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The World Sugar Market—Government Intervention and Multilateral Policy Reform

Ron Lord
Robert D. Barry

The World Su
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AGES 9062.

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The World Sugar Market--Government Intervention and Multilateral Policy Reform. By Ron Lord and Robert D. Barry, Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture. Staff Report No. AGES 9062.

Abstract

Extensive government intervention in sugar markets significantly affects sugar production, consumption, and trade. Many countries provide support for sugar producers, placing the cost on consumers and/or taxpayers. A trade liberalization scenario is analyzed in which only the industrial market economies are assumed to liberalize their agriculture. The analysis shows that compared with actual 1986-88 levels, liberalized levels of sugar production in 1986-88 would have been lower in the industrial market economies, and higher in the less-developed countries. Liberalization would have led to an increase in the world sugar price of 10-30 percent from its 1975-89 longrun average level, and would have reduced world price variability while increasing domestic price variability in many industrial market economies. Sugar production in the United States would have been lower, and consumption slightly higher. World sugar trade patterns would have shifted dramatically, but overall trade volume would have increased only marginally. Sugar substitutes, primarily high fructose starch syrups, would have increased market share, mainly in a few industrial market economies.

Keywords: Sugar trade, policy reform, trade liberalization, GATT negotiations, government intervention, high fructose starch syrup, sweeteners

Washington, DC 20005-4788   September 1990

Foreword

This report is a product of the trade liberalization project conducted in the Commodity Economics Division of the Economic Research Service (ERS). Eleven commodity monographs in the series "World Commodity Markets--Government Intervention and Multilateral Policy Reform" are anticipated from this study. The objectives of this series are to describe the role of individual commodities in world agricultural markets, to provide an overview of current policies for specific commodities throughout the world, and to evaluate the effects of a reduction in government supports and artificial barriers that hinder free competition among countries in the production and trade of commodities.

The monographs draw on earlier and ongoing analyses of government intervention and trade liberalization conducted by ERS in support of the Uruguay Round of multilateral trade negotiations, particularly calculations of producer and consumer subsidy equivalents and analyses of multilateral liberalization based on ERS's Static World Policy Simulation Model (SWOPSIM). The commodity reports build on these efforts and others in the agricultural economics profession to bring a commodity focus to ERS's work on global policy reform.

CED's project has been coordinated by Nicole Ballenger, Kate Buckley, and Joy Harwood. Pat O'Brien, Tony Grano, and Fred Hoff provided vision, direction, and support. Alden Manchester coordinated the outside reviews. Commodity reports and authors include:

Beef--Bill Hahn, Terry Crawford, Linda Bailey, and Shayle Shagam
Coarse Grains--Bengt Hyberg, Stephanie Mercier, and Linwood Hoffman
Dairy--Don Blayney and Dick Fallert
Fruits, Vegetables, Wine, and Tropical Beverages--Kate Buckley
Oilseeds--Tom Bickerton and Joe Glauber
Poultry--Bob Bishop, Lee Christensen, Stephanie Mercier, and Larry Witucki
Pork--Shayle Shagam
Rice--Nathan Childs
Sugar--Ron Lord and Bob Barry
Tobacco--Verner Grise
Wheat--Joy Harwood and Ken Bailey

The authors appreciate reviews by Bill Cromarty of Sparks Commodities, Tom Greer of Purdue University, Rigoberto Lopez of Rutgers University, Bill Motes of Sparks Commodities, and Andrew Schmitz of the University of California-Berkeley, as well as reviews by ERS and Foreign Agricultural Service staff. We wish to thank Fannye Lockley and Bill Moore for statistical assistance, and Diana Claytor, Brenda Powell, and Linda Hatcher for help in preparing the manuscript. Thanks to Kathy Lipton for special editorial assistance.

For a listing of ERS work in support of the Uruguay Round, see <u>Bibliography of Research Supporting the Uruguay Round of the GATT</u>, Agriculture and Trade Analysis Division, Economic Research Service, U.S. Dept. Agr., AGES 89-64, Dec. 1989.

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Robert D. Barry

Introduction

Most sugar-producing countries have a long history of supporting their sugar industries, either through border measures such as tariffs or quotas, or through direct aids. Government price-fixing is commonplace for both producer and consumer prices, with many industrial market economies maintaining high producer and consumer prices, and many less-developed countries fixing consumer prices at low levels. (See table 1 for a list of industrial market economies, less-developed countries, and centrally planned economies.)

Government interventions in sugar and sweetener markets have imposed large costs on taxpayers, consumers, and, in some countries, producers. Price stabilization measures within countries have contributed to unstable world market prices and imposed costs on other countries.

Participants in the current round of multilateral trade negotiations, occurring under the auspices of the General Agreement on Tariffs and Trade (GATT), are attempting to bring agricultural policies under the discipline of GATT rules. In the past, GATT regulation of agricultural policies has been rather loose and directed solely at their direct effects on trade. Purely domestic agricultural policies have not been included under the GATT.

This report describes how the world sugar market functions and the effects of government intervention in major sugar-producing and consuming countries. The report examines what might have transpired in sweetener markets in 1986-88 if the industrial market economies had eliminated trade-distorting agricultural policies.

The results of our scenario of trade liberalization in industrial market economies are presented, along with results of previous research. Liberalization would generally have increased the world sugar price, reduced its variability, and increased sugar trade. The industrial market economies would have reduced sugar production and increased imports, while the less-developed countries would have increased sugar production and increased exports. The centrally planned economies, which traded much of their sugar among themselves under barter arrangements, would have been less directly affected by liberalization than the industrial market economies and less-developed countries, but would nonetheless have experienced slight increases in production and trade. The term "centrally planned" is retained even though

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Table 1--Classification of industrial market economies, less-
developed countries, and centrally planned economies

Industrial market economies	Less-developed countries	Centrally planned economies
EC-12:	Brazil	Bulgaria
Belgium	Dominican Republic	Czechoslovakia
Denmark	India	China
France	Indonesia	Cuba
Federal Republic	Mauritius	German Democratic
of Germany	Mexico	Republic
Greece	The Philippines	Hungary
Ireland	South Korea	Poland
Italy	Swaziland	Romania
Luxembourg	Thailand	USSR
Netherlands	Turkey	Yugoslavia
Portugal		
Spain	(For some purposes,	
United Kingdom	rest of world included	
	in this category)	
Other Western Europe:		
Austria		
Finland		
Norway		
Sweden		
Switzerland		
Australia		
Canada		
Japan		
South Africa		
United States		

drastic changes have occurred in Eastern Europe in 1989 and 1990, since this
study's focus is on the period 1986-88.

Agriculture and the GATT

The General Agreement on Tariffs and Trade (GATT) was negotiated at the end of
World War II to provide an international forum to promote reduced government
interference in all international trade. However, the seven rounds of
liberalization talks completed to date have focused heavily on manufactured
goods, with little attention to agriculture. In the Uruguay Round of
multilateral trade negotiations, 1986-90, agricultural policies are being
seriously discussed within the GATT framework for the first time. Moreover,
many governments have come to recognize that many agricultural trade problems,
such as low world prices, are deepened by domestic food and farm policies, in
addition to export subsidies or import restrictions.

Earlier trade theory held that a nation will sell the goods it can produce
more cheaply than other nations and buy the goods which can be purchased for

less than it costs to produce at home. Under these circumstances, a nation is said to have an absolute advantage in that good which it can produce for less.

Even if a country has an absolute advantage in the production of most goods, it would still be to a country's benefit to trade. The theory of comparative advantage, first postulated by David Ricardo in the early 1800's, states that, in a simple two-good world, a country can improve welfare by shifting resources to the production of the good it can produce at the lowest cost relative to other countries. The increased production of this good can then be exported in exchange for a larger quantity of the other good than has been lost by the shift of resources. Comparative advantage is based on the concept of "opportunity cost" within nations, defined as the value of a reduction in the output of one product releasing inputs necessary to increase the production of another good. Since individual nations are endowed with different natural resources, climates, labor forces, and technology, the opportunity costs for production vary among nations. Mutually advantageous trade can arise among nations as long as differences in opportunity costs exist.

Policies to support agriculture tend to change the input and output prices that would normally prevail in a free-market economy, and distort the set of opportunity costs the farmer faces. Under such conditions, trade that would normally lead to benefits for both parties in the transaction may not occur.

The Current Policy Environment and the Uruguay Round

The world agricultural trade environment may see substantial policy reforms. In the communique issued from Punta del Este, in September 1986 at the start of the Uruguay Round of multilateral trade negotiations, participating nations publicly stated for the first time that domestic farm programs have an important distorting effect on world agricultural trade. In deciding to form an agricultural negotiating group so early in the round, GATT members sent a sharp signal to the world about their serious intention to deal with problems caused by agricultural support and protection.

The large budget cost of commodity programs is the factor that may now override domestic considerations which in the past have led to the adoption of extensive commodity programs. In the face of mounting public debt and budget deficits in many developed countries, the billions of dollars previously devoted to supporting farm income or encouraging farm exports are now vulnerable. Most countries contemplating such cuts wish to cushion the impact on producers in some way. The anticipated increase in trade volume and potential increase in some major world commodity prices resulting from multilateral trade liberalization would alleviate adverse farm income effects, as would so-called "decoupled payments" (that is, direct payments not linked to production or marketing) that may be permitted in a free-trade environment.

The midterm ministerial review in Montreal in December 1988 ended in a deadlock between the United States and the European Community (EC) on agriculture. In the December meetings, the EC refused to accept any language in agreements implying a total elimination of trade-distorting farm programs and the United States balked at settling for anything less.

In the followup meetings in Geneva in April 1989, the United States and the EC exhibited increased flexibility and all parties eventually reached an agreement calling for "substantial, progressive reductions in agricultural

protection" in the long term. The agreement also froze protection at current levels for 1989. A framework has thus been established for further negotiations and dialogue will continue, with high hopes for achieving substantial progress in agriculture.

Nine countries or country groups have submitted comprehensive proposals to be considered by the GATT agricultural negotiating group in the Uruguay Round. Table 2 summarizes six of these submissions. Most of the proposals are quite lengthy and complicated, and they represent a wide variety of approaches. At one end of the continuum are the proposals of the United States and the Cairns Group (Argentina, Australia, Brazil, Canada, Chile, Colombia, Fiji, Hungary, Indonesia, Malaysia, New Zealand, the Philippines, Thailand, and Uruguay) which favor largely eliminating policies that distort trade. At the other end is the EC plan, which offers relatively minor changes in existing programs. Proposals by Japan, the Nordic countries (Finland, Iceland, Norway, and Sweden), the group of net food importing countries (Egypt, Mexico, Jamaica, and Peru), Austria, Switzerland, and South Korea advocate varying degrees of reform.

The United States submitted a proposal in October 1989 with a detailed breakdown of policies present in the current policy environment. Certain types of programs, including export subsidies, import quotas, variable levies, and any price-support mechanisms that distort world prices, are listed as policies to be eliminated over varying lengths of time. Bona fide food aid, disaster assistance, environmental legislation, as well as decoupled direct payments, are designated as permissible policies. Policies which fall between these categories, such as input and investment subsidies that are equally available to all agricultural producers, are to be closely scrutinized and policed by GATT rules.

The EC opposes radical changes in world agricultural trade. Its proposal focuses on short-term efforts and maintenance of market shares. While the EC promotes the aim of progressively reducing support to re-establish balanced markets, it remains opposed to distinguishing between border and domestic policies that distort trade. EC officials are concerned about the cost to European agriculture under a free-trade regime at low world prices and are reluctant to expose their agricultural sector to such pressures by complete elimination of their support policies. One urgent concern of the EC is the relatively free entry of nongrain feed substitutes and protein meals into their market, which have been displacing higher priced domestic grains. The EC insists on the importance of being able to "re-balance" support and protection between such commodities.

The Nordic Group proposal also implies resistance to wholesale changes in agricultural policies. Its suggestions on trade reform are couched in terms of improving market access through reduction of tariffs, import levies, and quantitative restrictions, rather than elimination of those instruments, with priority placed on replacing the most trade-distorting policies with more decoupled forms of support. The Nordic countries are prepared to work toward elimination of most of their export subsidies.

Of the major groups submitting proposals prior to the midterm review, only the net food importing developing countries did not clarify or amplify their original position. The food importing group proposal focuses on resisting any overall price increases which would affect consumers in developing countries, though it supports "improving discipline" in the use of subsidies and

Table 2--Main elements of major negotiating proposals

United States (submitted October 25, 1989)
- Replace nontariff barriers with tariffs, to be phased down to zero or low levels over 10-year period (tariffication).
- Phase out export subsidies over 5-year period.
- Assign domestic policies to three groups: to be phased out (payments tied to output), to be disciplined (input, investment subsidies), and permitted (decoupled income support, environmental, disaster assistance, research, education).
- Treat less-developed countries based on development level in each.

European Community (submitted December 20, 1989)
- Reduce support and protection. Commitments would be expressed in terms of an aggregate measure of support.
- A form of tariffication could be accepted.
- Variable levies would be converted to fixed and variable components; fixed component reduced in line with other commitments and variable component to fluctuate according to market conditions. Deficiency payments to be included in tariffication.
- Flexibility in application of GATT rules to less-developed countries according to their actual level of development.

Cairns Group (submitted November 20, 1989)
- Prohibit measures not explicitly provided for in GATT rules (includes variable levies and quantity restraints--amounts to tariffication).
- All tariffs bound at low levels or zero.
- Prohibit new and phase out existing export subsidies.
- Reduce internal support through use of an aggregate measure of support where calculable, otherwise through commitments to reductions in support prices and budget expenditures.
- Similar internal policy categories to U.S. proposal.
- Measures in less-developed countries which encourage development to be exempt.

Japan (submitted November 27, 1989)
- Emphasize special nature of agriculture and food security.
- Insist on countries' right to support certain level of self-sufficiency in "basic foodstuffs."
- Export subsidies should be reduced and eliminated.
- Domestic support with no (or negligible) trade-distorting effects should be permitted; other policies reduced through commitments based on an aggregate measure of support.
- Allow less-developed countries longer time frame to achieve Uruguay Round goals.

Nordic Group (submitted December 19, 1989)
- Support gradual change in level and form of border protection.
- Tariffication is among feasible alternatives.
- Most export subsidies should be eliminated. Trade-distorting domestic subsidies should be displaced.
- Objective needs of individual less-developed countries must be considered.

Net Food Importing Developing Countries
- Negotiators should consider interest and problems of importers.
- Should continue special treatment of less-developed countries and food aid.
- Increased financial assistance should be given to food importing developing countries to compensate for post-liberalization price increases.
- Stricter discipline applied to export subsidies.

elimination of policies such as quotas, voluntary export restraints, and other trade restrictions.

Japan is the largest single major agricultural importer to introduce a proposal to GATT. The main focus of the Japanese proposal is on nontrade issues, such as food security. The Japanese prefer self-sufficiency programs for their basic foodstuffs, rather than relying on stockpiling or stable importation arrangements. They want to maintain the ability to use quantitative restrictions under Article XI of GATT rules for food security reasons. Japan supports enforcement of restrictions on variable levies and minimum support prices in agricultural trade, and supports progressive reduction and eventual elimination of export subsidies. Certain subsidies or expenditures which are devoted to improving infrastructure and social welfare,

such as those named in both the U.S. and Cairns Group proposals, are also suggested for exemption by Japan.

All major proposals call for harmonization of sanitary and phytosanitary standards and the eventual elimination of scientifically unjustified elements of sanitary and phytosanitary regulations of traded agricultural products. Differential treatment of developing countries is permitted in all major proposals, generally to be geared toward the level of general and agricultural development currently existing in each country. The role of an aggregate measure of support, envisioned as substantial after the first round of proposals, has been downplayed in the most recent proposals. Since the midterm review ended in April 1989, several other countries which are participants in the GATT Negotiating Group on Agriculture have also submitted proposals. These countries include Austria, South Korea, and Switzerland, separately, and Brazil and Colombia which submitted a combined proposal.

An example of the influence of current GATT rules on U.S. sugar policy is the 1989 GATT ruling that U.S. sugar import quotas were not being implemented consistently with U.S. GATT obligations (see box).

GATT Panel Ruling Against U.S. Sugar Quotas

In July 1988, Australia complained to the GATT that the U.S. sugar import quotas were in violation of GATT rules. A panel set up by the GATT to arbitrate the case ruled against the United States, and in June 1989 the GATT Council accepted the panel's ruling. The United States voted to accept the adverse ruling, in keeping with the U.S. commitment to a credible and effective GATT dispute mechanism.

The thrust of the Australian complaint was that the U.S. sugar import quotas were in violation of GATT Article XI, which in general prohibits quantitative import restrictions. The panel found that the U.S. operation of its sugar import quotas did not meet any of the criteria for exceptions from the Article XI prohibition on quantitative import barriers. Secretary Yeutter has stated that the United States will bring its sugar policy into compliance with GATT obligations.

The document submitted by the EC in support of the Australian case illustrates the complexity of interaction between commodities, and unintended effects which often accompany government intervention. The EC stated that the U.S. sugar program "... encouraged the growth of isoglucose (HFSS), and its by-product corn gluten feed, which was produced almost exclusively for export to the EEC. The distorting effects of these exports were serious in that they constituted a very cheap substitute for EEC cereals for animal feed and thus tended to encourage the growth of EEC milk and beef production." In other words, the EC claimed that the U.S. sugar program was partly responsible for dairy and beef surpluses in the EC.

Structure of the World Sugar Market

More than 110 countries produce sugar, which is processed from sugarcane in tropical climates as well as from sugarbeets in temperate zones. Some countries, including the United States, China, and Japan, produce both cane and beet sugar. Major players in the world sugar market include countries from all continents and stages of development.

World sugar output averaged 103.1 million metric tons (MMT) over 1986-88, at a value of more than $23 billion based on the free-market price of traded sugar. This period 1986-88 is broadly representative of the world market because production, consumption, and trade were close to trend and the world price was neither at the low nor high extreme of its historical range (although it was below average). At the higher, regulated prices received by producers and processors of sugar crops, production value exceeded an estimated $34 billion.

Trade Structure

Although sugar is among the most heavily traded agricultural commodities in the world, less than 30 percent of world production crosses national borders. Over 70 percent of world sugar output is consumed within the producing country, usually at government-regulated prices. Another part is exported under bilateral long-term arrangements at prearranged prices or under preferential terms, such as the U.S. sugar quota and the European Community's (EC's) Lomé Agreement (see box, "Special Arrangements"). Only about 20 percent (at times as low as 15 percent) of world sugar production is freely traded in international markets, largely as a residual after domestic needs and preferential sales are satisfied (fig. 1). The world free market for sugar is about equally divided between raw and refined sugar. Raw sugar prices are quoted f.o.b. Caribbean (Contract No. 11 in New York's Coffee, Sugar & Cocoa Exchange), or c.i.f. in the London Sugar Market (Contract No. 6) for which an f.o.b. Caribbean equivalent is derived. White, or refined, sugar prices are quoted in the London (f.o.b., Contract No. 5) and Paris markets.

Aggregate Production and Consumption Trends

World price fluctuations are associated with imbalances between production and consumption. Trend lines for 1965 to 1988 show that global production and consumption have risen about 2 MMT per year (figs. 2 and 3).

The introduction and then substantial expansion of high fructose starch syrup sweeteners (HFSS) after 1974, however, slowed down the rate of growth of world sugar consumption, which fell from 3.4 percent during 1965-74 to 2.4 percent during 1975-88.[1] World combined sugar and HFSS consumption increased an average of 3 percent per year during 1975-88, lower than the growth rate of sugar (alone) in the previous period. This decline was likely caused by the fall of per capita income growth in the low- and middle-income countries, from 4.1 percent during 1965-73 to 2.7 percent in 1973-80, and only 1.2 percent for 1980-85.

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[1] For consistency, the term HFSS is used, even for the United States where only corn is used as a source of starch for manufacturing the sweetener high fructose corn syrup (HFCS).

Special Arrangements in World Sugar Trade

A varying but large part of the sugar traded on world markets is under long-term pricing or preferential arrangements. The predominant special agreement is Cuba's barter arrangements with the USSR and other centrally planned economies, which take up about 75 percent of Cuba's total exports of 6.5 to 7.0 MMT and yield Cuba a premium price, though of limited value due to the inconvertibility of the ruble. There are also the 19 African, Caribbean, and Pacific less-developed countries which export 1.4 MMT of sugar each year to the EC under the Lomé agreement, at the EC internal premium support price. Further, the United States pays a premium price for its quota imports of over 1 million tons a year from a group of about 40 countries. Australia recently signed a long-term agreement to sell 300,000 tons per year to the USSR at a fixed (though unreported) price, which may be a signal of a possible future reduction in the USSR's reliance on Cuba. Altogether, about one-third of world sugar trade is conducted not at "world market prices," but at pre-arranged prices. This leaves about 20 MMT, or just under 20 percent of world production, trading at the "world" price.

