For the July 1 through September 30, 1982 a quota of 420,000 short tons was established. The quota for the 1983 fiscal year beginning October 1, 1982 is 3.3 million short tons. Quotas will remain in place until world prices rise and the duty and fee are sufficient to achieve the desired market stabilization price. About 30 percent of the 3.3 million ton quota for fiscal year 1983 will be filled by sugar from GSP countries and therefore, will be exempt from duties and fees. If the Caribbean initiative currently being considered is implemented, duty free imports would increase further.

High Fructose Corn Syrup (HFCS)

Since its commercial introduction in 1967, high fructose corn syrup (HFCS) has gained rapid acceptance in the U.S. sweetener market.^{1/} Shipments in 1981

^{1/}Sugar and Sweetener Report, USDA, May 1982.

of 2.65 million tons (dry basis^{1/}) were up 20 percent over the 1980 figure of 2.2 million tons. Between 1970 and 1980, HFCS jumped from .6 percent of U.S. consumption of caloric sweeteners to 14.8 percent (Figure 5), and to 18.4 percent in 1981. In contrast, refined sugar dropped from 83 percent to 66.7 percent of total U.S. caloric consumption in the 1970s and to 63 percent in 1981.

U.S. per capita consumption of caloric sweeteners rose from 111.2 pounds per year in 1960 to 125.6 pounds per year in 1981 (Table IV and Figure 6)-- an increase of 13 percent. There are four sources for this consumption: domestic beets, domestic cane, imported cane and corn sweeteners. Consumption of corn sweeteners increased 74 percent from 11.6 pounds per year in 1960 to 44.9 pounds per year in 1981. By contrast use of beet sugar and imported cane sugar peaked in the late 1960s to mid 1970s. By 1981 beet sugar use had fallen off slightly, back to its 1960 level while imported cane sugar was 23 percent below its 1960 level. Domestic cane sugar peaked in the late 1960s and now makes up the smallest portion of total per capita sweetener consumption.

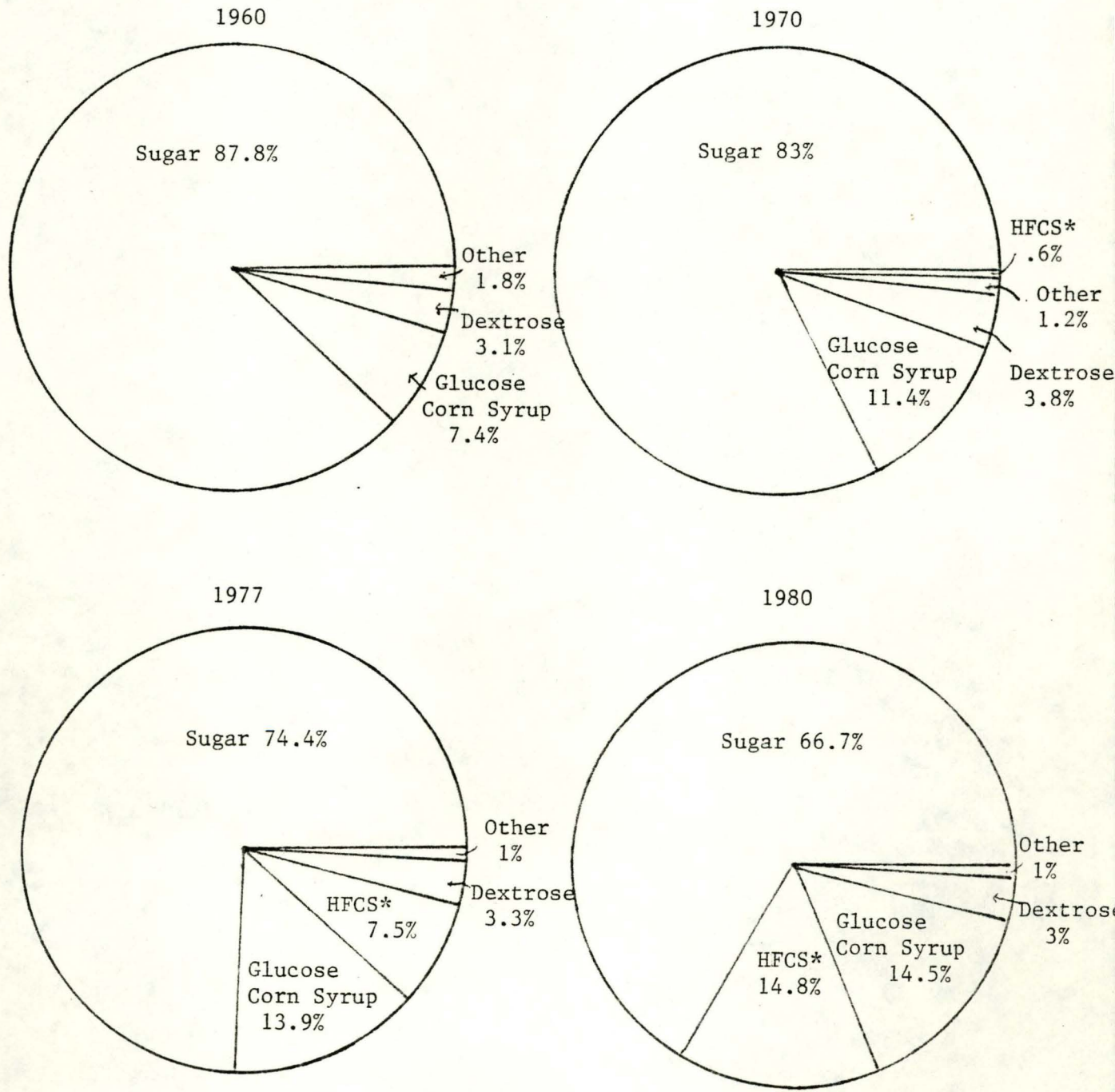
Variables related to technology, market conditions and policy have contributed to the substitution of corn sweeteners for sucrose and will continue to be important in the future potential for penetration of HFCS in the sweetener market.^{2/}

Production technology for HFCS has an impact on product characteristics and industry structure. Production takes place through the corn wet-milling process, during which various enzymes are added to create a product consisting

^{1/}Commercial (wet) rates were converted to a dry basis using factors of: 42%, HFCS, 0.71; 55% fructose HFCS, 0.77.

^{2/}The information that follows on HFCS is taken from High Fructose Sweeteners: Economic Aspects of a Sugar Substitute, H.F. Carman and P.K. Thor, Giannini Foundation Bulletin, July 1979; Page references are given in parentheses.

