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Cuba-USSR Sugar Trade

C. Suan Tan

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ABSTRACT

Cuba is the single largest sugar exporter and is reliant on sugar for some 70-80% of its total export revenue. Since 1960, Cuba's sugar exports have been distributed in the ratio of about 40:60 between the market economies and the centrally planned economies, with the Union of Soviet Socialist Republics as the dominant importer in the latter. This paper attempts to explain the distribution of Cuba's sugar exports between these two major markets during the 1960-83 period.

The 1959 Cuban revolution resulted in trade diversion from Cuba's neighboring countries to trade with the socialist countries, with the consequent loss of access to technology from the industrial market economies and the higher transport cost of trade with Eastern Europe and the USSR. The problems experienced by the Cuban sugar industry in the post-revolutionary period are shown to be associated with Cuba's attempts to attain economic growth and diversification away from sugar, without prejudicing its objective of increasing international solidarity with the socialist economies.

Empirical analysis supports the hypothesis that the distribution of Cuba's sugar exports is determined by the relative (world-to-Soviet) price for sugar, the ratio of Cuba's balance-of-trade with the market economies to that with the centrally planned economies, and the Soviet domestic sugar supply deficit. The Soviet price for Cuban sugar is partly determined by the Soviet supply of oil to Cuba.

Cuban sugar exports are estimated to affect the world price with an elasticity of about -0.7 . By complementing the two export share equations and the world price equation with equations for total Cuban production, Soviet production and consumption, the Soviet price for Cuban sugar and world production, consumption and stocks, the resulting 18-equation model facilitates assessment of the longer-term outlook for Cuban sugar in the world market.

Given the world sugar market outlook and the problems of Cuban economic development to date, the sugar industry does not appear able to provide the necessary impetus for economic growth and diversification.

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SUMMARY AND CONCLUSIONS *

This study of the Cuba-USSR sugar trade during the 1961-83 period shows that Cuba's sugar export behavior has been intertwined with its checkered economic development path resulting from experimentation with various modes of centralised planning. The difficulties Cuba experienced in attempting to achieve sustained development lie, in large part, in the conflicts inherent in attempting to allocate resources to satisfy the dual goals of domestic economic development and international solidarity with countries that are geographically distant from it. Its sugar export behavior, in terms of the proportion of sales to the CPEs and the market economies, is shown to be a function of relative sugar prices received from the USSR and the free market, the ratio of the balance-of-trade with the CPEs and with the market economies, and the Soviet sugar production-consumption gap relative to Soviet consumption. Prices received from sales to the USSR are related to world prices, with a lag; and to the balance-of-trade with the CPEs, which in turn is strongly influenced by the Soviet supply of oil for Cuban consumption and re-export.

The outlook for continued Cuba-USSR trade in sugar has bearing on the world market since Cuba's sugar exports constitute some 40-50% of the total sugar trade. In 1982, for example, Cuba's total exports were 7.7 million tons out of a total free market trade of about 15 million tons. Fluctuations in Cuban exports therefore contribute to fluctuations in the world price of sugar. Increased Cuban exports would, ceteris paribus, depress the world price and therefore need not imply increased hard currency foreign exchange earnings. The empirical estimates presented in this study show that the world sugar price is sensitive with a one-year lag to Cuba's share of the free market sugar trade. The long-run elasticity of world sugar price with respect to Cuba's export share is estimated to be about -0.7 in the historical period.

* This paper has benefitted from discussions with Jose F. Alonso whose assistance in providing relevant research materials is gratefully acknowledged. Useful suggestions from Ronald C. Duncan, who carefully read earlier drafts, and James Fry and assistance from James Linsalata in the preparation of figures and tables are also gratefully acknowledged.

This means that a 1% increase in Cuba's share of the free market trade will induce a 0.7% decline in the world sugar price in nominal terms.

Given the same levels of Cuban production and export and Cuban balance-of-trade with the CPEs and market economies, the higher the Soviet supply deficit (through either a fall in Soviet production or increase in Soviet consumption), the higher the Cuban share of exports to the CPEs. Increased Soviet consumption will reduce world stocks and hence raise world market prices. Since the Soviet price for Cuban sugar is partly determined by the world price, the Soviet price also increases. However, the USSR is known to adjust price changes for Cuba's sugar partly in accordance with Cuba's balance-of-trade position with the CPEs. An improvement in Cuba's balance-of-trade position with the CPEs would, therefore, induce a lower Soviet price rise than might otherwise have been warranted by the world price increase.

This study shows that Cuba's exports of sugar to the CPEs and market economies are strongly complementary, if not equally important. The long-term Cuba-USSR sugar arrangement thus differs from the special arrangements such as the US Quota Program and the Lomé Sugar Protocol in that the Cuba-USSR arrangement is partly tied to the Soviet supply of oil to Cuba, and influenced by Cuba's need for hard currency foreign exchange earnings. Furthermore, while the Soviet price for Cuban sugar is partially determined by the world price, as ultimately are prices set under the US Quota Program and Lomé arrangement, the Soviet price is additionally influenced by the Cuban balance-of-trade with the CPEs.