Figure 1

Structure of world sugar trade

Domestic market--72% World trade--28%

Free market, refined--35%

Free market, raw--35%

Special arrangements--30%

Percent of world production

Percent of world trade
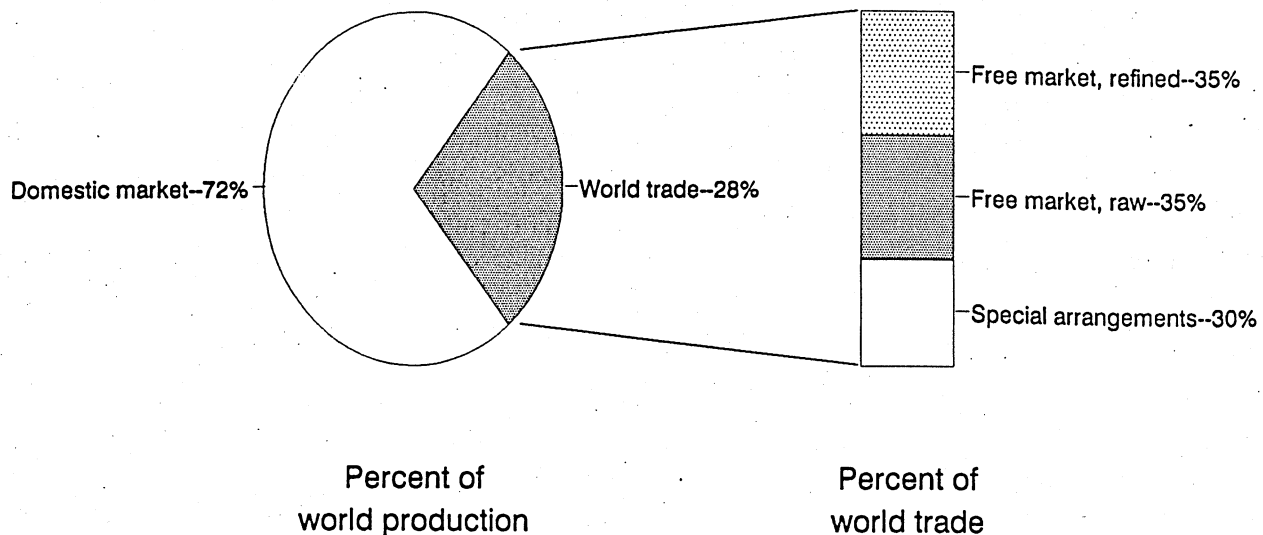
Based on estimated 1986-88 values.

Figure 2

World sugar production and trend, 1965-88

Million metric tons
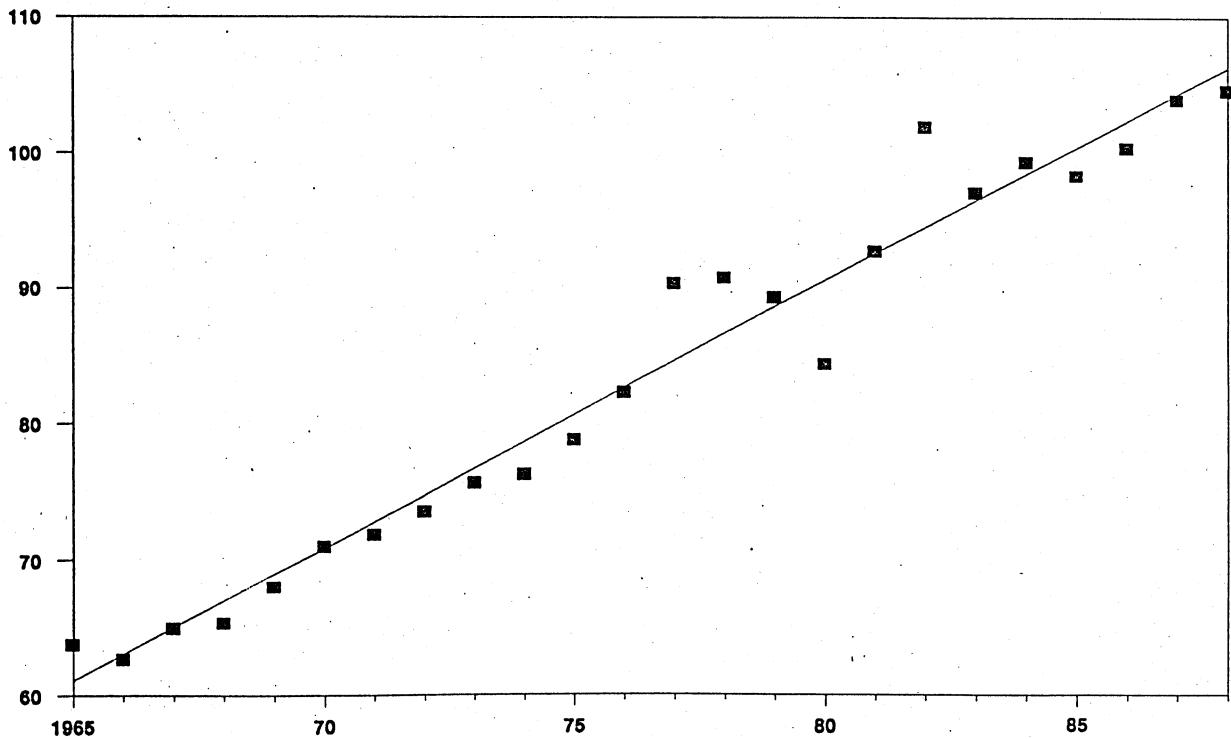
Figure 3

World sugar consumption and trend, 1965-88

Million metric tons
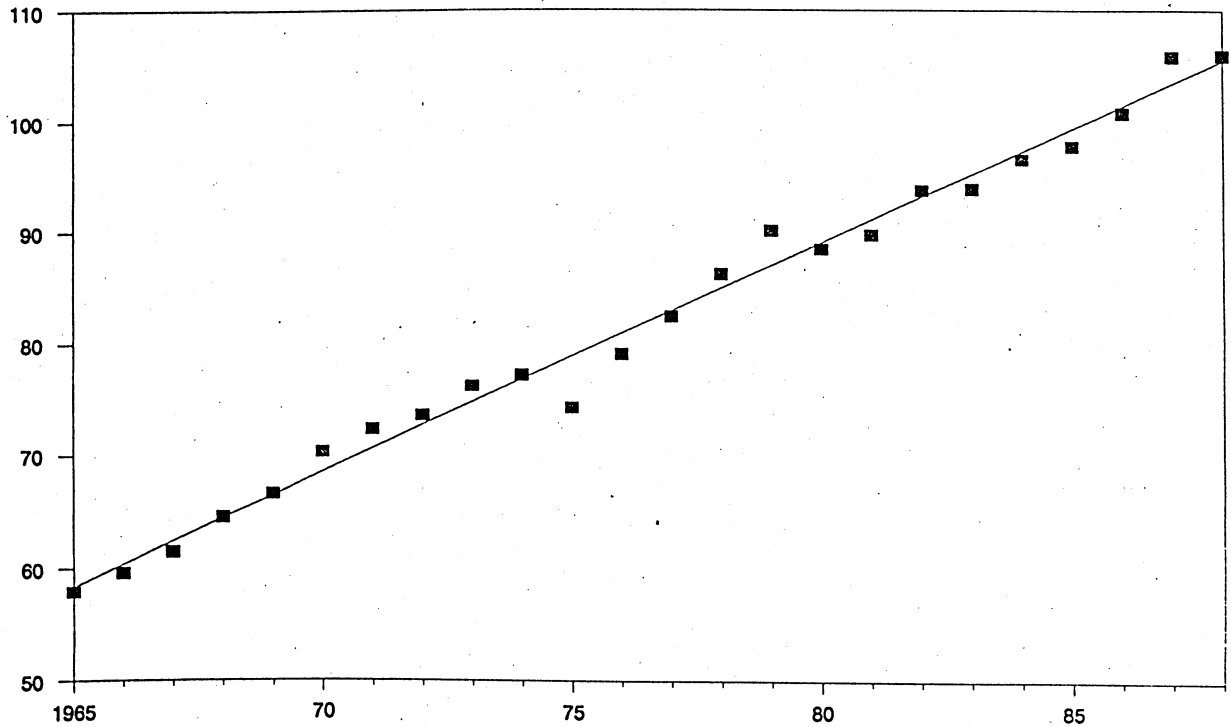
Global consumption is much more stable than production and is relatively steady from year to year, reflecting the stability of the human diet. Most variations in consumption from trend are due to stock changes or large variations in supply. Production, however, undergoes substantial fluctuations of weather. In any year, production and consumption can also be influenced by decisions of producers, traders, consumers, and governments. For the period 1965-88:

o The average annual change (plus or minus) in production was 3 MMT, and 2.5 MMT in consumption.

o Production was about twice as variable as consumption, as measured by the standard deviation of year-to-year fluctuations from the statistical trend.

o The largest annual increase in production was 9.2 MMT (1981); the largest decrease, 4.9 MMT (1983).

o The largest annual increase in consumption was 5.1 MMT (1987); the largest decrease, 2.9 MMT (1975).

o Declines in production occurred in 5 of the 24 years (1966, 1979, 1980, 1983, 1985), whereas declines in consumption occurred only twice (1975 and 1980). Much of the 1975 change was likely due to destocking.

The Sugar Price Cycle

Because even incremental changes in the world crop or shifts in government policy tend to have disproportionate effects in a small and residual market, sugar prices are among the most unstable in international trade. In periods of crop failure, governments may temporarily restrict exports to meet domestic needs, thus intensifying the upward movement of the world price. Many countries deal with shortages by rationing sugar. In periods of bumper harvests when output exceeds domestic needs, supplying nations may attempt to sell or "dump" their surpluses on the world market, exerting downward pressure on the world price.

Superimposed on the world sugar market's day-to-day price variability is a broad pattern of high prices for 1-2 years followed by a long period of low prices (fig. 4). The market is characterized by rapid increases, followed by equally rapid declines. The most recent spike occurred in the early 1980's. World sugar production saw two major shortfalls in the 1979 and 1980 crops resulting from bad weather in the USSR, India, and Thailand, sugarcane disease in Cuba, and reduced cane acreage for sugar in Brazil. Stocks fell and prices surged to an average of 41.1 cents in October 1980. Record production and stock buildup lowered prices to 8.4 cents in 1982, and further to 4 cents in 1985. Since 1985, stocks have steadily declined and prices have gradually risen, reaching an average of 12.8 cents in 1989.

Intermittently large investments in world sugar production and government intervention play key roles in the cycles of large price increases followed by low prices. Increases in production capacity during the high-price phase of the sugar cycle take several seasons to be absorbed by relatively steady but slow consumption growth. Processing facilities are expensive to construct and

Figure 4
World sugar price, nominal and real, 1950-89

U.S. cents/lb
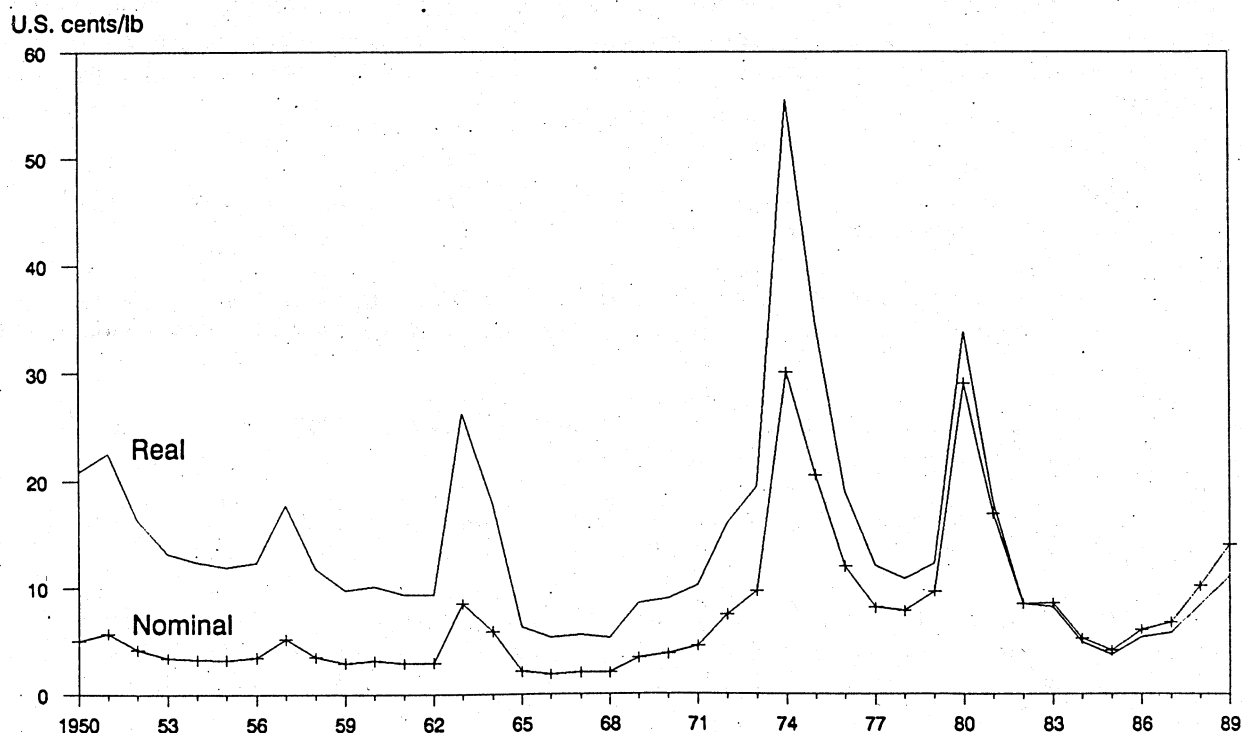
Note: Real price based on GNP deflator, 1982=100.

require large sizes to capture scale economies. Consequently, once in place, there is a strong incentive for plants to be fully utilized to spread out fixed costs. As a result, global sugar production tends to exceed consumption, stocks are built up, and prices fall. After 5-10 years of low prices and slow growth in production, world sugar demand typically approaches or catches up with processing capacity. At this point, a disruption to production could trigger an explosive price rise, and a new sugar cycle begins.

The cycle shows that sugar production responds rapidly to high prices but is much less elastic downward when prices fall. Rapid production increases bring down price spikes within 2 years, but high production levels tend to persist even at depressed prices which are below the cost of production for many exporting countries. Producers are able to maintain output because (1) previously high prices provide a reserve of funds, (2) the true price to the producer is the result of a blend between the "free" market and the higher priced domestic and preferential trade markets, and (3) governments intervene through price support and income programs.

While prices in the world sugar market are expected to continue in a broad cyclical pattern, changes in the structure of the world sugar market could keep the price run-ups below historical peaks. Such changes include:

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o Developing countries account for a much larger and growing percent of global sugar consumption and, with lower incomes than developed countries, are likely to drop out of the market sooner as prices rise.

o Both starch-based (HFSS) and low-calorie sweeteners are now more widely accepted as sugar substitutes. Low-calorie sweeteners, in particular, appear poised to take advantage of sugar shortfalls and high prices.

o Refined beet sugar accounts for a larger percent of trade and its production can respond more quickly than cane sugar to a price rise.

o Brazil's potential to switch sugarcane for processing between sugar or alcohol fuel, while uncertain now, in the future could provide a safety valve for world sugar prices, if Brazil were to make policy changes which favored sugar production.

These factors taken together have tended to stretch out the sugar cycle by moderating price run-ups and extending the period of low prices.

Major Sugar Producers

World sugar production, which averaged 63.85 MMT in 1965-67 (table 3), increased at an average annual rate of 2.3 percent to 103.05 MMT in 1986-88. The top 10 producers (with EC countries treated as a single producer) accounted for about 64 percent of world sugar output in 1965-67 and about 69 percent in 1986-88. Beet sugar accounted for about 43 percent of world production in 1965-67, and about 37 percent in 1986-88. The EC, USSR, United States, and China were the leading beet sugar producers in 1986-88, while India, Brazil, Cuba, Mexico, Australia, the United States, and Thailand were the top cane sugar producers. The share of the industrial market economies in global sugar production was relatively constant at about 30 percent from 1965-67 to 1986-88 (fig. 5). The centrally planned economies have seen their share fall from 35 to 27 percent, while the less-developed countries have increased their share from 37 to 45 percent.

<u>EC</u>

The EC has consistently led world sugar production since the mid-1970's, accounting for almost 15 percent of the world total in 1986-88 with production of 14.96 MMT. Most of the sugar in the EC is produced from sugarbeets, except for a small amount of cane production in Spain, and about 0.5 MMT of cane sugar from the French "DOM" (Departments d'Outre-Mer) countries of French Guiana, Guadaloupe, Martinique, and Reunion. DOM sugar is included in EC sugar statistics for France. Production efficiency varies widely by country, with France, West Germany, and the United Kingdom among the most efficient producers. In France, yields are very high, about 10 metric tons of sugar per hectare compared with a world average of about 4.4 metric tons and a U.S. average of about 6.1 metric tons.

With much smaller farms, EC cultivation practices are much more intensive than in the United States. The pace of research and development has benefited from the high returns to sugar assured under the Common Agricultural Policy (CAP). The relatively low returns to alternative crops, such as oilseeds, also stimulate beet profitability and the returns to research and development. A recent GATT ruling that EC oilseed producer subsidies violate GATT obligations

Table 3--Sugar production by major producing countries

Country 1/	Average 1965-67	Average 1975-77	Average 1986-88	1980	1981	1982	1983	1984	1985	1986	1987	1988
						Million metric tons 2/						
EC 3/	9.20 (2)	12.80 (1)	14.96 (1)	14.53 (1)	16.57 (1)	16.65 (1)	13.69 (1)	14.53 (1)	14.97 (1)	15.11 (1)	14.40 (1)	15.38 (1)
USSR	9.30 (1)	7.89 (2)	9.06 (2)	7.17 (3)	6.41 (4)	7.39 (5)	8.70 (3)	8.59 (3)	8.26 (3)	8.68 (2)	9.55 (2)	8.95 (3)
India	3.16 (6)	5.03 (6)	9.01 (3)	4.53 (6)	5.99 (5)	9.13 (2)	8.45 (4)	6.63 (5)	7.02 (5)	7.59 (4)	9.22 (4)	10.21 (2)
Brazil	4.24 (4)	7.43 (3)	8.38 (4)	8.27 (2)	8.73 (2)	8.94 (3)	9.56 (2)	9.26 (2)	8.46 (2)	8.00 (3)	9.27 (3)	7.87 (5)
Cuba	5.73 (3)	6.51 (4)	7.61 (5)	6.81 (4)	7.93 (3)	8.04 (4)	7.46 (5)	7.78 (4)	7.89 (4)	7.47 (5)	7.23 (5)	8.12 (4)
United States	3.73 (5)	6.05 (5)	6.24 (6)	5.31 (5)	5.79 (6)	5.42 (6)	5.22 (6)	5.34 (6)	5.42 (6)	5.68 (6)	6.63 (6)	6.42 (6)
China	2.39 (7)	1.73 (13)	5.37 (7)	2.80 (8)	3.45 (8)	3.70 (7)	3.90 (7)	4.30 (7)	4.00 (7)	5.70 (7)	5.53 (7)	4.88 (7)
Mexico	2.27 (9)	2.71 (9)	4.01 (8)	2.72 (9)	2.64 (9)	2.74 (10)	3.08 (9)	3.31 (9)	3.49 (8)	4.07 (8)	4.06 (8)	3.91 (8)
Australia	2.31 (8)	3.26 (7)	3.57 (9)	3.42 (7)	3.51 (7)	3.65 (8)	3.26 (8)	3.63 (8)	3.44 (9)	3.44 (9)	3.51 (9)	3.76 (9)
Thailand	.27 (29)	1.78 (12)	2.63 (10)	0.78 (20)	1.70 (13)	3.02 (9)	2.11 (11)	2.55 (11)	2.39 (11)	2.72 (10)	2.53 (10)	2.64 (10)
South Africa	1.43 (12)	2.15 (10)	2.32 (11)	1.78 (11)	1.99 (11)	2.37 (12)	1.58 (15)	2.28 (12)	2.54 (10)	2.25 (11)	2.23 (11)	2.47 (11)
Indonesia	.67 (17)	1.06 (14)	2.19 (12)	1.17 (14)	1.20 (17)	1.59 (16)	1.51 (16)	1.76 (14)	1.70 (13)	2.15 (12)	2.20 (12)	2.21 (12)
Poland	1.70 (10)	1.81 (11)	1.84 (13)	1.16 (15)	1.82 (12)	1.93 (13)	2.14 (10)	1.93 (13)	1.84 (12)	1.88 (13)	1.82 (13)	1.82 (13)
Turkey	.69 (16)	1.00 (15)	1.53 (14)	1.14 (16)	1.21 (16)	1.64 (14)	1.84 (13)	1.65 (15)	1.40 (16)	1.41 (15)	1.78 (14)	1.41 (15)
The Philippines	1.57 (11)	2.76 (8)	1.44 (15)	2.33 (10)	2.38 (10)	2.71 (11)	2.11 (12)	2.58 (10)	1.66 (14)	1.51 (14)	1.30 (15)	1.50 (14)
Japan	.57 (19)	.51 (22)	.95 (19)	.79 (19)	.81 (19)	.82 (22)	.87 (22)	.88 (22)	.93 (21)	.95 (20)	.96 (20)	.94 (20)
World total	63.85	83.87	103.05	84.49	92.76	102.00	97.21	99.41	98.37	100.45	104.01	104.70
Annual top 10 total	40.85	55.47	70.84	57.89	63.40	68.68	65.46	65.95	65.49	68.46	71.93	72.14
						Percent						
Annual top 10 as share of world total	64	66	69	69	68	67	67	66	67	68	69	69

Note: Figures within parentheses denote country rank among all sugar-producing countries or regions.
1/ Ranked by 1986-88 average production.
2/ Raw value.
3/ Data for the countries in the EC-12 for all years.
Source: International Sugar Organization.