Figure 5. U.S. Consumption of Caloric Sweeteners by Type



*High Fructose corn syrup.

Source: Sugar and Sweetener Outlook and Situation, Economics and Statistics Service, USDA, May 1981, p. 19.

Table IV. Caloric Sweeteners: Per
Capita U.S. Consumption by Source 1960-1981

Year	Domestic Beet	Domestic Cane	Imported Cane	Corn ^{1/} Sweeteners	Honey and ^{1/} Edible Syrups	Total
1960	25.2	28.1	44.3	11.6	2.0	111.2
1961	26.1	28.7	43.0	12.0	1.9	111.7
1962	24.5	27.4	46.0	12.9	2.0	112.8
1963	27.2	28.2	41.9	14.2	1.8	113.3
1964	28.6	30.3	37.9	15.0	1.7	113.5
1965	29.1	30.1	37.8	15.1	1.8	113.9
1966	28.3	28.7	40.3	15.4	1.7	114.4
1967	26.6	29.6	42.3	16.2	1.4	116.1
1968	27.8	26.8	44.6	17.2	1.6	118.0
1969	30.3	25.3	45.4	18.2	1.6	120.8
1970	31.3	25.0	45.4	19.3	1.5	122.5
1971	30.6	22.9	48.6	20.8	1.4	124.3
1972	30.3	25.3	46.7	21.1	1.5	124.9
1973	30.2	24.7	45.9	23.4	1.4	125.6
1974	25.8	20.8	49.0	25.1	1.1	121.8
1975	30.1	24.6	34.4	27.5	1.4	118.0
1976	32.0	22.4	39.0	29.7	1.3	124.4
1977	29.8	22.9	41.5	31.2	1.4	126.8
1978	27.4	22.9	41.1	33.7	1.5	126.6
1979 ^{2/}	26.5	21.1	41.7	36.8	1.4	127.5
1980 ^{3/}	26.9	24.3	32.5	40.6	1.3	125.6
1981 ^{3/}	25.6	21.5	32.3	44.9	1.3	125.6

^{1/} Dry basis. Recent corn sweetener consumption may be understated due to incomplete data.

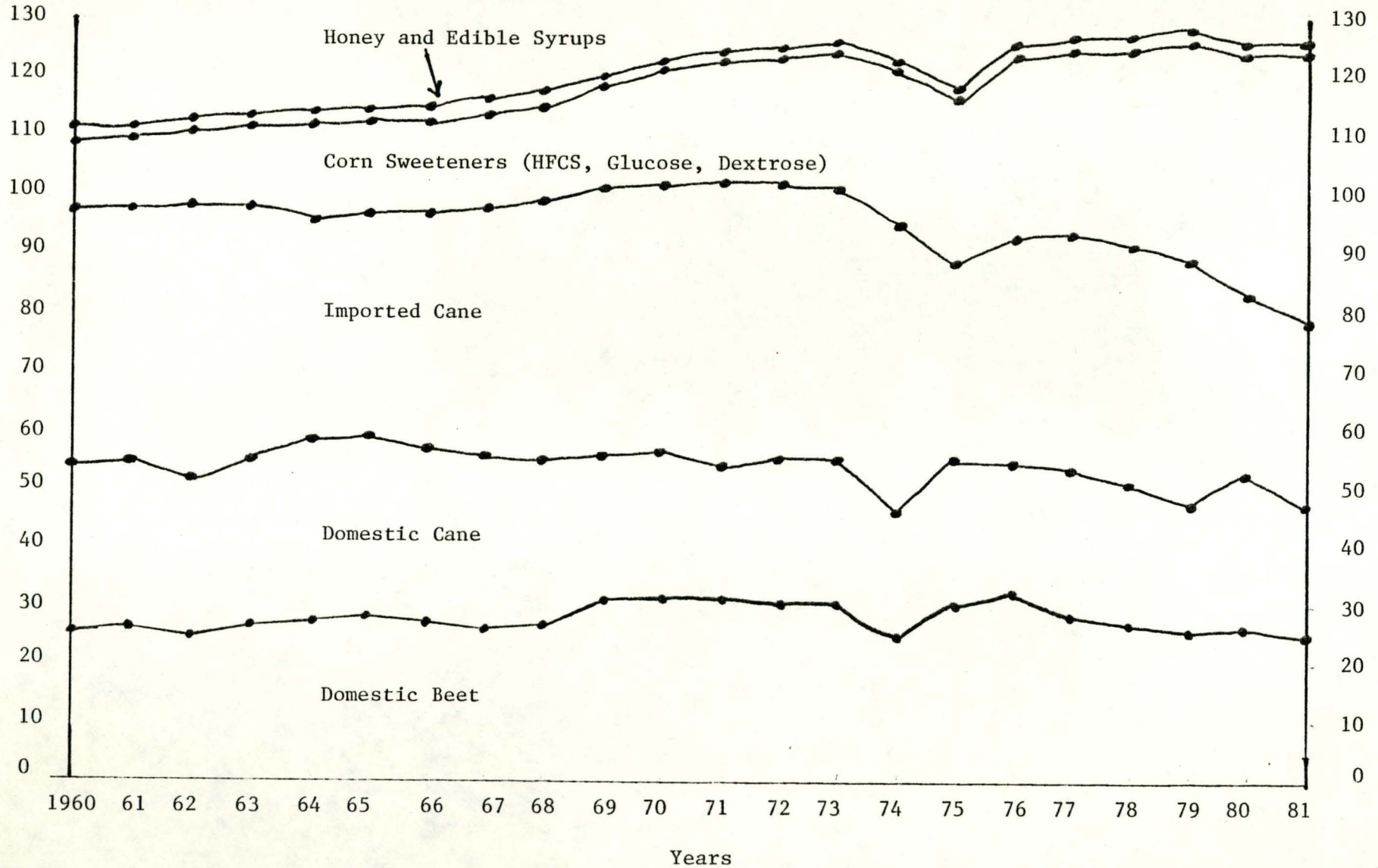
^{2/} Preliminary.

^{3/} Estimate.