In this context it would be remiss to overlook the geopolitical factor that explains the trade strategy of post-revolutionary Cuba, and which is implicit in the partial equilibrium analytical framework presented here. While a study of the full implications of this trade strategy is beyond the scope of this paper, one major and obvious outcome is Cuba's trade diversion from the United States and other nearby countries to the distant countries within the Council of Mutual Economic Assistance (CMEA). Two negative consequences of this trade diversion are (1) the loss of access to appropriate technology required for its economic development, and (2) the additional transport cost burden. The geopolitical factor also explains, at least partially, the foregone hard currency earnings borne by the USSR in its oil

exports to Cuba by allowing some of this oil to be re-exported by Cuba for hard currency foreign exchange earnings. This was especially so in the period from the 1970s to the early 1980s when oil prices remained high while sugar prices declined.

Cuban and Soviet sugar production is not expected to increase markedly in the coming decade. Even were Cuban production to increase markedly, the current poor outlook for world sugar prices means that there is little scope for markedly increasing Cuban exports without further depressing prices. Successful sugar-based diversification by Cuba may be envisaged, however, were the oil-sugar nexus with the USSR maintained with the following provisos: (1) Cuba receives more than compensating increases of Soviet oil for hard currency re-exports in a lower oil price setting; (2) the USSR and other CMEA countries are willing and able to absorb higher sugar imports from Cuba so that increased Cuban production will not result in a higher world stocks-consumption ratio; and (3) economic management in Cuba improves. Otherwise, the Cuban sugar industry appears unable to provide the impetus for economic growth and diversification by generating the hard currency needed to effect the technology transfer Cuba needs for its sugar and non-sugar industries.

I. INTRODUCTION

Cuba is the single largest exporter in the international market and relies on sugar exports for some 70-80% of total export revenue. Prior to the 1959 revolution, 60% of Cuba's sugar was exported to the United States at preferential prices under the US Sugar Program. Since 1960 Cuba's sugar exports have been distributed in the ratio of about 60:40 between the centrally planned economies (CPEs) and the market economies. The bulk of sugar exported to the CPEs has been sold to the USSR at prices higher than world prices.

In assessing Cuba's role in the world sugar market over the longer term, it is necessary to understand how its export shares to the CPEs and the market economies are determined. Before doing so it is useful to analyse the development and role of the sugar industry in the context of Cuba's economic development strategy and policies after 1959.

This paper attempts to identify the determinants of Cuba's sugar exports to the CPEs and market economies in the 1960-83 period. The analysis is aimed at understanding the Cuba-USSR sugar trade arrangement and providing answers to questions such as: (a) is there a parallel between the Cuba-USSR long-term sugar arrangement and special arrangements between other sugar producing and consuming countries, such as the US Sugar Quota Program or the Sugar Protocol of the Lomé Convention? (b) to what extent is the CPE--in particular the USSR--market a preferred market and the market economies' market a residual market? Or, are both markets of equal importance to Cuba? (c) given Cuba's unsatisfactory attempts to increase sugar production alongside economic diversification and the prospect of low world sugar prices, what is the longer-term outlook for Cuban sugar exports to the market economies? (d) to what extent is this outlook predicated on harmonising Cuba's development policies with Cuba-USSR relations?

The problems of the Cuban sugar industry are closely related to the problems of economic growth and diversification in post-revolutionary Cuba. The problems stem essentially from two non-mutually exclusive difficulties. The first difficulty is concerned with the experimentation with varying degrees of central planning and control of the economy that has led to a

checkered economic development path (and which critically affected the growth of the sugar industry). The second difficulty is concerned with the problem of harmonising resource allocation aimed at internal development with that aimed at increasing international solidarity with the socialist countries.

Typically, planning resource allocation for domestic economic development leads to consideration of the means to satisfy the demand for capital goods, human capital and technological progress. For Cuba the demand for capital goods, human capital and technology translates into a demand for capital imports, and hence demand for hard currency foreign exchange. However, Cuba's objective of international solidarity has imposed constraints on hard currency foreign exchange earnings and technology transfer. This is because even were the USSR or other countries within the Council for Mutual Economic Assistance (CMEA) willing to provide aid to relax the foreign exchange constraint, these countries can only provide some of the necessary investment goods, including those for the sugar cane industry. Yet the sugar cane industry is integral to Cuba's economic development, and successful growth of the sugar cane industry is predicated on appropriate capital goods imports to modernize the industry.