Figure 5

Percent share of world sugar production by industrial market economies, centrally planned economies, and less-developed countries

	1965-67	1975-77	1986-88
Less-developed countries	37%	44%	45%
Centrally planned economies	35%	25%	27%
Industrial market economies	28%	31%	28%
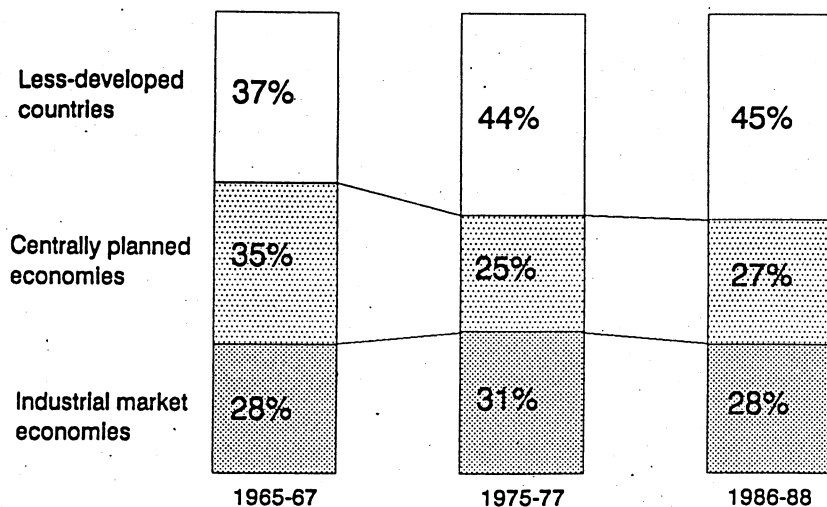
may result in lower returns for some competing oilseed crops, raising the relative profitability of sugarbeets.

EC seed companies have made rapid strides in improving the genetics of beets. EC farmers have largely switched from multigerm to monogerm seed varieties, which remove the need for hand-thinning and make mechanized planting easier. Processors, too, have continually found ways to improve efficiency and extract a higher percentage of sucrose from beets. Sugarbeet factories in the EC are the largest in the world, averaging almost twice the size of U.S. factories, partly due to a shorter processing season.

USSR

Sugar production in the USSR, all from beets, averaged 9.06 MMT in 1986-88. This was almost the same as in 1965-67 when it was the world's largest producer, but up from an average of 7.89 MMT in the mid-1970's.

The USSR lags behind most other beet producers in sugarbeet yield per hectare and recovery rates.[2] Collectivization has tended to constrain individual incentives for efficiency. Furthermore, the extensive size of farm

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   [2] "Recovery rate" is the percent of raw sugar derived from sugarcane or sugarbeets processed. Typically, this is 10 to 12 percent for sugarcane, slightly higher for sugarbeets.

operations, distance from processing facilities, and shortage of
transportation vehicles have impeded the timely delivery of beets for
processing and caused the loss of a great deal of sucrose. Sugar yields are
very low, at about 2.5 to 3 metric tons per hectare. The USSR harvests about
3.4 million hectares of sugarbeets annually, and if it achieved the world
average yield of 4.4 metric tons of sugar per hectare, it would be producing
about 15 MMT of sugar, 6 MMT over current production.

India

India produced 9.01 MMT of centrifugal sugar in 1986-88, all from sugarcane,
making it the world's third largest producer. Production was almost triple
the 1965-67 average of 3.2 MMT, when it ranked sixth. International Sugar
Organization (ISO) statistics do not include locally consumed traditional
sugars, such as gur and khandsari, which account for a significant share of
sugarcane use in some years.

India increased the area planted to cane by 90 percent from 1980 to 1988, but
yields declined by about one-tenth over the same period. Since sugarcane is
planted from cuttings, and growers re-plant from their own fields, investments
in genetic improvements of sugarcane are not easily recaptured in the private
markets. Consequently, most sugarcane research must be government-supported.
Most less-developed countries, including India, have invested relatively less
in research and development to raise productivity than have industrial market
economies producing predominantly beet sugar.

Brazil

Brazil is the world's fourth largest sugar producer, averaging 8.38 MMT in
1986-88, almost double its 1965-67 output. Brazilian sugar production is
profoundly affected by Brazil's ambitious sugarcane-based alcohol fuel program
which was started in the aftermath of the oil price hikes of 1973. Since
1984, over half of the cane grown in Brazil has been used to produce alcohol.
The area devoted to sugarcane rose from 2.6 million hectares in 1980 to 4.5
million hectares in 1988, but most of the increased cane production went for
alcohol.

Cuba

Cuba has been a top sugar producer for most of this century, and its entire
economy depends heavily upon sugar production and exports. Cuba produced 7.61
MMT from sugarcane in 1986-88, ranking fifth in the world.

Labor and managerial problems have reduced output in recent years. Small-
scale, labor-intensive farms have proven to be more efficient than the large
estates where the government has focused its efforts at mechanization. Small
farms, however, produce only 15 percent of Cuba's sugar. Weather problems
have also been a factor in reducing production for the past 4 years.

United States

U.S. sugar production averaged 6.24 MMT in 1986-88, up significantly from 3.73
MMT in 1965-67. Beet sugar averaged just over half of U.S. sugar output in
recent years. Between 1982 (following 1981 farm legislation) and 1988, beet
sugar output rose 44 percent and cane sugar 9 percent, compared with a
declining trend for both beet and cane sugar for the period 1975-82. These

trends correlate with lower levels of government support from 1975-82, and higher levels since then.

From 1982 to 1988, sugarbeet area rose about 27 percent from 254,000 to 321,000 hectares (1.0 to 1.3 million acres), and sugarcane area rose 14 percent, from 175,000 to 200,000 hectares (700,000 to 800,000 acres).

Among the four cane States, Florida and Louisiana have increased production and acreage rapidly since 1982. Texas has only one sugarcane mill and maintained fairly constant production in the 1980's. Hawaii, however, experienced declining area and production over the last decade, a trend most pronounced since 1986. High costs for land, labor, and other inputs are making it difficult for Hawaiian sugar to remain competitive, as alternative uses for sugarcane land, such as golf courses and tourist-related enterprises, have become attractive.

China

China was the world's seventh largest sugar producer over 1986-88, with production averaging 5.37 MMT each year. Production in 1987 and 1988 fell below the record output of 1986. About 20 percent of China's sugar comes from beets in northern provinces, and 80 percent from cane grown in southern, more tropical provinces. The cane share has increased slightly since 1980.

The sugar industry in China has not achieved the degree of modernization and efficiency that many other countries have. For example, the United States has 36 sugarbeet processing facilities compared with China's 133, but the United States can slice about 153,000 metric tons per day, more than double China's maximum. Recovery rates of the sucrose in cane and beets are much lower in China than in many other countries. Political reforms in China rejuvenated parts of the agricultural sector, and small-scale, cash-cropping of sugarcane and sugarbeets has apparently been encouraged, but China still lags considerably behind in sugar production technology.

Mexico

Mexico's sugar production, all from cane, rose from an average of 2.27 MMT in 1965-67 to 4.01 in 1986-88, putting Mexico in eighth place among world sugar producers. The growth in output from the mid-1970's to the late 1980's reflects the resurgence of an industry which was neglected during the "oil boom" years of the late 1970's and early 1980's. The government took over some sugar mills to avoid their collapse, and has provided some assistance to the industry. Land policies have kept average farm size small and economies of scale unrealized, but the government has recently announced intentions to reduce industry regulation, including wholesale privatization.

Australia

Australia produces the most cane sugar of any industrial market economy, and ranked ninth among beet and cane producers in 1986-88, with production averaging 3.57 MMT. Australia's production has grown slowly and steadily in recent decades. In the 1980's, the low profitability of export markets reduced production incentives, but the industry recently raised its sights toward significantly higher production. The cane industry in Australia is among the most technologically advanced in the world, especially in the area of mechanized harvesting.

Thailand

Thailand produces sugar from sugarcane, and has increased sugar production dramatically, moving from 29th in world production in 1965-67 to 10th in 1986-88. Annual production has risen from 0.27 MMT to 2.63, up by a factor of 10 in two decades. Thai producers have imported highly advanced technology from other countries, such as Australia.

Global HFSS Production

The development of HFSS significantly affected the market for sugar in the United States in the 1980's and has potential for major impacts on other countries. In 1988, world output of HFSS was 7.1 MMT, about 6.3 percent of the combined sugar/HFSS market, up from about 3 percent in 1980 and less than 1 percent in 1975 (table 4). The United States accounted for about 75 percent of world HFSS production in 1988. Japan and Canada are the only other major producers, together comprising 14 percent of world output.

The phenomenal growth of HFSS production in the United States is due in part to high U.S. sugar prices, and in part to the stimulus of the two price spikes in 1974/75 and 1979/80. HFSS, with costs of production in the United States around 12 cents a pound, can profitably be priced cheaper than refined sugar, which has been priced at 24-31 cents a pound in recent years (see box, "A Closer Look at Alternative Sweeteners"). Among the ranks of world sweetener producers, in only six countries does sugar production exceed U.S. HFSS production.

The EC has HFSS production quotas set at 292,000 metric tons per year. EC policies effectively prohibit the production of "second-generation" or 55-percent-fructose HFSS, which is more closely substitutable for sugar in liquid applications such as beverages. With quotas strictly allocated by country and no provision for exchanging quotas between countries, economies of scale such as exist in the United States are severely limited. High price supports for corn and other grains in the EC also reduce the potential competitiveness of HFSS. In recent years, HFSS production in the EC has averaged about 20,000-30,000 tons below the quota level.

Japan's HFSS production has grown from 353,000 metric tons in 1980 to 703,000 tons in 1988. In Japan, HFSS does not compete freely with sugar as in the United States, but on the other hand it is not limited by strict quotas as in the EC. Instead, Japanese policy raises the cost of production by requiring HFSS producers to purchase a fixed percentage of domestic potatoes along with imported corn, and by taxing HFSS to support the sugar regime.

Growth of HFSS production will be strongly influenced by sweetener policies in producing countries. Little further increase in HFSS's market share (about 43 percent of the sugar-HFSS total) is expected in the United States until a low-cost crystalline fructose sweetener is developed. Countries as diverse as China, South Africa, Brazil, and Australia are considering modest HFSS production expansion, but there is little chance that the growth of market share in any other country will duplicate the experience of the United States in the decade up to 1985. The potential for large increases in HFSS production lies in the developed countries such as Japan and the EC which have proven production capability but have so far restricted their production.

Table 4--World production of HFSS, and share of world sugar and HFSS consumption, 1975-88

Year	United States	Canada	EC	Other Europe	Japan	South Korea	Other Asia/ Oceania	Latin America	Africa	World total	World sugar consumption	HFSS as share of world sugar and HFSS consumption
	1,000 metric tons 1/											Percent
1975	485	NA	55	NA	107	NA	NA	NA	NA	647	74,330	0.9
1976	715	NA	75	NA	162	NA	NA	NA	NA	952	79,200	1.2
1977	940	NA	87	10	218	NA	NA	NA	NA	1,255	82,600	1.5
1978	1,135	NA	112	15	251	NA	NA	NA	NA	1,513	86,400	1.7
1979	1,450	10	145	15	310	8	1	NA	NA	1,939	90,300	2.1
1980	1,978	42	222	21	353	16	1	3	NA	2,636	88,650	2.9
1981	2,424	85	256	29	511	41	5	11	NA	3,362	89,910	3.6
1982	2,820	110	260	52	579	69	8	21	NA	3,919	93,970	4.0
1983	3,270	140	259	83	583	95	15	82	NA	4,527	94,080	4.6
1984	3,895	180	273	88	631	133	30	82	NA	5,312	96,800	5.2
1985	4,729	210	287	107	680	144	51	96	NA	6,304	97,950	6.0
1986	4,860	245	267	110	675	153	69	101	NA	6,480	100,940	6.0
1987	5,121	245	265	118	717	192	81	107	NA	6,846	106,030	6.1
1988	5,314	270	266	123	703	226	94	114	15	7,125	106,140	6.3

NA = Not available or no production.

1/ Dry basis.

Sources: Landell Mills Commodities Studies, Ltd.; Sweetener Analysis, various issues; and International Sugar Organization.

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A Closer Look At Alternative Sweeteners

The proliferation of alternative sweeteners over the last 15 years radically altered the conventional process of producing and distributing sweeteners, caused the reformulation of many food and beverage products, and reshaped the sugar industry.

There are three major categories of alternative sweeteners. High fructose starch sweeteners (HFSS) are derived from corn, wheat, potatoes, or other sources of starch. This category includes high fructose corn syrup (HFCS), the predominant starch sweetener in the United States and most other countries. The low-calorie or high-intensity sweeteners, such as saccharin, aspartame, cyclamate, and acesulfame-K, are many times as sweet as sugar per unit weight. The third category includes crystalline forms of fructose, which are not yet significant in market share, but may have a strong potential for growth.

Beginning in the last century, corn sweeteners (dextrose and glucose corn syrup) were developed for human consumption, but their market share was restricted because their "sweetness profile" was not competitive with sugar. In the 1960's, 42-percent-fructose corn syrup, or HFCS-42, began to substitute for liquid sugar. The development of 'second generation' HFCS or HFCS-55 in the late 1970's created a more powerful competitor for liquid sucrose.

HFSS, in the several countries where it is used, has been substituted for beet and cane sugar in a wide range of processed food products where liquid application is acceptable, such as beverages, baked goods, dairy products, and jams and jellies since its commercial introduction in 1972. Beverages, mostly soft drinks, account for over 70 percent of HFSS consumption in the United States, and over 90 percent of HFSS-55. Production of HFSS is a very capital-intensive process in which the basic ingredient (corn, wheat, or other) is wet-milled into starch and then further processed into one of a variety of sweeteners or into alcohol. When the input is corn, as in the United States, corn oil, corn gluten feed, and corn gluten meal are the three major byproducts.

Because it is in liquid form, HFSS is particularly suitable as a sweetener for soft drinks. However, HFSS also has a number of disadvantages and limitations. Its liquid form means it is confined to certain industrial uses. With its higher water content, HFSS also costs more to transport than an equivalent amount of sugar. Further, HFSS is more difficult to handle, since it must be maintained at 80 to 100 degrees F temperature when stored or transported.

To the extent it has been able to compete with sugar in particular uses, HFSS has dominated because of modern, automated, and efficient production facilities. Also, HFSS facilities can be operated year-round compared with 3- to 5-month seasonal operations for beet factories and most cane mills. HFSS supplies are more reliable and predictable, and prices are less volatile than sugar. While consumption of low-calorie sweeteners is growing, for the most part, low-calorie sweeteners have not substituted for sugar or HFSS, as much as created their own market niche. However, lower prices and improved quality could lead eventually to direct competition with caloric sweeteners, particularly with HFSS use in beverages.

Major Sugar Consumers

Population and income growth and the increased use of substitute sweeteners, mainly HFSS, are the dominant forces behind sugar consumption changes. In many developed nations, sweetener use has reached near-saturation levels. This fact, combined with slow population growth and typically high government-controlled consumer prices, has implied a slow or stagnant growth in sugar demand. High price policies for sugar have stimulated the development of substitutes, such as HFSS and low-calorie sweeteners (see box).

Reflecting these trends, the share of world consumption of the industrial market economies dropped from 45 to 26 percent from the mid-1960's to the late 1980's, as shown in figure 6, while the share of less-developed countries rose from 28 to 47 percent.

The USSR, the EC, the United States, and Japan rank among the 1986-88 period's top 10 sugar-consuming countries (table 5). The USSR led the world in per capita sugar consumption with an average of 48.7 kilograms (table 6). Total USSR consumption averaged 13.8 MMT, about 13 percent of world consumption. Sugar use for illegal home distilling increased after 1986, when the government restricted vodka sales as part of a now-defunct campaign against alcoholism, but sugar rationing introduced in 1988 probably reduced per capita consumption.

Figure 6

Percent share of world sugar consumption by industrial market economies, centrally planned economies, and less-developed countries

	1965-67	1975-77	1986-88
Less-developed countries	28%	47%	47%
Centrally planned economies	27%	21%	27%
Industrial market economies	45%	32%	26%
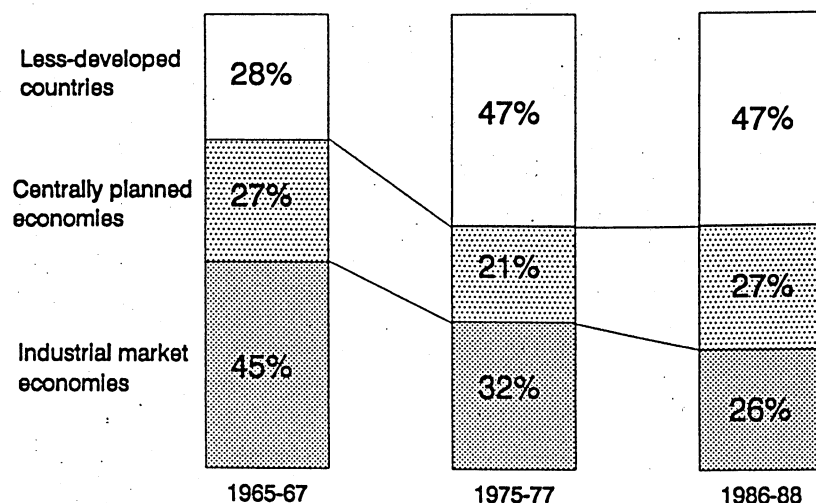
Table 5--Sugar consumption by major consuming countries

Country 1/	Average 1965-67	Average 1975-77	Average 1986-88	1980	1981	1982	1983	1984	1985	1986	1987	1988
						Million metric tons 2/						
USSR	8.98 (3)	8.68 (3)	13.82 (1)	12.75 (1)	12.72 (1)	13.00 (1)	13.09 (1)	13.20 (1)	12.61 (1)	13.40 (1)	14.10 (1)	13.95 (1)
EC 3/	11.10 (1)	11.70 (1)	12.12 (2)	12.40 (2)	12.09 (2)	12.19 (2)	11.94 (2)	12.07 (2)	12.02 (2)	12.21 (2)	11.92 (2)	12.24 (2)
India	2.83 (5)	3.03 (5)	9.53 (3)	5.04 (5)	5.95 (4)	6.71 (4)	7.18 (4)	8.24 (3)	8.97 (3)	8.69 (3)	9.73 (3)	10.18 (3)
China	2.53 (6)	2.33 (6)	7.40 (4)	3.60 (6)	4.10 (6)	5.00 (6)	5.50 (6)	5.70 (6)	6.35 (5)	6.70 (5)	7.50 (4)	8.00 (4)
United States	9.40 (2)	9.83 (2)	7.31 (5)	9.33 (3)	8.96 (3)	8.31 (3)	8.07 (3)	7.74 (4)	7.29 (4)	7.09 (4)	7.41 (5)	7.43 (5)
Brazil	2.86 (4)	3.79 (4)	6.47 (6)	6.26 (4)	5.87 (5)	6.10 (5)	5.91 (5)	6.20 (5)	6.08 (6)	6.59 (6)	6.57 (6)	6.24 (6)
Mexico	1.56 (8)	1.97 (8)	3.73 (7)	3.15 (7)	3.26 (7)	3.51 (7)	3.24 (7)	3.34 (7)	3.55 (7)	3.45 (7)	3.66 (7)	4.07 (7)
Japan	2.13 (7)	2.02 (7)	2.78 (8)	2.98 (8)	2.75 (8)	2.92 (8)	2.78 (8)	2.75 (8)	2.89 (8)	2.74 (8)	2.69 (8)	2.91 (8)
Indonesia	.63 (11)	.98 (10)	2.32 (9)	1.55 (9)	1.80 (9)	1.85 (9)	1.86 (10)	1.73 (10)	1.79 (9)	2.12 (9)	2.30 (9)	2.55 (9)
Pakistan	.50 (15)	.47 (15)	1.91 (10)	.78 (22)	.95 (19)	1.10 (15)	1.20 (15)	1.30 (14)	1.40 (12)	1.75 (10)	2.01 (10)	1.98 (10)
Poland	1.20 (9)	1.20 (9)	1.78 (11)	1.53 (10)	1.35 (10)	1.72 (10)	1.87 (9)	2.01 (9)	1.69 (10)	1.65 (12)	1.85 (11)	1.85 (11)
Egypt	.51 (14)	.59 (14)	1.69 (12)	1.12 (14)	1.34 (11)	1.45 (11)	1.55 (11)	1.60 (11)	1.60 (11)	1.65 (11)	1.65 (13)	1.78 (13)
Turkey	.53 (13)	.78 (13)	1.56 (13)	1.10 (16)	1.12 (15)	1.33 (12)	1.33 (13)	1.43 (12)	1.35 (14)	1.48 (13)	1.66 (12)	1.53 (12)
South Africa	.82 (10)	.95 (11)	1.41 (14)	1.29 (11)	1.30 (12)	1.33 (13)	1.34 (12)	1.33 (13)	1.37 (13)	1.38 (14)	1.43 (15)	1.42 (14)
The Philippines	.55 (12)	.89 (12)	1.28 (15)	1.21 (13)	1.13 (14)	1.07 (16)	1.21 (14)	1.28 (15)	1.34 (15)	1.18 (17)	1.44 (14)	1.22 (15)
World total	59.77	78.76	104.37	88.65	89.96	93.97	94.08	96.80	97.95	100.94	106.03	106.14
Annual top 10 total	43.40	45.53	67.39	58.59	58.85	61.31	61.44	62.98	63.24	64.74	67.89	69.55
						Percent						
Annual top 10 as share of world total	73	58	65	66	65	65	65	65	65	64	64	66

Note: Figures within parentheses denote country rank among all sugar-consuming countries or regions.
1/ Ranked by 1986-88 average consumption.
2/ Raw value.
3/ Data for the countries in the EC-12 for all years.
Source: International Sugar Organization.