Source: ERS, USDA

Figure 1. Caloric Sweeteners: Per Capita U.S. Consumption by Source 1960-1981

Per Capita Consumption lbs.



of a proportion of fructose (appendix III). Initially the product consisted of 42 percent fructose, 50 percent dextrose and 88 percent higher saccharides-- known as the first generation HFCS. More recently, a combination of 55 percent fructose, 42 percent dextrose and 8 percent higher saccharides is being produced and some companies have products with fructose levels between 70 and 90 percent. Higher levels of fructose contribute to the substitutability of HFCS for sucrose (sugar). Substitution of HFCS for sugar has varied among different products. "In most products, it is used as a partial rather than as a total replacement."^{1/}[4]

The beverage industry, which accounts for approximately 37 percent of total industrial sugar use in the U.S., has shown least acceptance of HFCS substitution. However, most bottlers had been authorized to use a maximum of 25 to 42 percent HFCS in their sweetener mix, which has recently been increased to 75 percent for second generation HFCS containing 55 percent fructose. To date, Coca-cola and Pepsicola have restricted use of HFCS in cola products, which account for 47 percent of the soft-drink market. It is anticipated that eventually HFCS will be used in cola manufacture--in particular the new "ultra" HFCS (high in fructose) which has now proven acceptable in these products.

Dairy products, comprising approximately 8.5 percent of total industrial sugar use, make extensive use of HFCS. HFCS is expected to replace all dextrose, and some sucrose in the typical dairy sweetener mix (56 percent sucrose, 14 percent dextrose and 30 percent corn syrup). "The advantages of HFCS include cost, stability, color and appearance"^{2/} plus a creamy, non-crystalline texture.

^{1/}Ibid. p. 4.

^{2/}Op cit. p. 32.

HFCS has substantially replaced sucrose in processed foods and this trend is expected to continue. Processed foods account for approximately 11 percent of total industrial sugar use. In 1974, Federal Food and Drug standards were revised, eliminating a 25 percent ceiling on use of corn sweeteners in jams, jellies and preserves. Processors of these products now use HFCS in a wide variety of sweetener blends, sometimes as high as 100 percent. Canned fruit typically uses 50-75 percent HFCS in the sweetener mix; fruit drinks from 25-75 percent, the latter applying to second generation HFCS.

Bakery products, which comprise approximately 20 percent of total industrial sugar use, now typically use 20 percent HFCS in the sweetener mix, largely replacing sucrose. Technical constraints limit further use--largely because of the syrup form of HFCS. Advantages include improved texture, color and stability, as well as retaining moisture and freshness.

Confections, making up approximately 14 percent of total industrial sugar use, have shown limited acceptance of HFCS as a sugar substitute. It is estimated that HFCS will eventually comprise about 20 percent of their sweetener formula, replacing mostly sucrose.

To the present time HFCS have replaced other sweeteners only at the industrial level. However, if as anticipated a technological breakthrough occurs in the early 1980s, to commercially and economically produce crystalline fructose, household consumer use of such a product could be expected to occur.

Industry structure tends to be concentrated, not only because HFCS is a new product but also because of high initial capital costs and economies of scale. Recent estimates of capital investment for a new HFCS plant achieving economies of scale are between \$50 million and \$75 million. Integration exists with sweetener users and some sugar refiners.

Growth in processing capacity (Table V) has been rapid and over-capacity has become evident. Estimated HFCS processing capacity has grown from 1,430 million pounds in 1975 to 5,055 million pounds in 1980. This capacity compares with production figures in the neighborhood of 2,500 million pounds in early 1982. Individual plant capacity varies widely, implying "that considerations such as input supplies, product and by-product markets, and product distribution are as important as internal cost-size relationships in the capacity investment decision." ^{1/}

Estimated total cost of production of HFCS are summarized in Table VI. It should be noted that individual plant costs could vary considerably from the estimated figures. Major operating costs include enzymes, utilities, labor and licenses. The cost of the corn input is net of the sale of by-products which are typically treated as a cost offset. Variations in corn prices and/or corn by-products will influence the net cost of corn. Major overhead costs include interest on investment, depreciation, insurance, taxes and management. Estimates yield a total cost per pound for HFCS in the range of 9.525 cents to 12.725 cents.

Prices of HFCS are normally set relative to sugar prices typically being 50-70 percent of sugar prices. ^{2/}

U.S. policies on feed-grains and sugar have various impacts on sugar, corn and HFCS. Policies affecting corn and corn by-product exports affect to a degree net input costs of HFCS. Sugar policies affect the domestic price of sugar and thereby the price level and rate of penetration of HFCS. Different types of intervention have different impacts on the domestic mix of sugar and HFCS use. In particular, quotas on sugar imports and policies supporting domestic sugar prices will encourage substitution of HFCS. Under recent low world sugar prices much HFCS production would not be profitable without regulation.

^{1/}Op cit., p. 15.

^{2/}Op cit., p. 28.

Table V. Estimated HFCS Processing Capacity by Firm & Plant
1975-1980

Firm/plant loca.	Year					
	1975	1976	1977	1978	1979	1980
	- million lbs. (dry basis) -					
American Maize						
Decatur, AL	--	--	240	240	240	240
Hammond, IN	--	--	--	--	--	--
Amstar						
Dinimett, TX	50	240	340	340	340	340
Columbus, OH ^{a/}	--	--	--	--	--	--
ADM/Corn Sweeteners						
Cedar Rapids, IA	40	350	700	700	700	700
Decatur, IL	--	--	325	325	325	325
CPC						
Argo, IL	40	200	200	200	250	250
Cargill						
Dayton, OH	--	--	330	330	330	330
Memphis, TN	--	--	--	--	--	--
Clinton						
Clinton, IA	550	700	700	700	700	700
Montezuma, NY	--	--	345	345	345	345
Heinz/Hubinger						
Keokuk, IA	--	--	--	300	300	345
Helly Sugar						
Tracy, CA	--	--	--	160	160	160
A.E. Stanley						
Morrisville, PA	400	400	400	400	400	400
Decatur, IL	350	350	350	350	350	600
Lafayette, IN	--	--	320	320	320	320
Industry Total	1,430	2,240	4,250	4,710	4,760	5,055

^{a/} Site selection not confirmed.

Source: High Fructose Corn Sweeteners: Economic Aspects of a Sugar Substitute, H.F. Carman and P.K. Thor, Giannini Foundation Bulletin 1894, (July 1979) p. 14.

Table VI : Estimated Total Costs of Production of HFCS

<u>Cost Category</u>	<u>Cost Estimate</u> ¹		
	--- ¢ per lb. ---		
Operating Costs			3.200
Overhead			
Interest and depreciatinn			3,125
Other			2.000
Subtotal			<u>8.325</u>
Corn (net of by-products)	1.20	to	4.40
TOTAL	9.525		12.725

1. Fob plant

Source: High Fructose Corn Sweeteners: Economic Aspects of a Sugar Substitute, H.F. Carman and P.K. Thor, Giannini Foundation Bulletin 1894 (July 1979).