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Table 6--World per capita sugar consumption by region, 1965-88

Year	United States	Central and South America 1/	Europe	USSR	Africa	Asia	Japan	Oceania 2/	World
			Kilograms 3/						
1965-67	47.9	33.8	38.0	44.4	10.8	6.6	20.7	55.9	18.6
1975-77	44.8	40.8	40.3	45.8	13.4	8.7	27.4	48.1	20.2
1986-88	29.9	42.8	41.8	48.7	14.7	11.6	22.8	43.9	20.9

1/ Includes Mexico.
2/ Heavily weighted by Australia.
3/ Raw value.
Source: International Sugar Organization.

U.S. per capita consumption fell 60 percent from 1965-67 to 29.9 kilograms in 1986-88, and total U.S. sugar consumption fell about 22 percent, primarily because of substitution by high fructose corn sweeteners. Overall U.S. caloric sweetener consumption per capita, on the other hand, rose over the period. In Europe, per capita sugar consumption grew from 38 kilograms in 1965-67 to 42 kilograms in 1986-88. After rising through the 1970's, per capita consumption of sugar in Japan fell about 20 percent to 22.8 kilograms in 1986-88 from 27.4 kilograms in 1975-77.

Most of the recent increases in world sugar consumption have taken place in the developing countries, reflecting high rates of population growth and rising incomes, particularly in Asia. In countries with low per capita incomes, sugar consumption often is very responsive to income changes, though more so when income rises than when it falls. The International Monetary Fund has persuaded some less-developed countries to raise previously low sugar prices as part of austerity programs required for new loans.

Government price policies also have a strong influence on less-developed countries' sugar consumption. In Thailand, for example, the government maintains high consumer prices which have dampened consumption growth. In contrast, Cuba has kept consumer prices low, so that per capita consumption is above 68 kilograms.

Among the top 10 consuming countries, India, China, Brazil, Mexico, Indonesia, and Pakistan are developing countries. The trend of less-developed countries increasing their share of world sugar consumption is expected to continue into the 1990's and is a major factor in shaping world sugar trade.

In Africa, per capita sugar consumption rose 24 percent from the mid-1960's to the mid-1970's, and then rose slightly to 14.7 kilograms in 1986-88, well below the world average of 21 kilograms. Africa has a large potential for increased sugar consumption, both on a per capita and total basis, if income growth increases.

In Central and South America, per capita consumption has risen along with incomes to 42.8 kilograms, about double the world average. Relatively low consumer prices partly account for the very high level of sugar consumption.

Per capita sugar consumption in Asia almost doubled over the last two decades to 11.6 kilograms in 1986-88, partly due to the rapid economic growth of the region. Consumption by Asian countries, however, was still only about half the world average due to dietary preferences and relatively low incomes. Rapid economic growth in the region is expected to result in continued increases in per capita consumption in the future.

Global Sugar Trade

World sugar trade rose steadily from the 1960's until 1982, when exports peaked at about 30 MMT, and then fell to about 27 MMT in 1988. This declining trend in the 1980's was partly the result of policies aimed at self-sufficiency in sugar among a large number of countries.

Sugar is among the most heavily traded agricultural commodities. In 1986, about 28 percent of world sugar production was traded, compared with 3 percent of paddy rice, 18 percent of wheat, and 12 percent of corn (table 7). Among the commodities included in table 7, only soybeans (29 percent) and coffee (81 percent) had a higher proportion traded. By volume, the 28 MMT of sugar traded in 1986 was exceeded only by wheat (96 MMT) and corn (58 MMT).

<u>Major Exporters</u>

The top 10 sugar exporters in 1986-88--Cuba, EC, Australia, Brazil, Thailand, South Africa, Mauritius, Mexico, Dominican Republic, and Swaziland--accounted for about 80 percent of world exports (table 8). In 1965-67, the top 10 exporters counted for only 61 percent of world exports. Industrial market economies increased their export market share from 17 percent in 1965-67 to 34 percent in 1986-88 (fig. 7). Centrally planned economies and less-developed countries each had about 41-42 percent of the export market in 1965-67, but slid to 29 percent and 37 percent, respectively, by 1986-88.

Cuba averaged about 25 percent of world exports in 1986-88, with annual exports of about 6.7 MMT of raw sugar. Before the 1959 revolution, Cuban raw sugar exports went mostly to the United States. Since 1961, however, the USSR has received the bulk of Cuban exports (see box, Special Arrangements). The remainder has gone to Eastern bloc countries such as Bulgaria and East Germany, and in recent years, China. Cuba appears to be shifting a larger percentage of its exports to destinations outside its traditional centrally planned economy trading partners. These exports, purchased primarily by capitalist countries, provide an important source of hard currency. The USSR purchased Cuban sugar at prices estimated at about 35 cents a pound in recent years, at official ruble/dollar exchange rates. With the world price ranging from 4 to 16 cents a pound since 1982, Soviet purchases have amounted to a form of foreign aid for Cuba. However, the Soviet currency is not convertible and is often considered to be worth only about one-fourth of the official exchange rate. The USSR also pays for much of its Cuban sugar with direct exchange of products, making the true value of payment difficult to estimate.

Until the mid-1970's the EC was one of the world's largest sugar importers. Under the Common Agricultural Policy, however, the EC emerged as a major exporter in the 1980's. The EC exports refined sugar, using export subsidies

Table 7--World trade as a percent of production for various crops, 1986

Commodity	World production	World exports	Exports as share of world production
	-- 1,000 metric tons --		Percent
Coffee, green	5,188	4,201	81
Soybeans	95,521	27,635	29
Sugar, centrifugal	100,090	28,171	28
Tobacco	6,109	1,301	21
Wheat	535,842	95,730	18
Corn	480,609	57,477	12
Cereals, total	1,867,116	202,868	11
Rice, paddy	475,533	12,156	3
Potatoes	308,548	5,540	2

Source: Food and Agriculture Organization of the United Nations.

Figure 7

Percent share of world sugar exports by industrial market economies, centrally planned economies, and less-developed countries
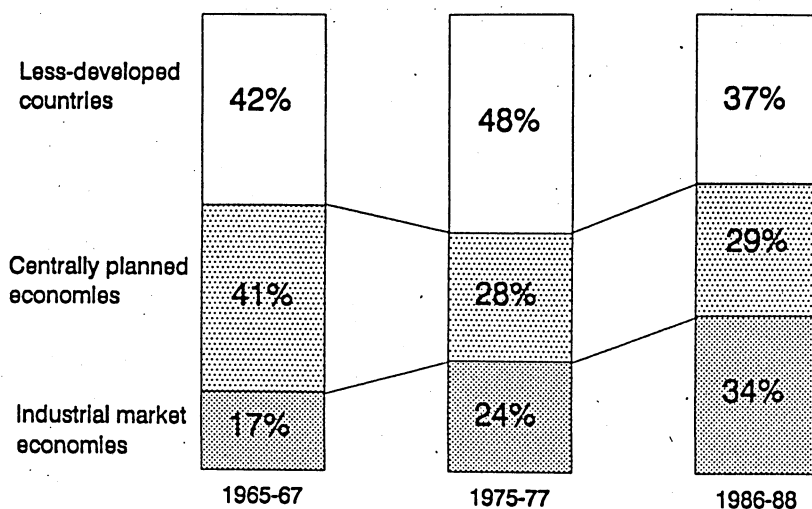
Table 8--Sugar exports by major exporting countries

Country 1/	Average 1965-67	Average 1975-77	Average 1986-88	1980	1981	1982	1983	1984	1985	1986	1987	1988
					Million metric tons 2/							
Cuba	5.11	5.91	6.72	6.19	7.07	7.73	6.79	7.02	7.21	6.70	6.48	6.98
EC-12 3/	1.10	1.78	4.92	4.34	5.42	5.61	4.91	4.39	4.28	4.37	5.48	4.92
Australia	1.52	2.52	2.84	2.41	2.98	2.50	2.43	2.59	2.65	2.71	2.83	2.98
Brazil	.94	1.82	2.19	2.66	2.67	2.79	2.80	3.04	2.61	2.55	2.42	1.61
Thailand	.06	1.16	2.03	.46	1.15	2.04	1.41	1.44	1.78	2.05	2.07	1.96
South Africa	.61	1.02	.96	.79	.74	.88	.57	.69	1.03	.87	1.11	.91
Mauritius	.59	.57	.68	.65	.46	.63	.64	.56	.57	.66	.70	.69
Mexico	.55	.08	.58	.00	.00	.02	.02	.00	.07	.22	.52	1.01
Dominican Republic	.59	1.03	.53	.79	.86	.85	.96	.89	.72	.48	.59	.53
Swaziland	.13	.21	.45	.32	.34	.34	.37	.39	.38	.50	.44	.40
United States	.02	.10	.43	.59	.95	.05	.20	.30	.36	.41	.59	.30
Guatemala	.05	.27	.35	.21	.23	.22	.40	.30	.29	.37	.30	.39
Czechoslovakia	.45	.16	.24	.19	.21	.15	.12	.23	.25	.35	.24	.13
World total	19.03	23.95	27.52	26.83	29.14	30.43	28.98	28.49	27.75	27.17	28.24	27.14
Annual top 10 total	11.60	16.31	21.91	19.20	22.64	23.59	21.28	21.31	21.59	21.30	22.79	21.99
					Percent							
Annual top 10 as share of world total	61	68	80	72	78	78	73	75	78	78	81	81

1/ Ranked by 1986-88 average exports.
2/ Raw value.
3/ Data for the countries in EC-12 for all years.
Source: International Sugar Organization.

except in years when world prices are high. The expansion of EC exports was the primary factor in growth of refined sugar exports after the mid-1970's. Refined sugar trade almost doubled from the mid-1970's to the mid-1980's, but has since stabilized at about 10 MMT per year. Major destinations for EC refined sugar are the oil-exporting Middle Eastern countries, North African countries, and sometimes centrally planned countries (table 9).

Australia exported about 2.8 MMT each year in the late 1980's, and has a comparative advantage in shipping sugar to the Far East and Oceania. China, Japan, South Korea, Malaysia, Singapore, and the USSR have been important destinations of Australian raw sugar in recent years. Exports to the United States have been curtailed since 1981 by reductions in the Australian quota, but shipments to Canada have continued at 0.3 to 0.5 MMT in the 1980's.

Brazil was the fourth largest sugar exporter in 1986-88, averaging just over 2 MMT per year. In recent years, about 50 percent of its exports have been refined sugar, making it the world's second leading exporter of refined sugar after the EC. Brazil has a comparative advantage in shipping to North American and many Caribbean and Latin American destinations. In recent years, Brazil shipped about 500,000 metric tons of sugar (both refined and raw) per year to the USSR (table 9). Significant quantities of refined sugar have also gone to the Middle East.

Thailand's sugar exports grew rapidly into the mid-1970's, reached a plateau, and then grew rapidly again in the late 1980's. In 1989, Thailand exported over 4 MMT. Thailand has a transportation advantage in the fast-growing Asian import market, and is emerging as an important exporter of refined sugar.

Among other major exporters, the Philippines was among the top five sugar exporters until 1981, but slipped to 18th in 1986. The larger U.S. sugar quota in 1988 and 1989 and higher world prices prompted a boost in production. Exports of about 145,000 metric tons in 1988 were below the levels of the 1970's. Swaziland, Zimbabwe, and Mauritius are among a large number of other significant less-developed country exporters.

Among the less-developed country sugar exporters are some which would not compete well in a free-trade environment, even if prices were higher. Prominent among this group are some Caribbean countries which have a share of both the EC's Lomé sugar import quotas and the U.S. sugar import quota.

Major Importers

The last 30 years have witnessed the decline in importance of sugar imports in the industrial market economies, and the growth of sugar imports by the centrally planned economies and less-developed countries, a trend which is also noticeable for other agricultural commodities such as wheat. The industrial market economies' share of world sugar imports fell from 57 to 25 percent from 1965-67 to 1986-88 (fig. 8) while the less-developed countries' share rose from 23 to 44 percent and the centrally planned countries' share rose from 19 to 31 percent.

Sugar imports by the USSR more than doubled from an average of 2.2 MMT in 1965-67 to 4.8 MMT in 1986-88. To supply rapidly rising per capita consumption, China's imports swelled to 2.4 MMT from only 0.5 MMT in 1965-67 (table 10). The USSR and China together represent about 27 percent of world imports in 1986-88, up from about 15 percent in the mid-1960's. Because the

Table 9--Leading sugar exporters and major destinations of their exports, 1986-88 average

Destination	Leading exporters				
	Cuba	EC-12	Australia	Brazil	Thailand
	1,000 metric tons				
Algeria	NA	302	NA	117	NA
Bulgaria	301	NA	NA	NA	NA
Canada	122	NA	497	NA	NA
China	773	NA	471	120	667
East Germany	NA	NA	NA	NA	NA
Egypt	NA	390	NA	NA	NA
German Democratic Republic	298	NA	NA	NA	NA
India	NA	212	NA	178	NA
Iran	NA	308	NA	160	NA
Iraq	NA	NA	NA	249	NA
Israel	NA	226	NA	NA	NA
Japan	377	NA	638	NA	436
Korea, South	NA	NA	371	NA	397
Malaysia	NA	NA	451	NA	NA
New Zealand	NA	NA	83	NA	NA
Nigeria	NA	389	NA	132	NA
Romania	162	NA	NA	NA	NA
Saudi Arabia	NA	252	NA	NA	NA
Singapore	NA	NA	118	NA	NA
Syria	NA	244	NA	NA	NA
USSR	3,730	NA	117	427	119
United States	NA	NA	81	129	NA
Yemen	NA	214	NA	NA	NA
Total	6,718	4,924	2,839	2,467	2,027
	Percent				
Exports as share of world exports	24	18	10	9	7

Note: Only top group of destinations is listed for each exporter, as follows: top seven for Cuba, top nine for the EC-12, top nine for Australia, top eight for Brazil, and top four for Thailand.
NA = Destination not in the top group.
Source: International Sugar Organization.

USSR and China are "command economies," their increased role in world sugar trade implies the potential for greater instability of purchases and arbitrary price changes.

Among the industrial market economies, the United States fell from being the world's largest sugar importer in the 1960's to fifth place in 1986-88, as imports fell from over 4 MMT to under 1.5 MMT. Fears about U.S. sugar import needs falling to zero have largely disappeared, at least in the short run, as

Figure 8

Percent share of world sugar imports by industrial market economies, centrally planned economies, and less-developed countries
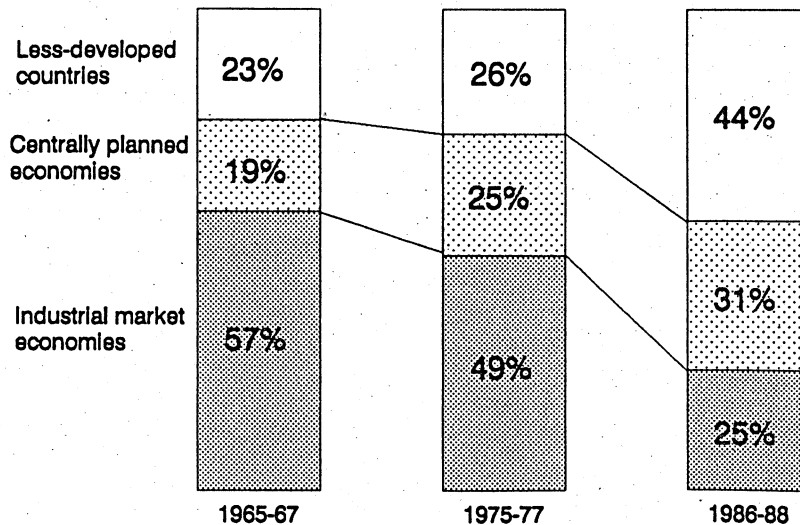
the last two U.S. sugar crops have suffered weather and disease problems and imports have risen from lows of 1 MMT in 1987 and 1988.

The EC switched from being a net importer to a net exporter over the last two decades, while Japan maintained imports at just under 2 MMT. Canada imports about 1 MMT per year.

Less-developed countries account for almost half of the world's sugar imports, but most less-developed countries import relatively small amounts. South Korea ranked highest among less-developed country importers and was in seventh place globally in 1986-88, due to a large refining industry which imports raw sugar and exports refined sugar. Some less-developed countries which have traditionally imported sugar, such as India and Pakistan, have now virtually achieved self-sufficiency, and in a given year may import or export depending on weather effects on production.

Global Sweetener Policies

Government involvement in the sugar market has a long history going back to the age of mercantilism and the establishment of colonial plantation economies. The policies of major sugar exporters and importers are summarized in tables 11 and 12. Almost all national governments intervene in the sugar trade, not only because sugar is a staple commodity that is used in a wide array of manufactured products, but also because of its sizable investment

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Table 10--Sugar imports by major importing countries

Country 1/	Average 1965-67	Average 1975-77	Average 1986-88	1980	1981	1982	1983	1984	1985	1986	1987	1988
						Million metric tons 2/						
USSR	2.20	3.92	4.87	4.98	5.20	7.36	6.00	5.70	4.48	5.17	5.06	4.37
China	.53	.87	2.42	.95	1.19	2.56	1.78	1.35	2.21	1.10	2.20	3.95
Japan	1.57	2.62	1.84	2.33	1.64	2.24	1.87	1.90	1.99	1.82	1.78	1.92
EC-12 3/	2.80	2.50	1.75	1.76	1.66	1.89	1.88	1.91	1.95	1.83	1.74	1.68
United States	4.03	4.34	1.44	3.80	4.65	2.39	2.67	3.02	2.27	1.80	1.22	1.31
Canada	.88	1.06	1.05	.91	.91	.91	1.00	1.05	1.16	1.28	.92	.96
Korea, South	.08	.37	1.03	.80	.76	.71	.78	.84	.90	.97	1.03	1.09
Malaysia	.17	.38	.73	.51	.46	.46	.56	.58	.62	.66	.67	.85
Egypt	.27	.23	.72	.47	.69	.78	.91	.90	.71	.74	.67	.75
Pakistan	.11	.01	.71	.16	.00	.00	.00	.02	.04	.75	.42	.96
India	.00	.00	.68	.20	.23	.00	.00	.39	1.78	1.05	.94	.05
Iran	.28	.41	.50	.79	.70	.47	.62	.61	.63	.65	.58	.28
World total	17.66	23.05	27.14	26.75	28.22	29.60	27.74	28.06	26.56	27.12	27.54	26.76
Annual top 10 total	12.85	16.70	16.86	17.82	18.51	20.42	18.59	17.87	18.08	16.52	16.23	17.84
						Percent						
Annual top 10 as share of world total	73	72	62	67	66	69	67	64	68	61	59	67

1/ Ranked by 1986-88 average imports.
2/ Raw value.
3/ Data for the countries in the EC-12 for all years.
Source: International Sugar Organization

Table 11--Policies of major sugar exporters

Country or region	Price or production policies	Trade policies
EC	Fixed prices to consumer and producer. Production quotas by country and producer. Restriction of substitutes.	Variable levies on imports. Variable subsidies on exports. Guaranteed imports of 1.4 million metric tons from African, Caribbean, and Pacific countries.
Australia	Fixed domestic prices. Production quotas. Marketing board regulation.	Pooled pricing of export and domestic sales by government board. Ban on imports (ended July 1, 1989) replaced by tariff. Government board controlled exporting until 1989.
South Africa	Industry-controlled price stabilization program.	Sales by industry board.
Brazil	Minimum producer prices. Regional production subsidies.	Government control of exports until 1989. Currently, exports private, but subject to government license to assure adequate domestic supply.
Thailand	High domestic prices.	Government control of exports.
The Philippines	Regulated producer, consumer prices.	Government regulation.
Dominican Republic	Government control of production.	None.
Cuba	Administered prices. Government control of milling.	Government sales. Export commitments to USSR and Council for Mutual Economic Assistance countries.

Sources: Hoff and Lawrence, Sturgiss and others.

Table 12--Policies of major sugar importers

Country or region	Price or production policies	Trade policies
Soviet Union	Government control of prices.	Government purchases. Special arrangement with Cuba.
United States	Price supports for beet and cane processors and growers.	Import quotas. Duties and fees.
Japan	Fixed producer/consumer prices. Taxes on HFSS production.	Tariffs, surcharges, and variable levies on imports. Long-term contracts for some imports.
China	Administered prices.	Government purchases.
India	Fixed producer price for cane. Fixed consumer price on part of sales.	Government control of trade.
Canada	Government support for sugarbeet growers (not processors).	None

Sources: Hoff and Lawrence, Sturgiss and others.

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requirements and role in generating employment and foreign exchange. However, the global impacts of extensive protection have narrowed the scope of the world free market, caused world prices to be more unstable, and impeded the potential for rapid adjustment of supply and demand to price signals. As a result, resources tend to be diverted from their comparative advantage, at a great cost in efficiency and overall social welfare.

Few producers or consumers face a freely determined market price for sugar in making production or consumption decisions. The most significant policies are those which contribute to a lower world price by keeping producer prices high and insulated from the world price. While the desire for self-sufficiency in sugar has been almost universal, achieving this goal has not been possible for all countries, in part because it can be very expensive. The industrial market economies have had a remarkable increase in self-sufficiency in the last three decades, with the production/consumption ratio rising from 0.67 in 1965-67 to 1.07 in 1986-88 (table 13). The less-developed countries and the centrally planned economies, on the other hand, have become net importers over the same period; the less-developed country self-sufficiency ratio fell from 1.38 to 0.95, and the centrally planned countries ratio fell from 1.42 to 0.98.