Farm Production Costs

Domestic sugar production costs, excluding land, vary considerably, among regions (Table VII and Figure 7). On average cane crop production costs are higher than those for beet on a dollar-per-acre basis. However, measured as dollar-per-net-ton or cents per pound costs between cane and beet production tend to be comparable. The high costs per acre in Florida and Hawaii are largely due to labor and repair items. It should be noted that costs per pound of cane sugar pertain to the raw sugar stage, whereas those for beet sugar reflect the refined sugar stage.

Costs for beet sugar alone show wide differences between regions. On a cents-per-pound basis, costs of production in Michigan and Ohio--the lowest cost region--are about half those in Texas and New Mexico--the highest cost region.

Such differences are largely accounted for by higher costs for all variable inputs except fertilizer (appendix IV). Machinery and management costs are also higher in the two states. In California and Arizona relatively higher costs of custom operations, labor, and purchased irrigation water contribute to overall higher costs of production. In these two highest cost regions, payments on interest are close to double interest costs in other producing states. In Michigan and Ohio, lower costs for seed, labor, management, fuel and lubrication, machinery and to some extent repairs keep overall costs lower than in other regions, although their costs for fertilizer are highest of any other producing state. It is interesting to note that labor costs tend to be higher in western regions; while except for Michigan, machinery costs tend to be lower in the west.

Comparing cost items in Michigan and Ohio with the national average (Table VIII), the four cost categories: total variable costs, machinery

Table VII. U.S. Sugar Crops Production Costs, Excluding Land^{1/}
by Region, 1980/81 Crop Year

Beets	\$/Acre	\$/Net Ton	¢/lbs Refined Sugar
Michigan and Ohio	359.56	18.90	8.080
Minnesota & N. Dakota	326.19	24.02	10.269
Kansas, Colorado, Nebraska, S.E. Wyoming	449.80	23.57	10.076
Texas, New Mexico	556.84	37.40	15.989
Montana, N.W. Wyoming S.W. North Dakota	474.25	22.86	9.773
East Idaho	539.91	24.54	10.491
W. Idaho & Oregon	590.93	22.78	9.704
California, Arizona	719.39	29.31	12.530
U.S.	471.59	24.95	10.667
Cane	\$/Acre	\$/Net Ton	¢/lbs Raw Sugar
Florida	746.59	22.69	10.800
Louisiana	443.44	19.28	10.942
Texas	626.48	22.71	12.788
Hawaii	2810.30	29.59	13.305
U.S.	911.78	24.30	11.800

^{1/}Includes variable costs (seed fertilizer, chemicals, custom operations, labor, fuel and lubrication, repairs, purchased irrigation costs, miscellaneous, interest plus machinery ownership, farm overhead, management, general and administrative, hauling allowance.

^{2/}Calculated for beet regions based on U.S. ratio of ¢ per lb./\$ per ton (10.667/24.95 = .4275).

Source: Various tables in Preliminary Report, "Cost of Producing and Processing Sugarcane and Sugar Beets in the United States," ESS Staff Report #AGESS 810421, April 1982.

Figure 7

Sugar Beets: Production Costs Per Ton, Excluding Land, 1980/81

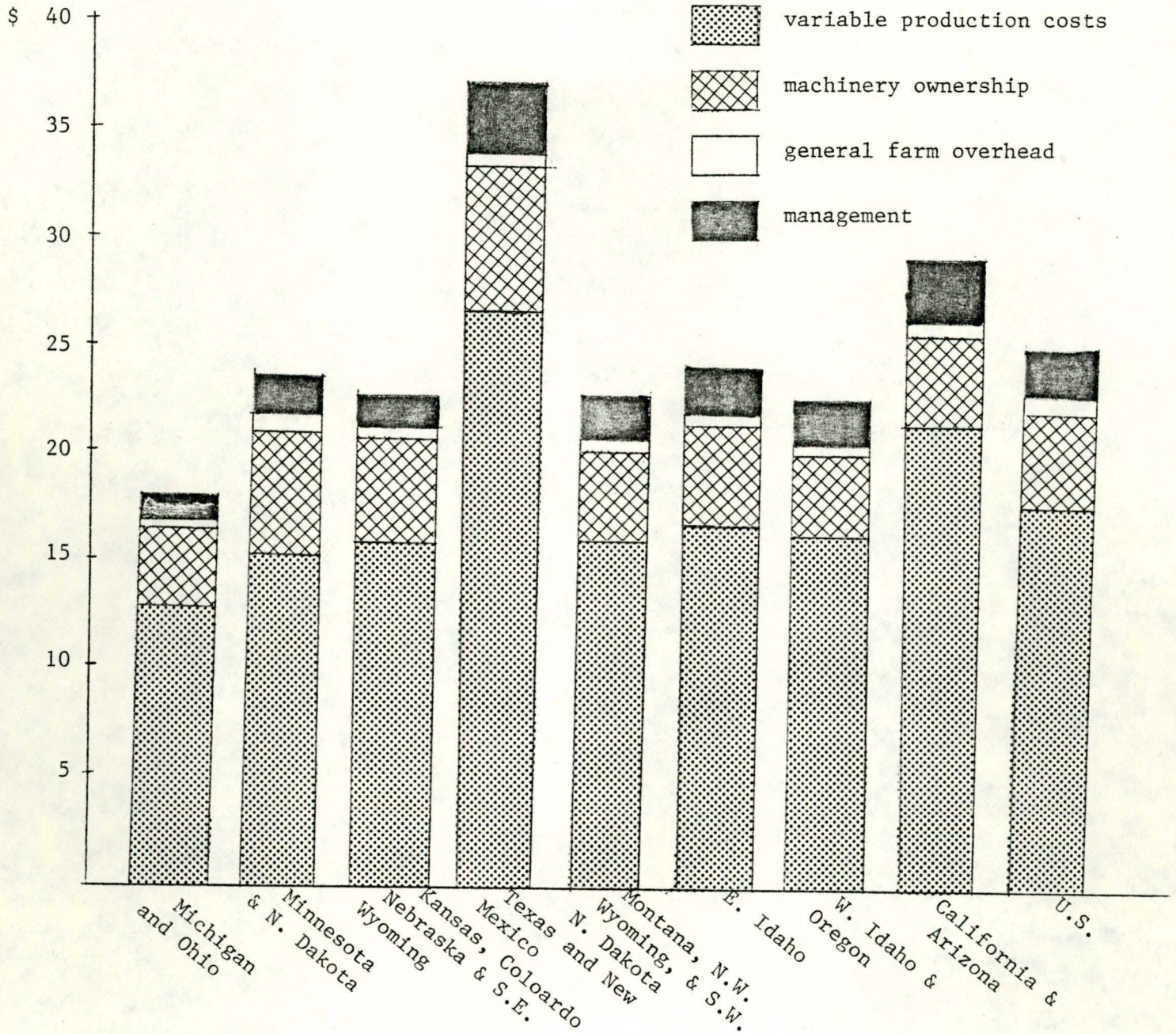


Table VIII. Preliminary Production Costs Per Ton Sugar Beets,
by Cost Item, 1980/81 Crop Year

Cost Item	Michigan & Ohio	U.S.
Variable	13.38	17.54
Seed	.29	.85
Fertilizer	4.26	2.92
Chemicals	1.51	2.40
Custom Operations	2.10	1.83
Labor	2.07	4.29
Fuel & Lubrication	1.28	2.26
Repairs	1.02	1.35
Purchased Irrigation Water	--	.53
Miscellaneous	.11	.13
Interest	.74	.98
Machinery Ownership	3.39	4.61
Replacement	1.66	2.33
Interest	1.44	1.91
Taxes & Insurance	.29	.37
General Farm Overhead	.41	.54
Management	<u>1.72</u>	<u>2.26</u>
Total excluding land:	18.90	24.95

Source: Table 16, Preliminary Report "Cost of Producing and Processing Sugarcane and Sugar Beets in the U.S.," ESS staff Report #AGE55810421, April 1982.

ownership costs, general farm overhead and management costs are consistently about three-fourths those of the U.S. average. Seed and labor costs are lower than this proportion while fertilizer and custom operations are higher than the average.

Cost and return data were obtained^{1/} for two states--Michigan and Minnesota--for various crops grown in respective sugar beet producing areas. Michigan beets (comprising 6.9 percent of total U.S. beet production) are grown largely in the "thumb" area of the state. Minnesota beets (17.6 percent of total U.S. production) are grown largely along the north-west border (Red River Valley) area of the state. USDA cost data include, inter alia, revenues and costs per acre for an average farm in each region.^{2/} These data are summarized in Table IX.

Table IX shows variations in average costs and returns for sugar beets and several alternative crops in Michigan and Minnesota. It should be noted, however, that average costs and returns do not reflect all considerations going into production decisions (e.g., income variability and security, economies of size, ownership of machinery, individual land potential), nor sensitivity to annual price changes. In 1980, Minnesota shows less choice of alternative crops than does Michigan if returns are to cover all costs excluding land. Only barley shows a positive net return at 1980 prices and production yields. In Michigan dry edible beans appear the next best choice to beet production--again at 1980 prices. In 1980 prices were abnormally high. At a lower price for sugar (holding all other prices constraint)

^{1/}Data are from the Firm Enterprise Data System, Oklahoma State University, Stillwater, Oklahoma.

^{2/}Individual farms are likely to have yields and input mixes which differ from the average which would imply different revenue and cost schedules.

Table IX. Alternate Crop Costs & Returns, Michigan & Minnesota, 1980

Product & Area	Total Variable Costs	Total Machinery Costs	Management & Overhead	Price per Unit ¹	Value per Acre	Returns net of Costs
<u>Michigan</u>						
Sugar Beets	\$246.41	\$67.36	\$39.63	\$40.70 (30.00 (16.93	\$777.78 573.30 323.53	\$424.38 ² 148.92) ³ -29.87)
Dry edible beans	111.31	46.87	24.07	24.50	314.58	132.22
Corn for grain	135.67	48.44	26.66	3.20	315.20	104.43
Soybeans	74.86	36.02	19.34	7.35	223.44	93.22
<u>Minnesota</u>						
Sugar Beets	212.57	74.38	38.17	44.10 (30.00 (16.93	605.49 411.90 232.45	280.43 ² 86.84) ³ -92.61)
Barley	44.84	35.90	16.72	2.95	104.13	2.67
Sunflowers	70.40	42.59	19.55	10.80	117.29	-15.25
Hard Red Spring Wheat	62.20	37.62	18.23	4.10	91.43	-26.62
Oats	56.45	37.57	17.65	1.75	67.74	-43.93

^{1/}Sugar beets: \$/ton; corn: \$/bu.; soybeans: \$/bu.; dry edible beans: \$/cwt.;
barley: \$/bu.; wheat: \$/bu.; oats: \$/bu. + sale of straw; sunflowers: \$/cwt.

^{2/}Shows revenue calculated at a lower price than that for 1980.

^{3/}Shows revenue calculated at the 1981 world price.

Source: Firm Enterprise Data System, Oklahoma State University, Stillwater, Oklahoma.

the advantage to beet production is greatly reduced while at the 1981 world sugar price there is a net loss to beet production. It should be noted that sugar prices in the past have been volatile implying a loss one year may be recouped in following years. However, this price instability may be accompanied by associated costs both economic and social, a factor not considered here.

Processing Costs

U.S. processing capacity for sugar beets has declined substantially in the last several years. Since the 1976/77 crop year, 17 plants have closed, leaving 40 remaining. No new processing plants are planned. Processing capacity in 1982/83 will be approximately 150,000 tons sliced beets daily, down 29 percent since 1976/77, and down 8.5 percent from 1981/82. Recent plant closings have occurred in California, Ohio, Nebraska and Colorado. As a result plantings have or will decline in these areas. California shows the largest decline at 20 percent in 1981/82. There will no longer be any plant in Ohio, where a significant number of producers have switched from sugar beets to corn and soybean production. Total acreage in the Michigan-Ohio region is expected to decline 13 percent over 1982/83.

Processing cost data are available only at a national level, though there may be wide variations among individual plants. Comparing processing costs for beet and cane sugar (Table X) shows variable costs to be much lower for cane sugar processing. Almost all variable cost items are more expensive in beet processing. Fuel, supplies and materials and to a lesser extent labor add significantly to beet processing costs. Only repairs and maintenance costs are lower for beet sugar processing. Total processing costs for cane sugar are 40 percent lower than for beet sugar.

When processing costs (net of revenues from the sale of by-products) are added to production costs (Table XI) net costs for beet sugar are typically

Table X. Comparative Processing Costs Per Ton for Raw Cane Sugar and Beet Sugar, 1980/81 Crop Year, U.S.