These shifts are more the result of government policies than changes in costs or comparative advantage, and the evidence from comparative costs of production is that these trends have resulted in a shift of production away from lower cost producers. The less-developed countries and centrally planned economies do not have the income, either from national treasuries or consumers, to support sugar industries to the extent observed in many industrial market economies. The international lending agencies have mostly stopped lending money for sugar processing facilities, after substantial investments in the mid-1970's.

Industrial Market Economies

The policies of the major industrial market economies work largely to protect domestic sugar industries, with some exceptions. On balance, these policies lower the world sugar price to the benefit of large importers such as the Soviet Union and China which have each imported more than 1 million metric tons a year from the "free market" in recent years. A country importing 1 million metric tons saves approximately $110 million on its import bill for each 5-cent decline in the world price, and some researchers have found that industrial market economy sugar policies have depressed prices by at least that amount in recent years (Wong and others).

United States

Comprehensive regulation of domestic sugar production, imports, and prices ceased when the 40-year old U.S. Sugar Act expired at the end of 1974. Government intervention reappeared to provide protection from low world sugar prices in 1977, 1978, and 1979 price-support programs. The Agriculture and Food Act of 1981 provided price support for part of the 1981 crop and for the 1982 through 1985 crops. The Food Security Act of 1985 provides protection for the 1986 through 1990 crops.

Table 13--Sugar self-sufficiency ratios, 1965-88 1/

Country/region	1965-67	1975-77	1986-88
Industrial market economies:			
EC-12 2/	0.83	1.09	1.23
United States	.40	.62	.85
Japan	.27	.25	.34
Total 3/	.67	.93	1.07
Less-developed countries:			
India	1.12	1.66	.95
Brazil	1.48	1.96	1.30
Mexico	1.46	1.38	1.08
Indonesia	1.06	1.08	.94
Total 4/	1.38	1.00	.95
Centrally planned economies:			
USSR	1.04	.91	.66
China	.94	.74	.73
Poland	1.42	1.51	1.03
Total 3/	1.42	1.29	.98

1/ Ratio of production to consumption.
2/ Data for EC-12 countries for all years.
3/ See table 1 for list of countries.
4/ Calculated as world minus industrial market economies' and centrally planned economies' totals.
Source: International Sugar Organization.

Nonrecourse loans are set by legislation to provide a floor price for sugar. Since sugarbeets and sugarcane are not "storable" commodities, the Commodity Credit Corporation (CCC) gives loans to the processors (not growers) of sugarcane and sugarbeets, with the sugar used as collateral. Loans are given only to processors who agree to pay growers at least a minimum price, established annually for each region by the USDA, for sugarcane or sugarbeets. In the case of a default, the processor would forfeit the sugar to the CCC without penalty. The loans are nonrecourse because the government has no option but to accept forfeiture as full satisfaction of the loan obligation, including the accumulated interest, regardless of the price of sugar at the time of default.

The 1985 Act specifies the minimum national nonrecourse loan rate for sugarcane at 18 cents a pound for raw cane sugar. Sugarbeets are to be supported at a level that is "fair and reasonable" in relation to the loan rate for sugarcane. This rate has usually run about 3 cents above the loan level for sugarcane.

To minimize the risk of the CCC acquiring sugar, a market stabilization price (MSP) is established. This price represents a price for raw sugar at which commercial sales would be more profitable than forfeiture of sugar used as

collateral for loans from the CCC. The market stabilization price is not a part of the legislation, but an administrative aid developed to carry out the legislation. For fiscal 1989, the market stabilization price was 21.80 cents a pound and actual market prices in New York averaged 22.49 cents (including insurance and freight charges). The fiscal 1990 market stabilization price is 21.95 cents per pound.

To get U.S. prices up to the market stabilization price, USDA estimates the domestic demand for sugar in the U.S. market and then utilizes a restrictive country-by-country import quota to control the total supply. No limit is placed on domestic production. Without the quota, low-priced sugar in the world market would flood the U.S. market and lower the U.S. price below the market stabilization price.

After 1974 and before May 1982, duties and fees were used to raise the U.S. sugar price to the desired level. However, the duty could not exceed 50 percent of the price of the U.S. sugar imports. When world prices plunged, tariffs could no longer assure achievement of the market stabilization price and restrictive country-by-country quotas were imposed. Today, only a nominal duty exists, at the legal minimum of 0.625 cent a pound. Fees are zero for raw sugar and 1 cent a pound for refined. With the restrictive quota in place, the duty and fee do not affect the price of U.S. sugar but serve to capture some of the price premium of sugar marketed in the United States. Most nations eligible to ship sugar to this country receive duty-free status under the Generalized System of Preferences (GSP), the Caribbean Basin Economic Recovery Act, (popularly known as the Caribbean Basin Initiative, or CBI) or both. All countries are subjected to the fee on refined sugar, little of which is imported except from Canada.

Allocation of the quota to about 40 individual countries is generally based on their share of the U.S. market during 1975-81 when imports were relatively unrestricted. Some changes have been made since the quotas began in 1982, such as the exclusion of South African sugar since the enactment of the Comprehensive Anti-Apartheid Act of 1986.

Government support for U.S. sugar producers takes the form of an enforced minimum market price, which places almost all of the cost of producer support on consumers. This is in sharp contrast to programs for many other U.S. crops, in which producer support comes from direct government payments and consumers pay a market-determined price. In a sense, consumers pay for the U.S. sugar program, whereas taxpayers pay for many of the other agriculture programs.

A measure of the amount of government support for any commodity in any country can be obtained by comparing domestic and world prices. Using this approach, about 63 percent of total U.S. sugar producer revenue is due to the government-determined market price (table 14). The estimates in tables 14 and 15 include transfers to sugar farmers (producers) only, not processors. In contrast, for 12 other major U.S. commodities, market price supports account for an average of 11 percent of revenue. The estimated annual dollar value of support for sugar producers due to government intervention over 1982-87 was about $1.1 billion (table 15). (See also Barry and others on government program effects.)

Table 14--Types of government support, U.S. sugar and major commodities, 1982-87 average

Type of support	Sugar		12 major commodities	
	Share of total support	Share of total revenue	Share of total support	Share of total revenue
	Percent			
Direct payments	0	0	28	7
Market price supports	92	63	40	11
Other transfers	8	5	32	8
Total transfers	100	68	100	26

Source: Webb, Lopez, and Penn.

Table 15--Transfers to U.S. sugar producers and all farmers due to government policies, 1982-87

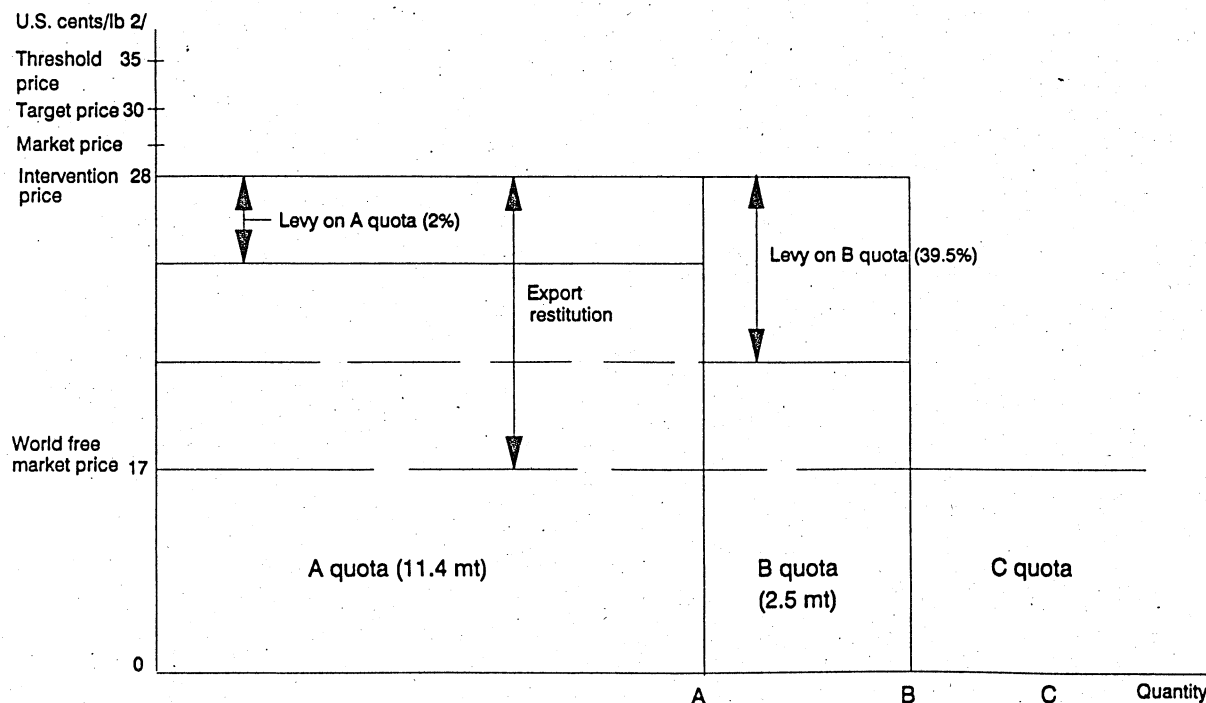| Item	1982	1983	1984	1985	1986	1987	1982-87 average
	Billion dollars						
Transfers to farmers:							
Sugar producers	1.0	1.0	1.2	1.0	1.3	1.2	1.1
All farmers	18.7	28.2	23.1	25.6	36.7	36.0	28.1
	Percent						
Transfers as percent of gross cash receipts:							
Sugar producers	64	66	79	68	73	60	68
Average of 12 commodities	17	26	21	24	36	33	26

Source: Webb, Lopez, and Penn.

European Community

The basic mechanisms of EC sugar policy include domestic production and price controls, export subsidies, and production controls on HFSS.

Figure 9
EC sugar quotas, administered prices, and levies 1/

```
U.S. cents/lb 2/

Threshold   35 ─
price

Target price 30 ─

Market price ─

Intervention 28 ─
price
                        ┌── Levy on A quota (2%)
                                                        Levy on B quota (39.5%)

                                        Export
                                        restitution

World free
market price  17 ─


             A quota (11.4 mt)              B quota          C quota
                                            (2.5 mt)

          0 ─
                                        A        B        C      Quantity
```

1/ Estimated from 1989 prices.
2/ 1 ECU = $US 1.148. Not to scale. Prices are for refined sugar.

Sources: Miller (1985) and U.S. Dept. of Agr., Econ. Res. Serv.

The EC establishes an "A" domestic production quota, allocated among the 12 member countries and set at estimated internal consumption requirements.[3] A "B" quota is established at about 20 percent of the "A" quota, and roughly corresponds to desired exports. For 1986-91, the A and B quotas are set at 11.4 and 2.5 MMT, respectively, for a total of 13.9 MMT, compared with 1986-88 average production of 15 MMT. Sugar produced above A and B quotas is termed "C" sugar and is not eligible for any price supports or export restitutions (defined below), and cannot be sold in the EC. However, producers may hold some percentage of C sugar at the end of the marketing year and apply it as the first allotment of A quota sugar the following year. Quotas are normally allocated to producing firms for 5 years and are not transferable between countries, but up to 10 percent of a quota may be transferred from one firm to another within a country.

A complex system of prices provides the basis for domestic industry support, as well as import policies and export enhancement efforts (fig. 9). The principal official prices, all expressed in white value and rounded, for simplicity, from actual prices in 1988, are:

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[3] The EC-12 countries are Belgium, Denmark, West Germany, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom.

o   Target price: Set by EC authorities as a price "which might be expected
    to apply in the market in a balanced supply/demand situation and under
    normal conditions of free competition" (30 cents).

o   Intervention price: Set at about 5 percent below the target price;
    varies by region (28 cents).

o   Threshold price: The minimum price at which imported sugar can enter
    the EC. The threshold price equals the target price, plus some storage
    costs, plus transportation costs from the areas of greatest surplus
    (north of France) to greatest deficit (Palermo, Sicily). In effect, by
    means of high tariffs, the threshold price insulates the EC sugar market
    from low world prices.

EC agencies are "purchasers of last resort," in that, if the processors
(refining companies) wish to sell sugar at the intervention price, the
agencies would be obligated to buy. In practice, very little sugar is
purchased by authorities because surplus sugar is exported with subsidies. To
be eligible for the intervention price, processors are required to pay growers
certain minimum prices for beets. These prices are calculated for each
growing region. The market price for sugar is always above the intervention
price and below the threshold price.

The variable levy, one of two EC border measures, is the gap between the
threshold price and the world price, but is applicable only on imported sugar
(it does not apply to Lomé quota imports, defined below) and has not been used
in years. The second border measure, the export refund or export restitution,
is used to allow EC sugar to be sold on world markets, and equals the
difference between the intervention price and the world price. In figure 9,
the export restitution is 11 cents per pound (28 cents - 17 cents). Traders
bid for the minimum subsidy they need to profitably purchase EC sugar and sell
it at lower world prices, and the tenders are awarded to the minimum bids on a
weekly basis.

In order to finance the large sums required for export restitutions when world
sugar prices are below the intervention price, as has been the case since
1982, sugar producers pay a levy of 2 percent of the intervention price on
their A and B sugar, and an additional 37.5-percent levy is placed on B sugar.
Because levies in the mid-1980's were insufficient to pay for the export
restitutions, an additional levy was imposed by the EC in 1988 to recoup all
budgetary costs for export refunds in the same year they were incurred. The
levies mentioned above reduce returns by about 15-20 percent on combined A and
B quota sugar.

An agreement with a group of African, Caribbean, and Pacific countries under
the Lomé Convention requires the EC to import about 1.4 MMT of raw sugar each
year at the intervention price (about 28 cents a pound, white value, or 23
cents a pound, raw value, in 1989). The export restitutions on exports of 1.4
MMT are paid for out of the general EC budget, not from co-responsibility
levies. Since the EC considers this to be a form of foreign aid, it is
considered unfair to burden EC sugar producers with this expense.

Strict quotas on the production of HFSS, or isoglucose as it is referred to in
the EC, are designed to prevent sugar from losing market share to this
substitute sweetener. For 1989, the "A" quota on HFSS is 241,000 metric tons

and the "B" quota is 50,000 metric tons. HFSS producers are also burdened
with a share of the cost of subsidizing sugar exports by paying restitutions
on their HFSS A and B quota sales of 2 and 37.5 percent, respectively, the
same levels of "co-responsibility" as paid by sugar producers. High price
supports for EC corn and wheat are a burden to HFSS producers. The higher
input prices are largely, but not entirely, offset by a special "Starch
Regime," which provides producer refunds to starch/HFSS producers (Leuck,
April 1990).

The major impact of EC sweetener policies over the last two decades has been
to raise EC sugar production, lower EC sugar and sweetener consumption,
convert the EC from a net importer to a net exporter of sugar, and lower the
world sugar price. While the EC sugar regime is partly "self-financing," it
is in fact the consumer who bears the burden of producer support through high
sugar prices and lack of access to HFSS.

Australia

The Australian sugar industry is highly regulated, although recently
introduced reforms have reduced the degree of government regulation. From
1915 until 1989, control of the Australian sugar industry was vested with the
State Government of Queensland through a Sugar Board. All exports and
virtually all domestic marketing of sugar had been handled by a single private
firm, CSR Limited, which owned about 95 percent of Australian refining
capacity, about 10 percent of sugarcane land, and about 25 percent of the raw
sugar mills. The domestic consumer price was fixed by the government at
levels that were usually higher than world prices and imports were prohibited.

Beginning in July 1989, the ban on imports (which had existed since 1915) was
replaced with a tariff of A$115 a ton, which is set to decline to A$70 a ton
(roughly 2.5 U.S. cents a pound) by 1992. Consumer prices now fluctuate at
approximately the world price plus transportation and tariff margins.

The Sugar Board limits the rights to grow cane to "assigned" areas in
Queensland, which produces about 95 percent of Australia's sugar. Sugar
growers in New South Wales, who produce the other 5 percent of Australia's
sugar, decided in 1989 to separate themselves from the Sugar Board and they
are planning to build their own refinery. This initiative will introduce some
competition into an industry which has never experienced it before.

In Queensland, the Sugar Board assigns the right to grow cane to specific
acres. Returns to growers and processors are made according to formulas which
blend the prices received from domestic and export sales, and over time,
balance receipts from these sales. Any sugar produced on unassigned land must
be sold to the Sugar Board at a price of about A$1 a ton, guaranteeing that no
cane is grown on unassigned land.

The Sugar Board will continue to regulate cane land assignments, which are
valued by their owners, and regulate other key aspects of the industry, such
as transportation. The regulations have tended to raise the average cost of
producing sugarcane, since many relatively unproductive acres are allowed to
remain in production, while expansion is restricted in lower cost areas more
suited for cane.

Australia's policy changes in 1989, which were imposed on an unwilling
industry by a determined government, may result in a significant increase in

sugar production after a few years of adjustment, especially if the New South Wales industry prospers. Further deregulation would be necessary to allow producers to fully respond to the world price, but the consumer price will now reflect world price movements.

Japan

Japan supports its sugar producers through a complex web of tariffs, variable import levies, and regulations, and through restrictions on HFSS. Japan's Raw Silk and Sugar Price Stabilization Corporation has monopoly power over the country's sweetener market. The corporation sets minimum prices which millers and processors must pay for cane and beet sugar, according to a parity-type formula. The corporation buys all domestic sugar from millers and processors, at prices which vary by location and type. Beets have a lower computed cost of production, for example, so the beet sugar purchase price is less than cane. The corporation simultaneously sells the sugar back to the miller or processor, at a price which makes domestic sugar competitive with imports. The price gap of this transaction amounts to a subsidy to the processor or miller. The tariffs and surcharges on imported sugar provide some of the money to support this subsidy, with the rest coming from general government revenues.

In 1987, the minimum payment to cane growers was 185,000 yen/metric ton in raw sugar equivalent prices which, at an exchange rate of 130 yen/U.S. dollar, gives a farm price of about 65 cents a pound of raw sugar, compared with a U.S. farm price of about 13 cents. The corporation bought raw sugar from mills for about 77 cents a pound and sold it back for about 33 cents, resulting in a miller subsidy of about 44 cents a pound.

The average 1987 import price of raw sugar was about 8.7 cents. Duties (14 cents), excise taxes (5-6 cents), and a variable levy (12 cents) are added to arrive at the "importer price" of about 41 cents, which is the basic cost to refiners of imported raw sugar, and the government guarantees that domestic raw sugar will be competitive with this price due to subsidies.

The surcharge derived from imported sugar was used to support the domestic sugar price. By 1982, however, the decline of sugar imports and the increase in domestic production had reduced the ability of this source of revenue to match the need for funds, and surcharges on HFSS production were instituted.[4]

HFSS is produced mostly from corn imported from the United States, Thailand, and South Africa. HFSS producers are required to use domestic potatoes in the ratio of 1 ton of potato starch for every 7.6 metric tons of corn starch. Any corn imported above a quota determined by this ratio is subject to a prohibitive tariff of 15,000 yen/metric ton, which is more than $100/metric ton and compares with a U.S. export price of about $100/metric ton f.o.b. Japan has announced two changes to take effect by 1992 that will reduce the effective burden of regulations on the HFSS industry: (1) the minimum potato/corn starch ratio will be raised from the current 7.6/1 ratio to 9/1, and (2) the tariff on extra-quota corn will be reduced from 15,000 yen/ton to 12,000 yen/ton. The HFSS surcharges are not scheduled for change.

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[4] The tax on HFSS is determined by a complex formula. For details, see Sturgiss, Tobler, and Connell.

In addition, there is a surcharge on HFSS production similar to that on sugar imports. All HFSS is purchased by the corporation and simultaneously sold back to the producer at a higher price, with the revenue used to reduce the surcharge on imported sugar. The effect is to tax HFSS producers to help domestic refiners, who have suffered from the reduced raw sugar imports of the last decade.

Japan's HFSS prices are in the range of 50-60 cents a pound, compared with U.S. prices of 15-25 cents. The cost of producing HFSS in Japan, while undoubtedly higher than in the United States, is well below these prices.

The net impact of Japanese sweetener policies has been to keep domestic production relatively high and consumption relatively low, while lowering world prices.

Less-Developed Countries

The less-developed countries comprise a very diverse group, among them some of the world's largest sugar producers and consumers, but also numerous smaller countries which may produce little or no sugar. The less-developed country share of world sugar exports shrank from 48 to 37 percent between the periods 1975-77 and 1986-88 (fig. 7), while their ratio of production to consumption fell from 1.29 to 0.98 (table 13), indicating a switch from net exporting to net importing status.

Brazil

Brazil occupies a unique role in the world sugar market because it produces alcohol from sugarcane as a primary domestic fuel, and potentially has some flexibility in switching sugarcane use between sugar and alcohol. As a result, Brazil has enormous sugarcane production capacity. About 231 MMT of sugarcane was produced in 1989, of which 40 percent was used for sugar and 60 percent for alcohol.

The Instituto do Açúcar e do Alcool (IAA) was a semi-autonomous government agency which formulated and executed sugar and alcohol policy for many years. The IAA was abolished by a decree on March 16, 1990, and unless the government reverses its decision, it appears that the decree will stand. It is not clear how the functions of the IAA will be reassigned. In the past, the IAA set a national cropping plan for cane allocations for alcohol and sugar and had control over sugar exports. Sugar lands and mills are privately owned and the domestic marketing and distribution of sugar is handled by the private sector.