Cost Item	Raw Sugar (Cane)	Beet Sugar
Variable	\$12.68	\$22.70
Cane Transportation/Beet Acquisition	\$2.23	\$3.52
Processing		
Labor	1.95	3.17
Fuel	.88	4.18
Supplies & Materials	1.03	3.57
Repairs & Maintenance	3.09	2.96
Labor Benefits	.91	1.20
Marketing	1.85	2.77
Interest	.74	1.33
Ownership	9.62	10.29
Depreciation	1.30	1.60
Interest	8.01	8.11
Taxes and Insurance	.31	.58
General & Administrative	1.28	1.86
Labor	.37	.77
Non-labor	.91	1.09
Dried Pulp (beet)	—	<u>4.10</u>
Total Processing Costs	\$23.58	\$38.95

Source: Tables 11 and 17, Preliminary Report, "Cost of Producing and Processing Sugarcane and Sugar Beets in the U.S.," ESS, USDA, April 1981.

Table XI. Sugar Crops: Production & Processing
Costs Per Ton, Preliminary 1980/81

Beets	Production (excl. land)	Processing	Credits ¹	Net Costs
U.S.	\$24.95	\$38.95	\$8.99	\$54.91
Michigan & Ohio	18.90	"	"	48.86
Minnesota & N. Dakota	24.02	"	"	53.98
Kansas, Colorado, Nebraska, S.E. Wyoming	23.57	"	"	53.53
Texas, New Mexico	37.40	"	"	67.36
Montana, N.W. Wyoming	22.86	"	"	52.82
S.W. North Dakota, E. Idaho	24.54	"	"	54.50
West Idaho & Oregon	22.78	"	"	52.74
California & Arizona	29.31	"	"	59.27
<u>Cane</u>				
U.S.	22.69	23.58	3.56	44.32
Florida	22.69	18.55	3.40	37.84
Louisiana	19.28	29.73	3.63	45.46
Texas	22.71	25.93	4.03	44.61
Hawaii	29.59	25.05	3.63	51.01

^{1/} Credits for beets include dried pulp and molasses; those for cane include molasses, and bagaase.

higher than those for cane. Florida and the Michigan-Ohio region are the lowest cost regions for cane and beet sugar respectively. Regional processing costs for cane sugar vary substantially and make a difference when ranking regions in terms of net costs (Table XI). It is anticipated that the same may occur for beet sugar, although the data are not available at the time of writing.

The Michigan Sugar Beet Industry

The processing industry in Michigan has been relatively stable over the last several years and no major changes are anticipated in the near future. Two companies Monitor Sugar Company and Michigan Sugar Company handle all the beet processing. Michigan Sugar Company processes roughly two-thirds of the beet crop. It operates five plants: one each in Saginaw (headquarters), Carleton, Sebawaing, Caro and Crosswell with a receiving station in Brekenridge which delivers to Carleton. Monitor has one plant at Bay City which takes roughly one-third of the crop.

The major part of Michigan sugar is sold to commercial users (such as bakeries, dairies, canneries, and soft drink manufacturers) in the form of bulk sugar. Monitor Sugar Company sells retail sugar under the brand name of "Big Chief Sugar". Michigan Sugar Company also sells retail largely using store brand names.

All sugar grown in Michigan is contracted. In 1981 there were roughly 22,500 contracts between producers and processors, split one-third and two-thirds between the two companies. It is difficult to estimate the number of producers since one farmer may have more than one contract, however a current rough estimate would be between 1200-1400 beet growers. Based on a two-thirds sample of total Michigan acreage, average contracted acres per farmer over the period 1979-81 was 41.4 acres, ranging from as small as 1 acre to as large as 550 acres.

Contracts are based on the producer receiving 53 percent of processor income subject to a formula which pays more or less than 53 percent depending upon the percentage of sugar in beets delivered by an individual farmer compared with the company average.

Conclusion

At the outset of this paper we indicated that an effort would be made to provide a tentative evaluation of the emerging economic position of the Michigan sugar industry. This can be done only sketchily. On the surface the picture looks favorable. USDA cost data indicate that farm production costs exclusive of land are the lowest in Michigan and Ohio when compared to other beet growing areas and to cane production. On the other hand support price levels for refined beet sugar for Michigan and Ohio are higher than any other region in the U.S. The price that processors must pay growers for beets to qualify for the loan program, in turn, are the lowest for any beet growing area (appendix II). These inconsistencies must either reflect data and measurement problems or a high allowance to processors in implementing the program--part of which is based on transport costs to primary outlets.

Another evidence of a favorable position for Michigan is that production has steadily increased since 1960. This has occurred despite the fact that alternatives to sugar beet production are relatively more profitable than in the other region where comparative cost data could be obtained--the Red River Valley.

Table XII Production of Sugar and Dry Beans,
Michigan 1960 to 1981 in Thousands

Year	Sugar Beets (tons)	Dry Beans (cwt.)
1960-64 av.	1,153	7,437
1965-69 av.	1,355	6,775
1970-74 av.	1,571	6,231
1975-79 av.	1,684	5,053
1980	1,892	7,752
1981	2,030	7,198

Despite these apparently positive factors an effort to judge future prospects for the Michigan sugar industry with current limits on information are risky. Total sugar use has been declining due to substantial displacement by high fructose corn sweeteners. There are unknown variables on the cost side particularly deregulation of natural gas prices. Fuel is a relatively much larger cost factor in beet processing than cane (appendix II). Given the apparent relation between production and processing costs per ton it is hard to see why U.S. cane sugar production has declined and beet production has generally held up (see tables VII and X in the manuscript). In the future there likely will be further displacement of sugar by corn sweeteners. These factors plus other unknowns (e.g., regional processing cost relationships) all create uncertainties that need further investigation to help arrive at an assessment that can be put forth with more confidence.

Appendix 1: Regional Prices for 1982 Sugar
Loan Program

The processing regions and applicable loan rates for refined beet sugar shall be as listed below:

Region number and description	Cents per pound
1. Michigan and Ohio	20.99
2. Minnesota and the Eastern half of North Dakota. . .	19.99
3. Northeastern quarter of Colorado; Northwestern quarter of Kansas; Nebraska; and the South- eastern quarter of Wyoming.	19.76
4. Southeastern quarter of Colorado; and Texas . . .	20.04
5. Montana and the Northwestern quarter of Wyo- ming and Western half of North Dakota	19.84
6. That part of Idaho east of the Eastern boundary of Owyhee County and of such boundary extended northward; and Utah	19.41
7. That part of Idaho west of the eastern boundary of Owyhee County and of such boundary extended northward; Oregon; and Washington	19.41
8. Arizona and California.	20.67

The processing regions and applicable loan rates for cane sugar, raw value, shall be as listed below except that, for such sugar processed in Hawaii or Puerto Rico but placed under loan on the mainland of the United States, the applicable loan rate shall be 17 cents per pound:

Region	Cents per pound
Florida	16.98
Louisiana	17.43
Texas	17.10
Hawaii	16.91
Puerto Rico	16.35

SUPPORT PRICES PER NET TON OF SUGARBEETS AND SUGARCANE

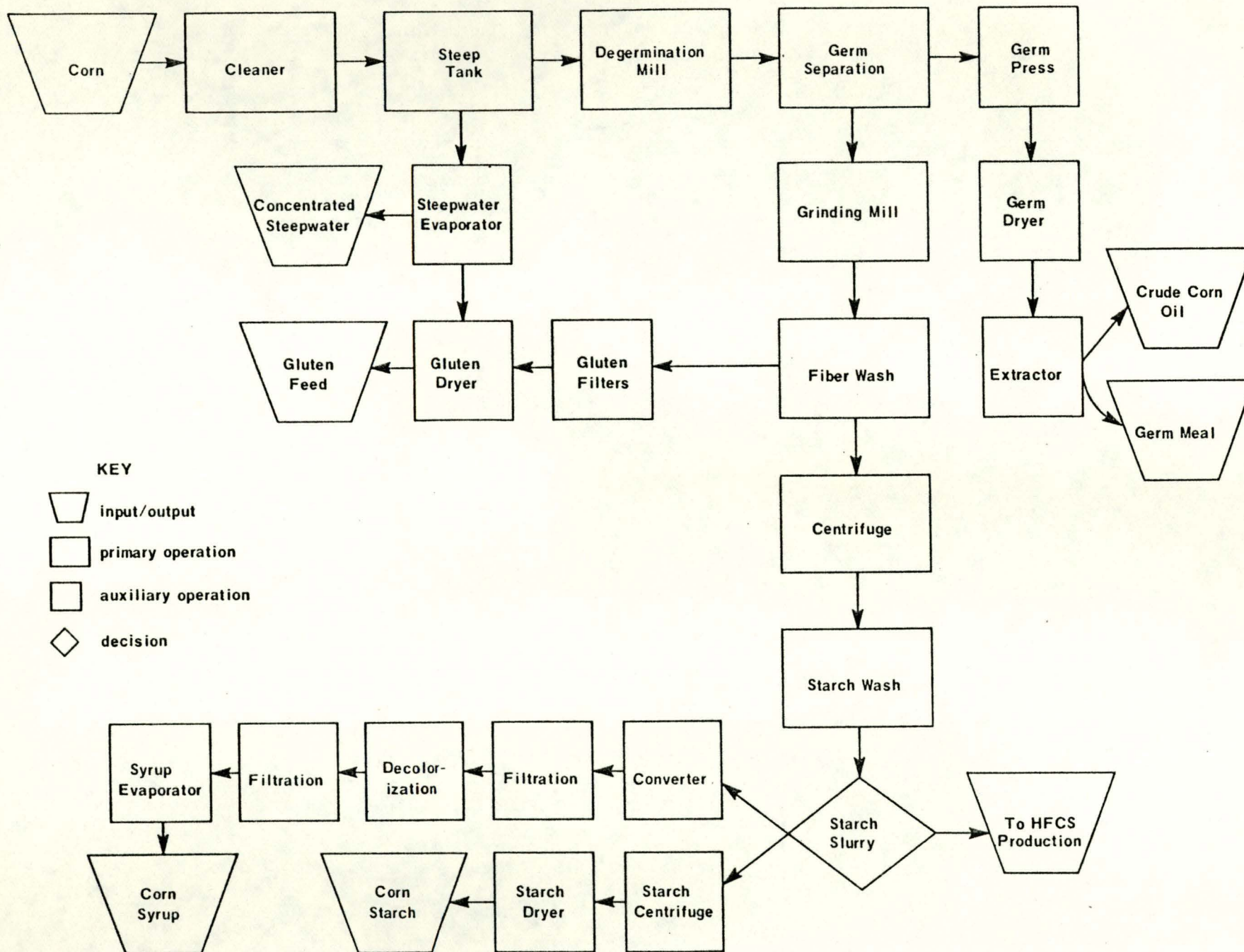
1. Sugarbeets of Average Quality.

<u>Region</u>	<u>Support Price Per Ton</u>
1	\$28.26 ^{1/}
2	30.76
3	30.41
4	30.85
5	30.53
6	29.85
7	29.85
8	31.82





2. For average quality sugarcane harvested between July 1, 1982, and June 30, 1983, in Florida, \$22.94 per net ton.
3. For average quality sugarcane harvested between July 1, 1982, and June 30, 1983, in Louisiana, \$20.99 per net ton: Provided, however, for sugarcane for which settlement is determined on the basis of a core sample, the minimum amount to be paid per gross ton of sugarcane shall be the amount determined by multiplying the total amount of sugar recovered per gross ton (CRS adjustment) of sugarcane delivered to the processor by 10.428 cents per pound, plus 58 cents per gross ton of sugarcane for molasses.
4. For average quality sugarcane harvested between July 1, 1982, and June 30, 1983, in Texas, the amount determined by multiplying 10.146 cents times the average pounds of cane sugar, raw value, recovered per ton from the sugarcane delivered to the processor by all producers, as adjusted by the processor to reflect the quality of the juice (normal juice sucrose and normal juice purity) extracted from the individual producer's sugarcane.
5. For average quality sugarcane harvested in calendar year 1982, in Hawaii, the amount determined in accordance with the standard marketing contract between growers and processors of sugarcane and the cooperatively-owned refiner of raw cane sugar which markets refined and raw cane sugar on behalf of its members and non-member patrons: Provided, however, that non-members of such cooperative shall be treated no less favorably than the members of the cooperative under the terms of the standard marketing contract.
6. For average quality sugarcane harvested in calendar year 1982, in Puerto Rico, that price determined in accordance with the provisions of Puerto Rico Law No. 426, also known as the Puerto Rico Sugar Law, and the rules issued thereunder by the Sugar Board of Puerto Rico.
7. The foregoing prices must be adjusted for sugarbeets or sugarcane of non-average quality under the method agreed upon by the producer and processor.

1/ Provided, that if: (1) the sugar extracted by a processor from the 1982-crop yields, on the average, less than 232.54 pounds per net ton of sugarbeets delivered and accepted by the processor, or (2) the processor's net return on byproducts per net ton of sugarbeets delivered and accepted by the processor averages less than \$6.53 per net ton, the required minimum price support rate per ton of sugarbeets may be adjusted. The adjusted rate will be determined by (a) multiplying \$.2008 (the loan rate per pound less \$.0094 considered as fixed marketing costs) by the average pounds and hundredths of pounds of sugar extracted per net ton, (b) adding thereto the net return to the processor on byproducts per net ton of sugarbeets delivered and accepted and (c) multiplying the results by 53.1 percent.