Producer prices in Brazil have been fixed by the IAA above the world price for some time, while consumer prices are held at levels among the lowest in the world. Brazil's sugar production costs are supposedly a basis for the prices fixed by the government, but it is unclear how they are calculated. Brazil's cost of production for both raw and refined sugar are quite low by world standards. However, policies, such as a higher price guarantee for the northeastern higher cost region, prevent the industry from producing at least cost.

In the mid-1980's, many analysts felt that the technical possibility of substitution between alcohol and sugar would allow Brazil to respond more quickly to changes in the world sugar price and moderate world sugar price increases. However, the necessity of providing alcohol for vehicles, many of which will not run on any other fuel, has forced the government to emphasize

alcohol over sugar production, even during 1988 and 1989 when sugar prices were rising. In late 1989 and early 1990, Brazil was forced to import large quantities of ethanol from the United States, and has imported methanol and wine alcohol from other sources. It now appears that Brazil could increase its share of world sugar exports significantly only if the government is willing to significantly reduce the role of alcohol as a vehicular fuel, which would be extremely difficult due to the large number of alcohol-dependent cars.

India

India has a highly complicated sugar production and distribution system. Government regulations are extensive, and yet the sugar market is not entirely predictable. The indeterminacy, largely on the supply side, arises from uncertainty of producer returns. Nationally established minimum prices for sugarcane are often exceeded at the state and mill level. Also, producers of traditional gur and khandsari sugars (whose prices are unregulated) competitively bid for supplies of sugarcane. Gur accounts for about 40 percent of cane sugar production in India, khandsari (semi-white centrifugal sugar) about 2 percent, and milled white sugar about 58 percent. Consumption is broken down in about the same percentages because India is essentially self-sufficient in sugar, and imports or exports depend largely on weather effects on production.

Milled sugar production is governed by national and state regulations on investment, production quotas, and prices. Mills are either publicly owned, cooperatives, or investor-owned enterprises. The role of privately owned mills has been in decline for at least two decades because licenses for new mills are being granted only to cooperatives and public mills. Cooperatives, which tend to be the most efficient producers, account for nearly 60 percent of India's productive capacity and output.

Mills have to compete for supplies of sugarcane not only among themselves, but against gur and khandsari producers. Often the mills are at a disadvantage because government prices for milled cane sugar keep mill cost-return margins low. Minimum prices for cane (paid by the mills to the growers) are established nationally, but State governments have the right to set higher minimums. Gur and khandsari producers price their sugar independently, and pay lower wages and fewer taxes, giving them considerable advantage in bidding for cane supplies.

The marketing of milled sugar is also a convoluted process, broadly defined as a two-tiered pricing scheme. The first tier applies to "levy sugar,"--a nationally set price. The central government requires sugar mills to supply quotas of levy sugar to the Food Corporation of India at prices which are set by individual state governments. That is, consumers throughout India pay a uniform price for levy sugar, but the price paid to the mills varies by state. Consumers use ration cards to purchase levy sugar at fair price shops.

The remaining domestic supplies of milled sugar, plus all imported sugar (if any), are sold at free-market prices. However, by regulating the timing and quantity of "free-sale" sugar, the government can indirectly guide prices to levels considered appropriate. In the 1980's, the volume of free-sale sugar was permitted to rise faster than levy sugar. Free-sale sugar now accounts for about 60 percent of total milled sugar sales. The government also

regulates returns to producers by differential excise taxes for levy sugar versus free-sale; traditional sugars are free of excise taxes.

Centrally Planned Economies

The agricultural policies of many of the centrally planned economies have changed radically in the past year, but in the period under review, agricultural policies were generally marked by state control of production and pricing. While a great deal of state support has been provided to the sugar industries of many of the centrally planned economies, it is also likely that the overall inefficiencies of central planning have been a burden to some potentially efficient industries, so that on balance it is difficult to characterize the impact of the policies of this group of countries on the world sugar price.

Cuba

Cuba's position as the world's largest sugar exporter is partly explained by a comparative advantage in sugar production. At the same time, President Castro has committed to using sugar as the engine of growth for Cuba's economy.

The Cuban government owns all of the sugar mills and purchases all cane at a fixed and guaranteed price. Cuba keeps the consumer sugar price among the lowest in the world, averaging about 7 cents a pound (U.S. official exchange rate) in recent years. Per capita consumption is about 70 kilograms a year. The government's policies, while providing direct assistance to the industry, also contribute to inefficiencies.

After the Cuban revolution, the USSR agreed to purchase a large volume of Cuban sugar. Over half of Cuban sugar exports have gone to the USSR since 1961. The USSR pays a price premium for Cuban sugar, but since rubles are an inconvertible currency, the value of this "aid" is hard to measure. At one time the USSR gave Cuba oil in exchange for sugar, which Cuba could sell for hard currency. However, that arrangement seems to be over, or at least diminished.

USSR

State control is the dominant factor of Soviet sugar policy, and the government controls inputs, prices, and production plans. The inefficiencies of Soviet agriculture are well-documented and apply to sugar as to other commodities and industries. A continuation of the recent moves toward a more market-oriented society could result in increased efficiency in all agricultural production, including sugarbeets. The USSR has a high cost of production for sugar, and any gains in efficiency could translate into increased output. However, the magnitudes of these possible changes cannot be estimated with any degree of confidence.

The USSR is initiating some HFSS production, but does not have surplus supplies of grain to use as a source of starch, and costs are expected to be high. HFSS is not expected to achieve a significant share of the sweetener market within the next 5 years.

The large volume of USSR sugar imports has helped support world prices, particularly in recent years when Cuba had difficulty in meeting its bilateral sugar export commitments to the USSR.

China

The disbanding of rural communes in China in the early 1980's, which gave wide latitude for households to make their own agricultural production and marketing decisions, led to increases in productivity and production. However, the government-fixed prices for sugar at the mill, wholesale, and retail levels were held constant for over 20 years until raised in 1988 in an attempt to stimulate sugar production. The government has also subsidized some inputs such as fertilizer and improved seed for beets.

While making some moves toward more market-oriented policies, the government reserves control over sugar pricing and occasionally imposes sugar rationing.

China is building a few small HFSS plants, but these are not expected to make a significant contribution to total sweetener consumption in the near future.

Global Sweetener Market Competitiveness

Cross-country comparisons of costs of production are very difficult to measure and, once made, to properly assess. Even within a single country, it is not always easy to produce an accurate set of cost of production accounts which can answer the questions which are most important to policymakers, such as who will respond at various prices. With these caveats in mind, we briefly review costs of production for sugar and HFSS.

Costs of Production

A consistent set of USDA cost data for U.S. sugar crops is available for the 1981-87 crop years. The USDA measures the costs of producing sugar at both the farm level, which is the "production cost," and the factory level, which is the "processing cost." From 1981 to 1987, the trends in U.S. sugar costs of production and processing were downward, for both beet and cane sugar, as can be seen in figure 10.

Beets

From 1981 to 1987 beet sugar production costs fell 9 percent (table 16). Variable production costs fell 22 percent, as labor-saving and other technological advances were made in the field, while fixed production costs rose 14 percent, mostly due to rising land costs. Variable costs accounted for about 55-60 percent of total production costs.

Over the same period, beet sugar processing costs fell 37 percent, far more than production costs. Variable processing costs fell 38 percent and fixed processing costs fell 34 percent. Variable costs accounted for about 70 percent of total processing costs. The relatively large reductions in processing costs were due largely to higher quality beets and technological improvements within factories, as well as increased volume, which lowered unit costs. Overall production and processing costs fell 23 percent. Beet sugar costs per pound on a refined sugar basis were estimated lower than raw cane sugar costs on a raw basis (fig. 10). It should be noted that 1987 was an unusually low-cost year for beet sugar, as both beet yields (22.4 tons per acre U.S. average) and recovery rates (266 lbs of sugar per ton of beets) were at record high levels.

Figure 10

U.S. cost of producing and processing refined beet sugar and raw cane sugar, 1981-88 crops

Cents/lb

Crop year
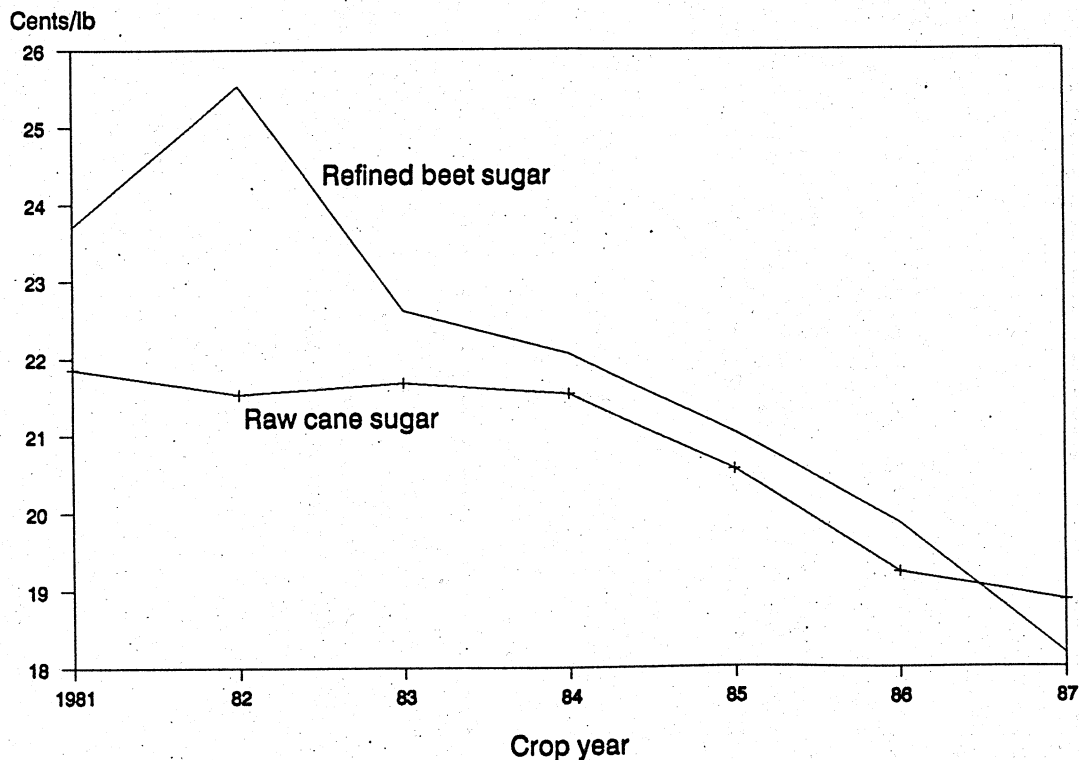
Cane

Cane sugar production costs fell 15 percent from 1981 to 1987 (table 17). Variable production costs fell 19 percent and fixed production costs fell 5 percent. Variable production costs accounted for about 65 percent of total production costs over the period.

Cane sugar processing costs fell 12 percent, slightly less than production costs, and far less than the 37-percent drop in beet sugar processing. Technological advances in cane milling appear not to have been as rapid as in beet processing, which may be partly a result of a higher level of investment in beet processing facilitated by relatively higher average returns in beet sugar processing.

Real Costs

Inflation from 1981 to 1987 amounted to about 25 percent (based on the GNP price deflator). When adjusted for inflation, the combined cost of producing and processing cane and beet sugar fell 31 and 39 percent, respectively.

Table 16--Variable and fixed costs of producing beet sugar in the United States, 1981-87

Item	1981	1982	1983	1984	1985	1986	1987	Change 1981-87
	- - - - - - - - Cents/lb 1/ - - - - - - - -							Percent
Production:								
Variable 2/	7.39	7.55	7.77	7.29	6.91	6.36	5.80	-22
Fixed 3/	4.08	4.80	5.19	4.90	4.64	4.72	4.65	14
Total	11.47	12.35	12.96	12.19	11.55	11.08	10.44	-9
Processing:								
Variable 4/	8.98	9.21	6.86	6.99	6.85	6.35	5.59	-38
Fixed 5/	3.26	3.96	2.80	2.88	2.64	2.42	2.15	-34
Total	12.24	13.17	9.66	9.87	9.49	8.77	7.73	-37
Total production and processing	23.71	25.52	22.62	22.06	21.03	19.85	18.18	-23
Total variable costs	16.37	16.76	14.63	14.28	13.76	12.71	11.38	-30
Total fixed costs	7.34	8.75	7.99	7.78	7.28	7.14	6.79	-7

1/ Refined sugar, bulk basis.
2/ Sum of variable and operating capital costs.
3/ Sum of fixed, nonland capital, and land costs.
4/ Sum of variable and 70 percent of dried pulp costs, net of byproduct credits.
5/ Sum of fixed, general and administrative, and 30 percent of dried pulp costs.

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Table 17--Variable and fixed costs of producing raw cane sugar in the United States, 1981-87

Item	1981	1982	1983	1984	1985	1986	1987	Change 1981-87
	- - - - - - - - - Cents/lb 1/ - - - - - - - - -							Percent
Production:								
Variable 2/	9.53	9.38	9.72	9.10	8.56	7.92	7.72	-19
Fixed 3/	4.59	4.35	4.56	4.51	4.54	4.32	4.34	-5
Total	14.12	13.73	14.29	13.61	13.10	12.24	12.07	-15
Processing:								
Variable 4/	5.30	5.54	5.10	5.57	5.24	5.00	4.89	-8
Fixed 5/	2.43	2.26	2.30	2.37	2.21	2.00	1.92	-21
Total	7.73	7.80	7.40	7.94	7.45	6.99	6.81	-12
Total production and processing	21.85	21.53	21.69	21.54	20.55	19.23	18.88	-14
Total variable costs	14.83	14.92	14.82	14.66	13.80	12.92	12.62	-15
Total fixed costs	7.02	6.61	6.86	6.88	6.75	6.32	6.26	-11

1/ 96-degree raw sugar.
2/ Sum of variable and operating capital costs.
3/ Sum of fixed, nonland capital, and land costs.
4/ Variable costs net of byproduct credits.
5/ Sum of fixed and general and administrative costs.

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Global Cost-of-Production Comparisons

International production cost comparisons for sugar, or any commodity, are difficult to come by and are complicated by different definitions of costs, different accounting practices, and exchange rate changes. Nonetheless, cost data can provide a useful perspective on the comparative advantage of producing sugar in different countries. A recent cost comparison across countries for sugar and HFSS are available from a study by Landell Mills Commodities Studies, Inc. (1989). All of Landell Mills data are in nominal U.S. dollars.

For U.S. refined beet sugar, Landell Mills results show a range of 16.7 to 23.1 cents a pound over the period 1979/80 to 1986/87 (table 18).[5] Total variable costs comprised about 48 percent of the total cost for beets, and averaged 9.46 cents for the period, while fixed costs averaged about 10.5 cents. U.S. raw cane sugar costs, expressed on a "white sugar equivalent" basis, ranged from 18.96 to 23.75 cents a pound over the period. The Landell Mills data, like USDA data, support a view that beet sugar has a cost advantage over cane sugar in the United States.

The five low-cost beet sugar producers, according to Landell Mills Commodities, are France, West Germany, Belgium, Turkey, and Chile. This group's average cost ranged from 14.88 to 20.68 cents a pound over 1979/80 to 1986/87 (table 18). This compares with the group of five low-cost cane producers (Malawi, South Africa, Swaziland, Zambia, and Zimbabwe), whose average over the period ranged from 12.58 to 17.15 cents, white value.

The major cane sugar exporters (Cuba, Brazil's center-south region, Australia, Thailand, Dominican Republic, South Africa, and Mauritius) had lower costs than the major beet sugar exporters (France, West Germany, Belgium, Denmark, Netherlands, and Turkey).

The cane group of 61 countries/regions had a weighted-average cost ranging from 17.54 to 20.55 cents (white value), against the 31 beet countries/regions' weighted average cost which ranged from 25.52 to 29.47 cents. The highest average-cost year for cane, at 20.55 cents, is about 5 cents a pound lower than the lowest year for beets.

The only industrial market economy country to appear on the lists of five highest cost beet or cane producers is Japan, which shows up as a high-cost producer for both beets and cane. The four other high-cost cane producers are either less-developed countries (Congo, Paraguay, and Guadeloupe) or centrally planned economies (Vietnam), and the four other high-cost beet producers are centrally planned economies (China, Romania, Bulgaria, and USSR).

Global HFSS Costs

HFSS costs of production for all countries ranged from 13.83 to 17.88 cents a pound over 1979/80 to 1986/87, giving HFSS a cost advantage over even low-cost beet sugar producers whose costs ranged from 14.88 to 20.68 cents a pound. HFSS costs are only slightly higher than low-cost cane producers at 12.58 to

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[5] For proprietary reasons, the Landell Mills data cannot be reported in specific detail.

Table 18--Costs of producing starch and processing raw cane sugar, beet sugar, and high fructose starch syrup, United States and selected categories of world producers, 1979/80-1986/87

Category	Range of average production costs, between 1979/80-1986/87
	Cents/lb 1/
Raw cane sugar:	
United States	13.90-18.30
Low-cost producers 2/	8.03-12.23
High-cost producers 3/	32.58-45.20
Major exporters 4/	10.38-13.07
World total 5/	12.59-15.36
Cane sugar, white-value equivalent:	
United States	18.96-23.75
Low-cost producers 2/	12.58-17.15
High-cost producers 3/	39.27-52.99
Major exporters 4/	15.14-18.06
World total 5/	17.54-20.55
Beet sugar, white value:	
United States	16.70-23.10
Low-cost producers 6/	14.88-20.68
High-cost producers 7/	36.78-48.60
Major exporters 8/	15.13-20.98
World total 9/	25.52-29.47
High fructose syrup: 10/	
United States	12.20-15.86
World total 11/	13.83-17.88

Note: Weighted averages except for the United States.
1/ Measured in current U.S. cents a pound, ex-mill/factory basis.
2/ Average of five countries (Malawi, South Africa, Swaziland, Zambia, and Zimbabwe).
3/ Average of five countries (Congo, Paraguay, Guadeloupe, Vietnam, and Japan). Excludes Uganda.
4/ Average of seven countries (Cuba, Brazil (center-south), Australia, Thailand, Dominican Republic, South Africa, Mauritius).
5/ Average of 61 sugarcane-producing countries.
6/ Average of five countries (Chile, France, Turkey, West Germany, and Belgium).
7/ Average of five countries (China, Japan, Romania, Bulgaria, and USSR).
8/ Average of six countries (France, West Germany, Belgium, Denmark, the Netherlands, and Turkey).
9/ Average of 31 countries.
10/ Cents per pound, dry weight, 42-percent HFSS.
11/ Average of 12 countries (Canada, Argentina, Japan, South Korea, Spain, Belgium, France, West Germany, Italy, the Netherlands, United Kingdom, and United States).

17.15 cents. U.S. HFSS costs of production are 12.20 to 15.86 cents a pound, making the U.S. competitive with all world sugar producers.

However, it is not possible to accurately gauge the competitiveness of HFSS in other parts of the world based on the U.S. experience. Many factors which are important for competitiveness cannot be captured in measures of cost of production. For example, one of the reasons for the competitiveness of HFSS in the United States is the existence of an efficient and cheap transportation system, which is important since HFSS is only about 70 percent solids.

Summary

The above evidence indicates that the lowest cost sugar producers are cane producers, a group which includes the large exporters. However, some low-cost beet producers are competitive with the low-cost cane producers. According to Landell Mills, over the 8-year period 1979/80 to 1986/87, costs in the United States (mainland only) ranked 33rd of 61 countries/regions in raw cane sugar, 7th of 31 countries/regions in beet sugar, and lowest of 12 HFSS-producing countries/regions. U.S. HFSS may be the world's lowest cost caloric sweetener.

Previous Studies of Sugar Trade Liberalization

Several recent studies have analyzed the consequences of world sugar market trade liberalization. The studies differ in scope, assumptions, and methods, but a common theme is a comparison of what the world sugar market would be like with and without some or all of the various trade-distorting policies. Some of the studies cover many other commodities besides sugar, and therefore provide a comprehensive scope at the expense of detail on results for sugar. The studies are summarized in terms of results given for changes in the world sugar price, the variability of the world sugar price, and the volume of world sugar trade (table 19).

Since the world sugar market has been distorted by government intervention, parameters estimated from historical data are not likely to stay constant under conditions of trade liberalization. However, this is true not only for sugar but almost any economic analysis involving structural change.

Attempts to model agricultural commodities are complicated by "cross-commodity effects." For example, to estimate the impact of trade liberalization on corn markets, it would be important to consider liberalization's effect on corn as well as crops competing on the supply side (soybeans or alfalfa) and also on the demand side as feed (wheat or barley). The impact on livestock prices, and, in turn, demand is also an important component of the analysis.

Analysis of the sugar market is simplified by the fact that the prices of other commodities do not greatly affect the demand for sugar, with the exception of HFSS. But even HFSS is a substitute in very few countries. On the supply side, too, production of sugarcane is somewhat insulated from the prices of other crops because of ratooning--the cane is grown from the root of a plant that has been cut down and is harvested 2 or more years from one planting in most countries. On the processing side, it is difficult to start and stop the use of cane milling and beet processing facilities worth tens or hundreds of millions of dollars.

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Table 19--Results from studies on impacts of trade liberalization on world sugar price, price variability, and trade

Study	Base year	Liberalization by: 1/	World price effect	World price variability effect 2/	World trade effect
			Percent		
World Bank	1980-82	EC	3	NA	-5
		Japan	1	NA	1
		United States	1	NA	3
		OECD	5	-15	2
		All market economies (10 percent only)	8	-80	60
		Developing countries	3	-70	60
Zietz and Valdez	1979-81	All industrial market economies	13-30	NA	10-31
	1983	All industrial market economies	29-65	NA	36-75
Tyers and Anderson	1980-82	EC	18	-22	NA
		Japan	2	-8	NA
		United States	3	-14	NA
		All industrial market economies	22	-31	NA
Johnson and others	1986	Industrial market economies	29-46	NA	NA
		Global	45	NA	NA
Kirby and others	1986	10-percent liberalization by: 3/			
		All market economies	1.4	NA	1.4
		United States, EC, and Japan	1.3	NA	.6
		World minus United States, EC, Japan	0	NA	.9
Roningen and Dixit	1986	Industrial market economies	53	NA	13
Wong, Sturgiss, and Borrell	1985	10-percent liberalization by OECD	3.8	0	1

NA = Not available.

1/ Complete liberalization unless otherwise specified.

2/ Percent reduction in the coefficient of variation.

3/ Reducing all producer subsidy equivalents and consumer subsidy equivalents by 10 percent. See Webb, Lopez, and Penn for definition of producer subsidy equivalents and consumer subsidy equivalents.

Sources: See references for citations.

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Impacts on the World Sugar Price

Virtually all the studies found that the world sugar price rises following trade liberalization. The degree of price increase varies with the model, assumptions, and base period, as shown in table 19. All prices are in real terms (adjusted for inflation).

Of the studies simulating full trade liberalization by industrial market economies, the World Bank found that liberalization by the EC would raise the world sugar price by 3 percent. The gain would be 1 percent if only the United States, or Japan, liberalized trade (table 19). The small price increase found in the World Bank study has been attributed to the fact that the world sugar price was high in the base period, 1980-82, and measured rates of protection were low. Tyers and Anderson found the world price could increase as much as 22 percent if all industrial market economies liberalized. Zietz and Valdez reported price gains of up to 65 percent, depending upon the base year. Roningen and Dixit used data from 1986, when world prices were low (and support rates for sugar were very high) and reported a world price increase of 53 percent.

Of studies simulating partial trade liberalization, Kirby and others found that a 10-percent cut in support rates by all market economies would raise the price 1.4 percent. Wong, Sturgiss, and Borrell reported that a 10-percent cut in support in industrial market economies would raise the world price by 3.8 percent.

The evidence from the studies reveals:

o Partial trade liberalization, such as a 10-percent reduction in support levels by the industrial market economies, would have only a very small impact on the world price.

o Liberalization by all industrial market economies would raise the real world price. In the literature reviewed, the price increase ranges from 8 percent using a base period of 1980-82, to 65 percent from a base year of 1983.

o Among the industrial market economies, EC policies appear to have the most depressing effect upon the world price.

Impacts on World Sugar Price Variability

The studies which addressed the issue found that world price variability would be reduced by trade liberalization.[6] The World Bank found a reduction in variability of up to 80 percent, if all market economies liberalized by 10 percent. Tyers and Anderson found a reduction in variability of up to 31 percent, if all industrial market economies liberalized.

Wong, Sturgiss, and Borrell found no reduction in price variability resulting from a 10-percent cut in price support levels of OECD countries. However, in

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[6] Variability is here measured as the "coefficient of variation," the variation of annual average prices about their mean.

Studies of Trade Liberalization

World Bank (1986): Static simulation model, 30 countries, and 7 commodities. Liberalization simulated by removing nominal protection coefficients. Base years for data are 1980-82, but liberalization assumed to start in 1986. Simulates variability in prices by utilizing historical supply variability "shock" for each of 100 computer forecasts, and then taking the variation of the 100 forecasts. Model similar to Tyers and Anderson (1987).

Zietz and Valdes (1986): Static, synthetic, single-commodity sugar model, 58 less-developed countries, 17 Organization for Economic Cooperation and Development countries, and a "rest-of-world" category. Liberalization simulated by removing a "tariff-equivalent" price wedge. Base years are 1979-81 and 1983.

Tyers and Anderson (1987): Static simulation model, 30 countries, and 7 commodities. Liberalization simulated by removing nominal protection coefficients. Base years for data are 1980-82, but liberalization assumed to start in 1988. Simulates variability in prices by utilizing historical supply variability "shock" for each of 100 computer forecasts, and then taking the variation of the 100 forecasts. Forecasts given are for 1995, that is, after enough time for longrun adjustments.

Johnson and others (1988): Static synthetic model framework. Liberalization simulated by producer subsidy equivalent (PSE) and consumer subsidy equivalent (CSE) removal, in less-developed countries as well as industrial market economies. Base year is 1986. Medium-term (3-5 year) results.

Kirby and others (1988): Static synthetic model framework, 12 regions, and 22 commodities. Liberalization simulated by PSE and CSE reductions of 10 percent. Base year is 1986. Medium term (3-5 year) results.

Roningen and Dixit (1989): Static synthetic model framework, 11 regions, and 22 commodities. Liberalization simulated with PSE and CSE removal in industrial market economies. Base year is 1986. Medium-term (3-5 year) results.

Wong, Sturgiss, and Borrell (1989): Dynamic, structural, single-commodity sugar model. Nine regional sectors and a rest-of-world category. Sugar supply is asymmetric; that is, for important countries, increases in sugar supply following price peaks are not matched by equivalent decreases in supply following symmetric price declines. Responses to a 10-percent cut in producer and consumer price support levels in the United States, Japan, and the EC are reported.

See also: Sudaryanto; Rendleman and Hertel; Bureau of Agricultural Economics; Borrell, Sturgiss, and Wong; Sturgiss, Tobler, and Connell; Sparks Commodities; and Landell Mills Commodities (1987).

a scenario where there was no change in producer support but where OECD consumers could buy sugar at the (fluctuating) world price and where low-cost producers could expand without government restriction, world price variability was reduced by 33 percent. The evidence from both these studies, as well as from economic theory, is that liberalization would reduce world price instability.

Impacts on World Sugar Trade

World sugar trade would rise following liberalization, according to most studies. The World Bank found increases of up to 60 percent in volume, if all market economies liberalized by 10 percent. If Japan or the United States liberalized, trade would rise by an estimated 1 and 3 percent, respectively. If only the EC liberalized, world sugar trade would fall by 5 percent because EC exports would decline.

Zietz and Valdez found that full liberalization would increase world sugar trade from 10 to 75 percent depending on the base year. Roningen and Dixit reported an increase of 13 percent.

Tyers and Anderson report that the industrial market economies would have a combination of export reductions and/or import increases of about 8 MMT per year, with most of the shift accounted for by lower production. The two studies which looked at partial liberalization found much smaller trade effects; Kirby and others reported an increase of 1.4 percent following a 10-percent liberalization by all market economies, while Wong, Sturgiss, and Borrell reported a 1-percent increase.

Implications of Trade Liberalization on the World Sweetener Market

In this study, the industrial market economies are assumed to fully liberalize their agricultural policies, including all domestic and trade policies that could affect world prices and production incentives for sugar and HFSS. The less-developed countries and centrally planned economies are assumed to hold all policies constant. These assumptions are not the same as the GATT proposals of the United States or any other party; in fact, many of the proposals initially presented at the GATT, including that of the United States, aimed to more fully bring the trade policies of the less-developed countries into conformity with GATT rules.

The effects given below are intended to be illustrative of probable sweetener market changes and should not be interpreted as precise outcomes. When major structural changes occur, results cannot be determined exactly, and there is a very wide margin of possible error in any forecast.

Enough time is assumed for the expansion or contraction of production facilities. The time required for millions of tons of sugar production to cease in some countries, while millions of tons of capacity are added in others, is certainly many years and is not easy to specify. We assume sufficient time for adjustments to be made. Population, tastes and preferences, and technology are held constant. Income is also held constant, other than as affected by liberalization, so that all observed changes are presumed to be the result only of liberalized industrial market economy policies. Prices of substitutes and complements for sweeteners are not

presumed to be constant, if such price changes would be expected from liberalization; for example, the prices of wheat and small grains are assumed to rise following trade liberalization.

The base period for quantities of supply and demand is 1986-88 while the base period for the price is 1975-89. The 1986-88 period was chosen because production, consumption, and trade were considered to be representative of the global structure of the sugar market. The year 1988 is the most recent for which comprehensive data were available, but a 3-year average would minimize the effect of unusual events such as drought, hurricane, or a political upheaval. For price, an even longer period, 1975-89, was considered to provide the best representation of an "equilibrium" price.

The results are derived from the authors' best judgments, not from an econometric model. Consistency checks were made, such as balancing world supply and demand for sugar and HFSS, taking into account resource constraints and, to the extent possible, cross-commodity linkages. None of the econometric models found in the literature satisfactorily includes HFSS, which is less an indictment of sweetener researchers than it is a testament to the complexity of the sweetener market.

Impacts on the World Sugar Price

World prices for sugar likely would have been higher if trade liberalization had been in effect over 1986-88, the most important reason being the decline in industrial market economy production which would have resulted from the removal of many billions of dollars of support from industrial market economy sugar industries. Government interventions which restrict production, such as in Australia, are generally not as significant on a global scale as those which increase production, such as in the EC, United States, or Japan. The world price increase would have been moderated by greater production in lower cost countries, particularly less-developed countries, which would have responded to the higher world price by moving out along their supply curves. This result is consistent with the world price changes cited in the studies listed in table 19.

If the liberalization scenario had been "global," the removal of government supports in the less-developed countries and centrally planned economies would imply much smaller adjustments in the industrial market economies.[7] It is even possible that government support levels in the less-developed countries and centrally planned economies have been high enough so that, were these countries to liberalize, almost no adjustments would be necessary in the industrial market economies. Unfortunately, there is not sufficient data to support this conjecture; it is in the nature of command economies that levels of "support" are very difficult to define and measure.

Liberalization would likely be phased in over time, but there is a large number of possible ways to phase in reductions of support, and analysis of the possibilities is beyond the scope of this study. The level of world stocks at the time of liberalization, and whether the world price was in a low or high

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[7] It seems likely at this writing that Eastern Europe will embark on some form of trade liberalization, although it is too soon to predict how this is likely to affect sugar. This section, however, deals with 1986-88.

phase, would have a large impact on producers in the years following liberalization. A key factor to recall, however, is that production would have to fall somewhere in order for the world price to rise; not all producers in countries which have provided protection would have been able to withstand the full force of competition in the liberalized environment.

The world sugar price average over 1986-88 was 7.6 cents a pound, compared with a 1980 average of 29 cents, a 1983-85 average of 5.9 cents, and a 1988 average of 10.2 cents. The nominal world sugar price averaged 11 cents a pound during 1975-89, which in real terms (1982 dollars) is a 13-cent average. Based on the authors' best judgment, liberalization would have increased the real world price above its longrun average about 10-30 percent, to a range of 14-17 cents, or 15-20 cents in 1987 dollars. This price increase would be about 100 percent above 1986-88 levels.

Impacts on Sugar Price Variability

A major goal of sugar policies in the industrial market economies has been to stabilize domestic sugar prices, which has resulted in the "exporting" of price instability from the protectionist country to the world market. Liberalization would spread supply shocks out across a much larger market, and with both producers and consumers in industrial market economies able to respond to price changes, the variability of the world price would be much reduced from historical levels. The removal of constraints on substitutes would also reduce world sugar price variability, as it would increase the responsiveness of sugar demand to price. This reduction in price variability would contribute to more rational longrun planning and investment worldwide, removing a major cause of the previous cycle of short, high-price spikes and long periods of low prices.

Increased global price stability would reduce uncertainty, allowing producers and consumers to operate in a less risky environment. Under standard economic assumptions, price stability generally benefits exporters and harms importers (Coyle and others), although exporter gains exceed importer losses, leading to an overall welfare gain. The reciprocal nature of trade means that, if in the market for some other commodity, the roles of importer and exporter were reversed, both countries would experience a net gain from reduced price variability when trade in both commodities is allowed.

Increases in the variability of domestic prices in countries and regions such as the United States, the EC, and Japan would inevitably accompany the opening up of domestic markets, and contribute to increased risk. Reductions in world price variability would be directly correlated with the degree of participation in liberalization, and if the entire world (instead of just the industrial market economies) were to liberalize, the degree of reduction in world price variability would be greater. This is an illustration of the paradox of "Which came first, the chicken or the egg?" Producers want to be insulated from unstable world prices, and yet world price instability is increased as more countries insulate their sugar sectors from world price movements. A dynamic market economy is not consistent with rigid, fixed prices; it is precisely through responding to price movements that producers and consumers in a market economy achieve efficient allocations of resources, and thus income growth. Reduced world price variability is, in a sense, a consequence of good policy, not a goal in and of itself.

Impacts on Sugar Production

Our results show 1986-88 global sugar production approximately the same with and without liberalization. This result assumes that HFSS production capacity as of the early 1980's was in place before liberalization. Sugar production changes in individual countries, however, would be significant.

Industrial Market Economies

With trade liberalization, overall industrial market economy sugar production would have been lower by an estimated 20 percent, about 23 instead of 28 MMT (fig. 11).

United States. U.S. sugar production would likely have declined. Since sugar is the result of both farming and processing operations, the costs of both enterprises must be considered. One difficulty with attempting to use costs as a basis for forecasting production is that a region may have low-cost producers, but high-cost processors, or vice-versa. The complex reactions of both producers and processors to changing prices is very difficult to forecast.

Most U.S. cane-producing areas would have found it hard to compete at a world price of 15 cents, particularly with increased price variability. But there are few alternative crops in Florida, Louisiana, Hawaii, and Texas, and lower returns might simply have reduced asset values. The land would have been used in its best alternative, which might still have been cane production. The value of a cane mill in alternative uses is very low. In table 17, total producer and processor variable costs for cane sugar were measured at about 13 cents in recent years, below the liberalized price. But 13 cents is a national average, and those cane producers with the highest variable costs, well above the average, would have been vulnerable.

Many U.S. beet-producing areas would have continued making positive returns. Overall beet production would have declined, however, particularly in regions such as California where there are many alternative crops which yield good returns. In the nonirrigated beet-producing regions, the prices of grains and soybeans would determine whether the best use of land was for beets, or some other crop. Although world prices for grains are projected to rise following industrial market economy liberalization (see Harwood and Bailey, and Hyberg, Mercier, and Hoffman), the U.S. farm price would likely fall, as the decline in government payments would not be entirely matched by the increase in the market price.

The national average variable cost of producing refined beet sugar in recent years was about 12-14 cents (table 16). A world raw sugar price of 15 cents would be consistent with a U.S. refined cane sugar price above 20 cents (transportation cost to the United States of 1.5 cents, plus refining margin of 4 cents). At this price, the average U.S. beet sugar producer would have had no trouble continuing in production, but some producers with costs well above the average would have been vulnerable.

Our best judgment is that U.S. production would have fallen by about 30 percent, from 6.6 to about 4.6 MMT. The decline in U.S. sugar production could have been much less than 30 percent, if there had been few cane or beet producers with costs well above the average, or if expansion in some areas had offset declines in others.

Figure 11

Impacts of liberalization on sugar markets of industrial market economies, centrally planned economies, and less-developed countries
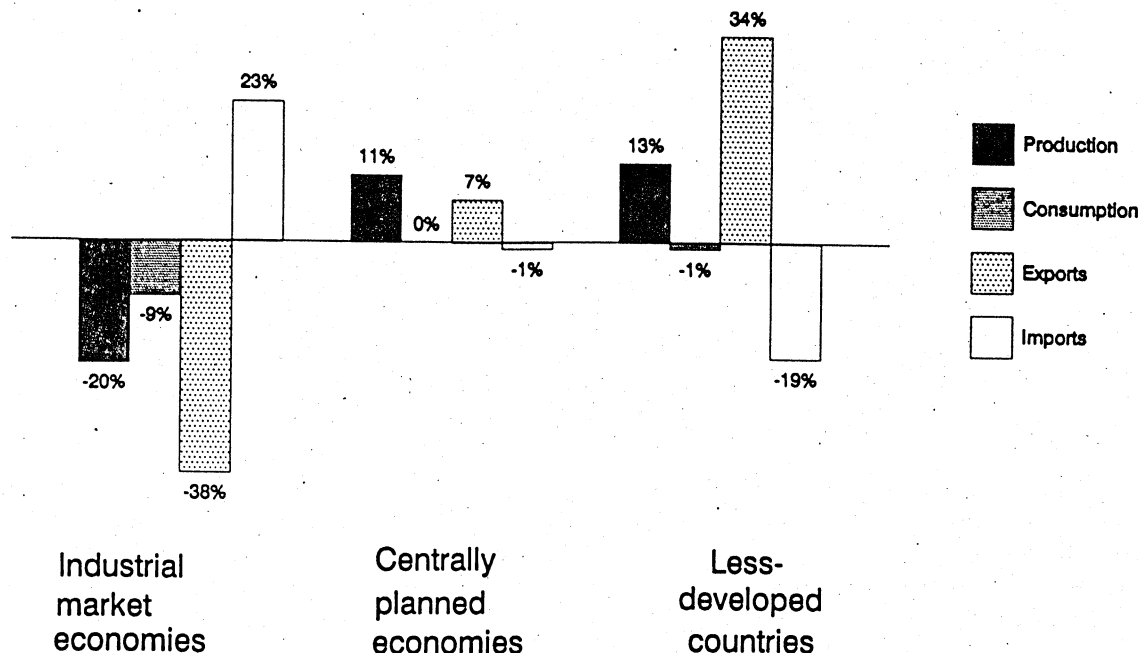
U.S. HFSS production would have been up about 100,000-200,000 tons to offset reduced supports from Canada. This result assumes the world price spike of 1979/80 occurred and gave its stimulus to the U.S. HFSS industry before liberalization occurred, and that U.S. consumer prices for sugar remained above production costs of HFSS. If U.S. wholesale refined sugar prices had been 20 cents, which would have been lower than the actual 1986-88 average of 23-24 cents by about 20 percent, HFSS production would not have been reduced at all.

EC. EC production would have fallen by about 25 percent, from over 14 to about 11 MMT. The absolute decline in EC production of over 3 MMT would exceed the U.S. 2-MMT decline, but would be lower in percentage terms. Reasons for the smaller percentage production decline include the fact that costs and producer prices (net of co-responsibility levies) are lower than in the United States. Most of the production decline would have been in regions such as Italy and Ireland which have costs well above the EC average; some regions might have expanded.

HFSS producers in the EC would have had access to corn at the U.S. price plus transportation costs, which are low; HFSS would have been very competitive with sugar for liquid sweetener markets. HFSS market penetration in the EC would have been complicated by the fact that ownership of much of the wet-milling industry is in the hands of sugar producers; but we assume that "loyalty to sugar" would not override profit maximization and HFSS production would have risen to about 3.5 MMT, compared with the historic level of about 0.2 MMT.

<u>Other Western Europe</u>. Sugar production in Other Western Europe would have been about 70 percent lower, 0.25 MMT instead of 0.85 MMT. HFSS production would have been three times as high, about 0.3 MMT instead of 0.1 MMT.

<u>Japan</u>. Sugar production in Japan, which occurs at very high costs, would have almost ceased, although as some firms failed, the remaining firms might have sufficiently lowered their costs to continue producing for a period of time. Additional refineries would have been needed unless refined sugar was imported, since about three-quarters of the decline in domestic production would have been refined beet sugar. Refiner margins would have been lower due to much lower domestic prices. HFSS production would have been 900,000 tons instead of 700,000 tons, not entirely offsetting the sugar production decline.

<u>Australia</u>. Australia would have had significantly higher sugar production, about 4.5 MMT instead of 3.5 MMT, particularly if it had eliminated its restrictive domestic regulations. HFSS production, which was about 10,000 tons, would not have changed.

<u>South Africa</u>. Since South Africa would have been in a good position to respond to the higher world price, it would have produced about 20 percent more sugar. HFSS production would have been only slightly above actual production of 10,000 tons, and would not have achieved more than 1 or 2 percent of the sweetener market. Corn is cheap in South Africa, but not cheap enough to drop the costs of producing HFSS below the cost of domestic sugar.

<u>Canada</u>. In Canada, sugar production would have dropped considerably. We assume that the increase in the world price would be insufficient to replace the loss of government support. As with the U.S. industry, however, it is possible to envision scenarios where the Canadian industry had managed to lower costs, or where alternative enterprises became less attractive, in which case the two beet factories might be able to continue.

Canadian HFSS production, substituting for higher priced sugar after liberalization, would have exceeded the 250,000 tons actually produced. The industry has traditionally enjoyed a profitable outlet in the U.S. market, where HFSS prices were much higher due to the U.S. sugar program. Liberalization would have lowered HFSS prices to Canadian producers and eliminated price differentials between the United States and Canada. While most Canadian HFSS would have found markets within Canada, the proximity of Canadian HFSS production to Northeast U.S. markets would have provided a transportation cost advantage over Midwest U.S. producers of HFSS.

Less-Developed Countries

Sugar production in less-developed countries would have been about 53 MMT, 13 percent more than actual production of 47 MMT.

Brazil's sugar production would have been about 20 percent higher, assuming its alcohol policies and the price of oil were held at 1986-88 values. Although there are small HFSS facilities in Brazil, the low cost of domestic sugar would have precluded any significant HFSS expansion.

India and Mexico would have produced about 5 and 3 percent more sugar, respectively. Thailand would have been able to produce perhaps as much as 50 percent more, the largest increase of any producer, as its sugar policies in 1986-88 were flexible and producers were exposed to world price signals. We

assume that capital for the large increase in processing facilities would have been secured. Other less-developed countries which would have increased production, mostly by about 5-15 percent each, would have been Indonesia, the Philippines, Dominican Republic, and Swaziland.