A FLOW DIAGRAM FOR CORN WET MILLING

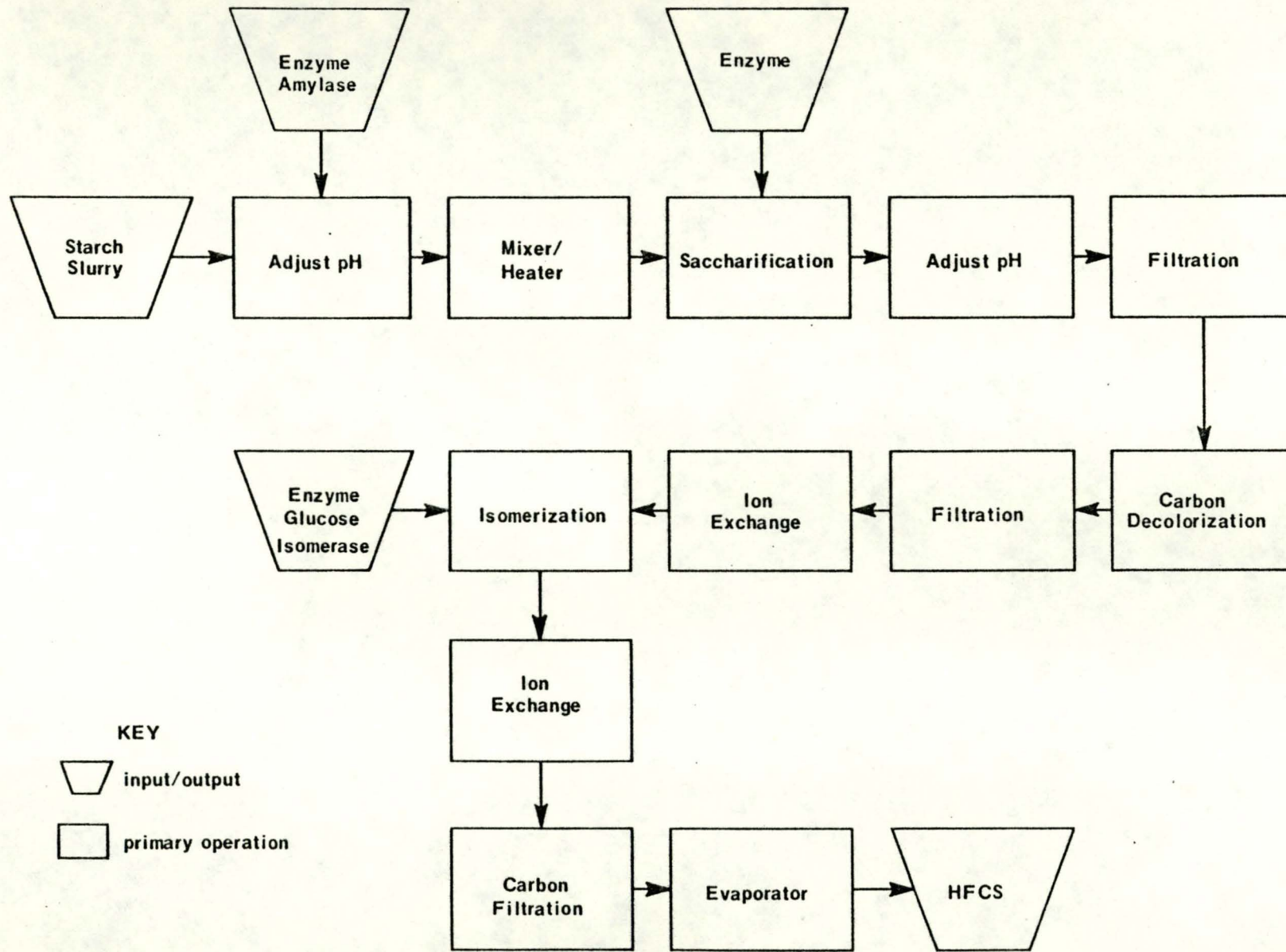


KEY

-  input/output
-  primary operation
-  auxiliary operation
-  decision

Source: Russo, 1976.

A FLOW DIAGRAM FOR PRODUCTION OF HFCS FROM CORN STARCH*



* This is the production process utilized in the ADM Corn Sweeteners plant in Cedar Rapids, Iowa. Source: Russo, 1976.

APPENDIX IV

Sugarbeets: Preliminary production costs per ton, by cost item,
specified study areas, 1980/81 crop year

Cost item	Regions								United States
	Mich. & Ohio	Minn. & N. Dak.	Kan. & Neb. & S.E. Wyo.	Tex. & N. Mex.	Mont. & N.W. Wyo. & S.W. N. Dak.	East Idaho	W. Ida. & Ore.	Calif. & Ariz.	
	<u>Dollars</u>								
Variable	13.38	15.51	15.95	26.86	16.11	17.20	16.96	21.98	17.54
Seed	.29	1.42	.84	1.24	.87	.85	.81	.50	.85
Fertilizer	4.26	2.78	2.36	2.00	3.62	3.32	3.55	2.48	2.92
Chemicals	1.51	2.91	1.89	5.93	1.38	1.44	1.89	3.13	2.40
Custom operations	2.10	.51	.83	3.48	.30	.91	1.14	4.42	1.83
Labor	2.07	3.66	4.91	4.70	4.91	4.22	4.31	5.10	4.29
Fuel and lubrication	1.28	1.86	2.58	5.32	1.84	3.41	1.73	2.35	2.26
Repairs	1.02	1.51	1.38	2.65	1.28	1.50	1.77	1.08	1.35
Purchased irrigation water	—	—	.31	—	.57	.63	.89	1.28	.53
Miscellaneous	.11	.03	.04	—	.57	.12	—	.22	.13
Interest	.74	.83	.81	1.54	.77	.80	.87	1.42	.98
Machinery ownership	3.39	5.67	5.12	6.51	4.36	4.83	3.43	3.86	4.61
Replacement	1.66	2.78	2.60	3.50	2.22	2.54	1.78	1.99	2.33
Interest	1.44	2.41	2.13	2.59	1.79	1.93	1.37	1.58	1.91
Taxes and insurance	.29	.48	.39	.42	.35	.36	.28	.29	.37
General farm overhead	.41	.66	.36	.63	.31	.28	.32	.80	.54
Management	1.72	2.18	2.14	3.40	2.08	2.23	2.07	2.67	2.26
Total excluding land	18.90	24.02	23.57	37.40	22.86	24.54	22.78	29.31	24.95