Centrally Planned Economies

Sugar production by the centrally planned countries would have been about 11 percent higher. USSR sugar production would have been about 10 MMT, the same as without liberalization, as policies in 1986-88 were not flexible enough to allow a significant production response to higher world prices. Cuba would have been able to respond only slightly, and sugar production would have been about 8 MMT, 10 percent above the actual level of 7.23 MMT. Sugar production in China and other centrally planned economies would have risen somewhat because higher world sugar prices would have encouraged domestic production.

Impacts on Sugar Consumption

Worldwide sugar consumption would have been roughly the same before and after liberalization, following the result of unchanged world production, since in any period of time, worldwide consumption and production must be in rough balance, except for changes in stocks.

Industrial Market Economies

Demand for sweeteners in most industrial market economies is quite unresponsive to changes in price and incomes. The major change in sweetener consumption would have been an increase in HFSS at the expense of sugar in the EC and Japan. Overall, industrial market economies would have consumed about 9 percent less sugar and about 60 percent more HFSS.

United States. U.S. sugar and HFSS consumption would have increased slightly, about 2 percent, as prices of both would have fallen 10-20 percent. As HFSS market penetration was near its technical maximum level in 1986-88, it would have maintained just above 40 percent of the combined sugar/HFSS market.

EC. In the EC, combined sugar and HFSS consumption would have increased, but sugar consumption would have been lower by about 20 percent due to HFSS inroads in traditional liquid sucrose markets. HFSS consumption would been about 3.5 MMT instead of 0.2 MMT. The maximum potential market share of HFSS in the EC is lower than in the United States due to a much lower per capita consumption of soft drinks. HFSS use would have peaked at about 25 percent of the 13 MMT combined sugar/HFSS market.

Other Western Europe. In nations of Other Western Europe, sugar consumption would have been about 10 percent lower, although total sweetener consumption would have been up about 3 percent due to higher HFSS consumption (0.3 MMT instead of 0.1 MMT). HFSS would not have attained as large a market share as in the EC, as countries in Other Western Europe do not have the large consumer markets needed to justify the large-scale investments required for low-cost HFSS production. Intra-European trade in HFSS would be limited by the high cost of transporting HFSS, which is about 70 percent water. The market share of HFSS in most Other Western Europe countries would have risen to levels somewhat below the EC's 25 percent.

<u>Japan</u>. In Japan, total sweetener consumption would have been higher by about 5 percent, all accounted for by higher HFSS consumption which would have been 900,000 instead of 690,000 metric tons, an increase of 30 percent. Sugar consumption would not have increased even with the lower consumer price, due to competition from HFSS. The HFSS share of the sugar/HFSS market would have increased to about 25 percent, compared with actual 1986-88 levels of about 20 percent.

<u>Australia</u>. Sugar consumption in Australia, where the consumer price would have risen slightly, would not have been significantly different. Liberalization would also not have changed the level of HFSS consumption of about 10,000 metric tons. The cost advantages of HFSS in countries with cheap access to corn, such as the United States, Japan, EC, Canada, and South Africa, do not exist in Australia, which would have to either import corn, incurring large transportation costs, or use wheat, which has much higher valued alternative uses than corn.

<u>South Africa</u>. In South Africa, sugar consumption would have been lower, as the higher world price would have been transmitted to consumers, many of whom would have had to cut back on sugar consumption. HFSS consumption would not have changed, as HFSS is simply not competitive with sugar in South Africa.

<u>Canada</u>. Canada's total sweetener consumption would not have been affected very much, though the domestic price of sweeteners would have risen. The share of HFSS in the combined sugar/HFSS market would have risen from about 3 percent to 20 percent, as over 200,000 metric tons of HFSS, which was previously exported to the United States, would have mostly been consumed domestically. Sugar consumption would have fallen slightly due to increased HFSS use.

<u>Less-Developed Countries</u>

Changes in sugar consumption in the less-developed countries would have been less than in the industrial market economies, mainly because HFSS substitution is not feasible in most less-developed countries, but also due to the fact that consumer prices in most less-developed countries have not been maintained so far above world price levels. Consumer prices would have risen most in those countries which did not previously maintain high consumer prices, and did not have policies to shelter urban consumers from high world sugar prices. Overall less-developed country sugar consumption would not have changed.

Brazil, India, and Mexico accounted for almost 40 percent of less-developed country sugar consumption in 1986-88. All three would probably have allowed some increase in consumer sugar prices in response to the higher world price, and consumption in these three countries would probably have been lower, perhaps by 2-3 percent. Low-cost exporters for whom sugar exports constitute a significant source of foreign exchange and national income, such as the Dominican Republic, Swaziland, and Mauritius, would almost certainly have experienced income gains which would have more than compensated for higher domestic sugar prices, and sugar consumption in these countries would probably have increased.

Nonsugar producing less-developed countries would have faced price increases significant enough to reduce consumption, and on balance, less-developed countries would have consumed about 1 percent less sugar.

Centrally Planned Economies

Governments of the centrally planned economies would not likely have allowed their domestic sugar prices to rise, even though subsidies for sugar would have imposed large budgetary costs on national treasuries. It is likely that the USSR, regardless of the world price, would have allowed only a small reduction in consumption. China would have likely been unable to completely offset the higher world price, thus would probably have reduced consumption by 1 percent. Cuba would likely have kept its domestic price, and thus consumption, constant. Overall, centrally planned economies' sugar consumption would not have changed significantly.

Impacts on World Sugar Trade

Impacts of liberalization on world sugar trade would have been far more dramatic than on world production or consumption.

Industrial Market Economies

Industrial market economy sugar imports in 1986-88 were about 6 MMT per year, and exports were about 10 MMT. Liberalization would have caused a swing of about 8 MMT in the net trade position; annual exports would have fallen to about 6 MMT, and annual imports would have risen to about 10 MMT. This result is consistent with Tyers and Anderson and most other studies. Overall industrial market economy exports would have fallen about 38 percent, and imports would have risen about 23 percent.

World trade in HFSS has been limited mostly to Canada's exports to the higher priced U.S. market, which would likely be sharply reduced with liberalization. It is possible that some expansion of HFSS trade would have occurred in Europe, but only in very small amounts.

Among the industrial market economy exporters, the EC, which has been the world's second-largest sugar exporter in recent years and the largest exporter of white sugar, would have reduced net sugar exports to about 1.5 MMT. The EC's comparative advantage in supplying refined sugar to Middle East and North African markets would have continued. EC sugar imports under the Lomé convention pose a special problem: they clearly are a preferential trade arrangement, and yet the EC has claimed that the basic purpose of the Lomé sugar arrangements is to provide a form of foreign aid to poor exporting countries. We assume the Lomé special arrangement would have been eliminated, and the EC would have ceased importing sugar. Australian sugar exports would have been about 30 percent higher, up by 0.8 MMT. South Africa would have increased exports about 20 percent.

Among industrial market economy importers, the United States would have imported about 3.8 MMT instead of the actual average of about 1.2 MMT, due to lower domestic production and slightly higher domestic consumption. New refinery capacity would have been needed to handle the increase in imports, although some of the increased imports of raw sugar would have simply replaced domestic raw sugar. Instead of coming from about 40 countries which share the quota, sugar would have come from a few dominant suppliers such as Australia, Brazil, or Thailand. South Africa and Cuba would be natural suppliers geographically, but the political problems between those countries and the United States are not assumed to be solved by liberalization.

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Japan's imports would have risen about 50 percent, as domestic production would have ceased. Canada would have imported the same level of sugar, about 900,000 metric tons, and would probably have ceased exports of refined sugar to the United States, except for very nearby markets.

Less-Developed Countries

Over 1986-88, less-developed countries (all countries not counted as industrial market economies or centrally planned economies) averaged sugar exports of about 10 MMT, imports of about 13 MMT, and net imports of about 3 MMT. With liberalization, the less-developed country net trade position would have been reversed, as annual exports would have risen to about 13 MMT and annual imports would have shrunk to about 10 MMT, yielding annual net exports of a positive 3 MMT. Overall, less-developed country exports would have risen 34 percent, and imports fallen 19 percent.

Most less-developed country exporters would have exported more sugar. Brazil would have grown to be the world's second largest exporter, behind only Cuba, and India would likely have been a more regular exporter. Countries such as Thailand and the Philippines, with more stable and higher prices, would have taken advantage of their comparative advantage in sugar and achieved higher exports.

Caribbean Basin Initiative (CBI) Countries

Sugar is an important commodity for many of the countries covered by the U.S. CBI legislation. Thirteen CBI countries have a share of the U.S. sugar import quota, and six have a share of the EC's Lomé sugar quota. Over 1986-88, about 51 percent of CBI total sugar exports were under either the U.S. or EC sugar import quota (table 20). Assuming that all nonquota sugar received the No. 11 world price, which averaged 7.65 cents a pound in 1986-88, the CBI countries' total revenue from sugar exports averaged $541 million per year.

If the world price had been 15 cents (almost double the actual level) and production levels the same, total revenue from sugar exports after liberalization for the CBI group would have been $564 million, up $23 million from the actual level. Eight countries would have lost and five would have gained from liberalization, but the impacts would have been very uneven. The Dominican Republic ($34 million) and Guatemala ($43 million) would have been the largest gainers in terms of gross revenue, because they are by far the largest exporters in absolute terms and have a relatively smaller dependence on preferential markets than most of the other countries. The countries most dependent upon preferential markets, such as Barbados, Guyana, Jamaica, St. Christopher-Nevis, and Trinidad and Tobago, would have been the largest losers. Whether positive or negative, liberalization's impacts would have been large relative to the size of the economies for these countries.

It is unlikely that volumes produced and exported would actually have remained constant under liberalization, as assumed in table 20; some low-cost CBI countries, such as the Dominican Republic, would likely have increased production, while others would have cut back. If this occurred, the effects shown in table 20 would likely be understated for both winners and losers. In particular, without the benefit of the high price guarantees from the EC and United States, some CBI countries would likely have ceased exports and perhaps even production altogether.

Table 20--Caribbean Basin Initiative (CBI) country impacts of trade liberalization

CBI-designated countries 1/	1986-88 average				U.S. and EC quotas as share of total sugar exports	Total revenue from quota and "free-market" exports	Liberalized total revenue from all sugar exports	Revenue change under liberalization 3/	Sugar exports as percent of total exports, 1982-84 average 4/
	Quota sugar exports under:			Total sugar exports					
	U.S. quota	EC quota 2/	U.S. and EC quotas combined						
	- - 1,000 metric tons 5/ - -				Percent	- - - - - Million dollars - - - - -			Percent
Barbados	8.3	53.8	62.1	77.5	80	31.65	25.64	-6.01	8
Belize	13.8	43.2	57.0	91.4	62	32.27	30.21	-2.06	39
Costa Rica	21.7	NA	21.7	70.7	31	17.90	23.38	5.48	2
Dominican Republic	190.7	NA	190.7	531.8	36	142.16	175.88	33.72	34
El Salvador	31.1	NA	31.1	75.1	41	21.22	24.84	3.61	4
Guatemala	52.8	NA	52.8	354.4	15	74.31	117.21	42.90	5
Guyana	10.6	170.6	181.2	185.7	98	85.88	61.42	-24.46	35
Haiti 6/	8.3	NA	8.3	4.0	100	3.70	1.32	-2.38	1
Honduras	20.1	NA	20.1	59.4	34	15.56	19.65	4.09	4
Jamaica	13.7	127.0	140.7	144.8	97	66.64	47.89	-18.75	7
Panama	23.0	NA	23.0	27.9	83	11.05	9.23	-1.82	11
St. Christopher-Nevis 6/	8.5	16.7	25.2	22.5	100	11.63	7.43	-4.20	NA
Trinidad and Tobago	8.6	46.8	55.5	59.3	93	26.56	19.63	-6.93	1
Total	411	458	869	1,705	51	540.53	563.73	23.20	NA

Note: Not designated as CBI beneficiaries: Anguilla, Cayman Islands, Nicaragua, Suriname, and Turks and Caicos Islands.

NA = Not applicable.

1/ Designated countries which do not have a U.S. or EC quota are: Antigua and Barbuda, Aruba, Bahamas, British Virgin Islands, Dominica, Grenada, Montserrat, Netherland Antilles, St. Lucia, St. Vincent, and the Grenadines.

2/ Assumed filled.

3/ Calculated as the difference between 1986-88 and post-liberalization revenues from both quota and free-market sugar exports. Assumed price after liberalization is 15 cents per pound. Positive number indicates revenue gain from liberalization.

4/ World Bank (1988).

5/ Raw value.

6/ Exports assumed sufficient to cover U.S. and EC imports.

Sources: Quota data from USDA and CAP Monitor. 1986-88 export data from International Sugar Organization.

Centrally Planned Economies

Trade liberalization would have caused overall centrally planned economies' sugar imports to fall slightly, about 1 percent, and exports to rise about 13 percent. The only significant centrally planned economy exporters are Cuba and Poland, which would have accounted for all of the increased exports, assuming they could have responded to the higher world price.

Of the centrally planned economy importers, China would have imported less sugar due to budget constraints, as would have several of the other Eastern European countries. USSR imports are not very sensitive to world price, and thus would not have changed significantly, given continuity of the USSR/Cuba sugar agreement.

Impacts on Sugar's Longrun Real Price Trend

Inflation, an ongoing fact of life in most of the world today, contributes to an increase in the nominal price of sugar over time, other things being held constant.

Time is often used as a proxy variable for technological change and other economic forces which might contribute to persistent changes in real prices. A measure of the degree to which changes in one variable can explain changes in another is the coefficient of determination, R^2.[8] The R^2 for the real world sugar price regressed against time is 0.01, which is very low. The annual percentage decline (over 1950-89) in the real sugar price of 0.6 percent is very low, and a number in which we have little confidence (table 21). This is in contrast to the percentage declines over 1945-89 in the real price of corn (2.7), wheat (2.7), soybeans (1.1), cotton (2.5), and rice (2.4), which have reasonably strong correlations with the time trend.

The coefficient of variation of the real sugar price over 1950-89 is 0.70, about double the average of the other commodities, which range from 0.25 for soybeans to 0.43 for corn. The extreme swings in the real world sugar price are also evident from the fact that the highest price during 1950-89 was a multiple of 15 times the lowest price, a very high multiple for an annual average commodity price. The highest multiple among the other commodities is rice, for which the highest price is 9 times the lowest.

These statistics provide evidence that the real world price of sugar has had greater variability, and shown less of a decline, than the real price of many other agricultural commodities. One hypothesis to explain these findings is that the high level of protection afforded much of the world's sugar production has maintained costs (and therefore, in the long run, prices) above levels which might have been expected in the absence of such a high degree of protection, or has maintained production in countries in which costs are relatively high.

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[8] The coefficient of determination, R^2, is a measure of the proportion of variation accounted for in one variable by another. Here, it would be the variation in sugar price accounted for by "time," where time is used as a proxy for technical change.

Table 21--Real price statistics of major commodities, 1945-89

Price statistic	Sugar 1/	Corn	Wheat	Soybeans	Cotton	Rice
	Cents/lbs	- - - - - Dollars/bu - - - - -			Dollars/lbs	Dollars/cwt
Average annual:						
Absolute change	-0.09	-0.11	-0.14	-0.08	-2.3	-3.50
Minimum (year)	3.64('85)	1.30('86)	2.09('86)	4.13('86)	44.0('88)	3.24('86)
Maximum (year)	55.50('74)	9.50('47)	10.02('47)	11.72('74)	164.0('50)	29.55('73)
Range	51.90	8.20	7.93	7.59	120.0	26.31
Average	14.00	3.88	5.34	7.57	91.0	14.65
			Percent			
Annual percentage decline	-.6	-2.7	-2.7	-1.1	-2.5	-2.4
			Index			
Coefficient of variation	.70	.43	.40	.25	.36	.39
R-squared of linear time trend	.01	.66	.72	.23	.79	.63
			Ratio			
Maximum divided by minimum	15.2	7.3	4.8	2.8	3.7	9.1

Note: Real prices, using U.S. GNP deflator, 1982=100.
1/ For years 1950-89.
Source: U.S. Dept. Agr., Econ. Res. Serv.

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The world sugar price reflects the effects of government policies, whether they subsidize or tax producers or consumers. Most studies indicate that the net effect of all countries' sugar policies has been to lower the world market price, shown in figure 12 as the gap, "effects of government supports." (Note that policies are not assumed to have lowered domestic prices.) If no liberalization occurs, the real price of sugar would presumably follow the status quo of line A, a very slow (if any) decline. However, if liberalization occurs, there are several possibilities.

If the effects of government support have been to lower only the level of the real world sugar price, but not the trend, then path B would occur after liberalization, and the price trend would continue the historical level. If, however, government support policies have slowed down technological change, then path B' might occur following liberalization, that is, an increased rate of decline of the real sugar price, perhaps at the 2-3 percent rate observed for other agricultural commodities. It is possible that government policies have, on balance, increased the pace of technological change, in which case a post-liberalized sugar price might actually stay constant or rise (not shown).

Following liberalization, which path would the sugar price have taken after 1986-88? It is our estimate that B' is more likely, given the degree to which government policies have encouraged or maintained sugar production with little regard to efficiency. If the path were along B', there would have been longrun benefits of liberalization of reductions in real costs, and thus prices. This "additional" reduction in price would complicate the estimation of what a liberalized price would have been in 1986-88, and illustrates the extreme difficulty of being precise about liberalization scenario price estimates.

Figure 12

Alternative real world sugar price trends under trade liberalization
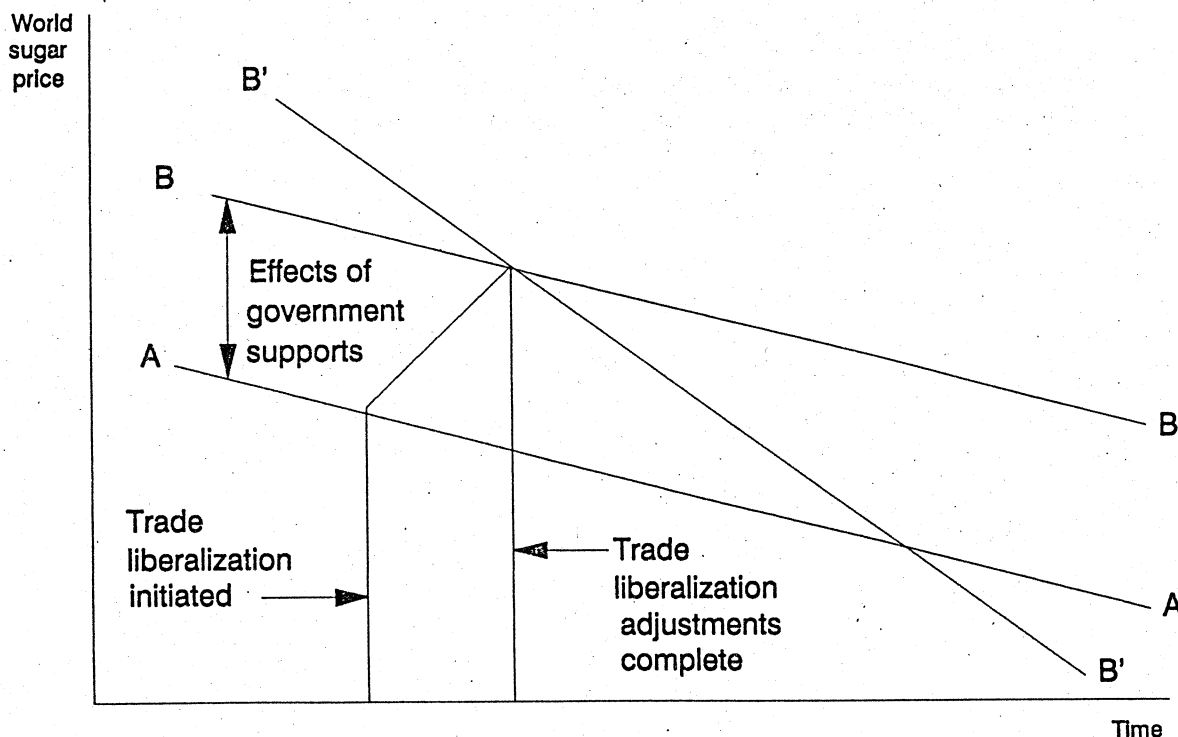
Conclusions

The scenario envisioned in this report is not the same as the GATT proposal of any country or block of countries. This report has attempted to answer the question: If the industrial market economies had eliminated their trade-distorting agricultural policies, and the less-developed countries and centrally planned economies had not, what would the global sugar market have looked like over the years 1986-88, assuming sufficient time to adjust to the liberalized environment?

The key effects of industrial market economy liberalization, compared with actual 1986-88 values and derived from the authors' judgment, and understood to be indicative rather than precise estimates, are:

o The real longrun equilibrium world sugar price would be 10-30 percent higher than the 1975-89 average of 13 cents (in 1982 dollars), in a range of 14-17 cents, and about double the 1986-88 average price.

o Sugar production would have shifted away from industrial market economies toward less-developed countries, with some exceptions.

o U.S. sugar production would have declined, perhaps by as much as 30 percent.

o Global sugar consumption would have fallen slightly. Additional HFSS substitution would have occurred in some industrial market economies, and higher prices would have cut consumption in some less-developed countries. Centrally planned economy countries' consumption would have changed little.

o Sugar trade would have shifted dramatically. With some exceptions, the industrial market economies would have exported less and imported more, and the less-developed countries exported more and imported less.

o The centrally planned economies would have adjusted less (in production, consumption, and trade) than the industrial market economies and less-developed countries, due to the closed nature of their economies.

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