The behavior of Cuban sugar exports to the CPEs and the market economies during the period 1960-83 is analysed in the context of the two difficulties that Cuba has been facing. Section II outlines the various socialist development strategies and economic policies which Cuba has experimented with and the problems encountered during the 1960-83 period. Section III reviews the impact of these policies on the sugar industry and the experience with mechanisation in the industry. Section IV analyses the Cuba-USSR sugar trade, and puts forward the hypothesis that Cuban sugar export shares to the CPE and market economies are jointly determined with both markets of equal importance. Section V presents the empirical results on the export shares determination hypothesis. The results suggest that Cuban sugar exports to the CPEs and market economies are strongly complementary, if not equally important to Cuba. Section VI discusses the extension of the export shares equations to a simultaneous equation model for examining the potential effects on world price of Cuban sugar exports under alternative scenarios. Equations for determining world sugar price, Soviet sugar price, Soviet

production and consumption, and world stockholdings are first estimated. Simulation of the 18-equation model under alternative assumptions about Cuban production and balances of merchandise trade with the CPEs and market economies provides estimates of the sensitivity of the world sugar price to Cuban exports, and the sensitivity of Cuban export shares distribution to continuation of Cuban-USSR relations and to worsening of the Soviet supply deficit.

II. ECONOMIC POLICIES OF CUBA SINCE 1960

Commencement of the Cuba-USSR Relationship in 1960

The special sugar trade between Cuba and the USSR, dating since 1960, is closely related to the economic policies adopted by Cuba in the post-revolutionary period. A review of these policies shows how the sugar industry has been affected by Cuba's checkered economic development path, and how the special sugar trade was adjusted accordingly to help Cuba maintain its socialist economy and persevere with its socialist economy experiment.

Prior to the 1959 revolution Cuba was closely associated with the United States, politically and economically. In 1959, almost 60% of Cuba's sugar exports went to the United States, providing the United States with one-third of its domestic consumption requirements.

The revolutionary policies began with agricultural collectivisation (including sugar processing capacity) which was completed in 1960. In the same year the Central Planning Board (JUCEPLAN) was established. Although Cuba retained its sugar supply quotas to the US market after the revolution began, this quota was reduced by 0.7 million tons in 1960 as a result of a conflict between the two countries over oil refining arrangements. In 1961 diplomatic relations between Cuba and the United States were severed after the United States rescinded the Cuba sugar export quota. Thereafter, the socialist countries became Cuba's primary trading partners; the USSR stepped into the role previously played by the United States as the major purchaser of Cuban sugar. At the same time, the USSR also became the sole supplier of petroleum and petroleum products to Cuba.

Centralization and Economic Crisis in 1962-63

During the 1961-63 period an attempt was made to adopt the early Soviet socialist economic model. This model emphasized heavy industrialization for which technical advice was given by Soviet, Czechoslovakian and Polish economists. Collectivisation was extended to nationalization of most institutions, and the conversion of agricultural cooperatives into state farms. The highly centralized annual and medium-term plans were formulated by the JUCEPLAN. In 1962 prices became centrally fixed and rationing was

introduced. Thus a network of central ministries and agencies had to be created to provide the infrastructure necessary for operating the centralized economy which emphasized egalitarianism. In 1963 the Second Agrarian Reform Law introduced the system of compulsory state procurement quotas (acopio) at prices set by the state.

These major economic upheavals in 1962-63 led to the worst economic recession for Cuba in the revolutionary period. The fall in productivity caused by the disorganization resulting from the new administrative changes was exacerbated by the exodus of skilled manpower during the revolution. The sugar sector suffered from (1) the loss of professional cane-cutters, (2) the development of disguised unemployment upon the state's allocation of labor in an attempt to ensure full employment, and (3) the reduction in sugar cultivated area to 75% of the 1958 area. The lack of informational and managerial control also led to high spoilage and wastage of agricultural products, thereby further reducing the sugar harvest. Since economic diversification and the industrialization program was premised on continued growth of the sugar sector's earnings, the decline in the sugar sector created bottlenecks for the industrialization program. Consequently, Cuban dependence on the USSR deepened with the latter providing credit to cover the 1962-63 cumulative trade deficit of more than half-a-billion pesos.

Market Socialism and Emphasis on Sugar, 1964-66

The 1962-63 economic crisis led to the temporary shelving of the heavy industrialization program and a re-emphasis on sugar as the basis for economic growth. Throughout 1964-66 a debate ensued over the type of economic development model to adopt. The two contending models were those of:

1. market socialism introduced by Soviet economist E.G. Liberman and which the Soviet economy had begun experimenting with since the early 1960s, and
2. highly centralized planning-cum-full collectivisation, with emphasis on raising the consciousness of workers and managers as introduced by China's Mao Tse-Tung via the Great Leap Forward campaign of the late 1950s, and promoted in Cuba by Ernesto 'Che' Guevara.

The debate was conducted by simultaneous experimentation with both models for different sectors of the economy. Interestingly, the market socialism model was applied to agriculture (including sugar) and trade (both domestic and foreign), while the Maoist-Guevara model was applied to the remaining two-thirds of the economy. The rationale for the choice of model applications was that Cuba is essentially an agrarian economy that is highly dependent on foreign trade. This need to interact with the outside world invoked the need to employ the market mechanism. The concurrent implementation of both development strategies meant the introduction of the Soviet system of work quotas and wage scales, the use of budgetary finance in the two-thirds of the economy that was following the Maoist-Guevara model, and a proliferation of sectoral plans of which the most important was that for sugar.

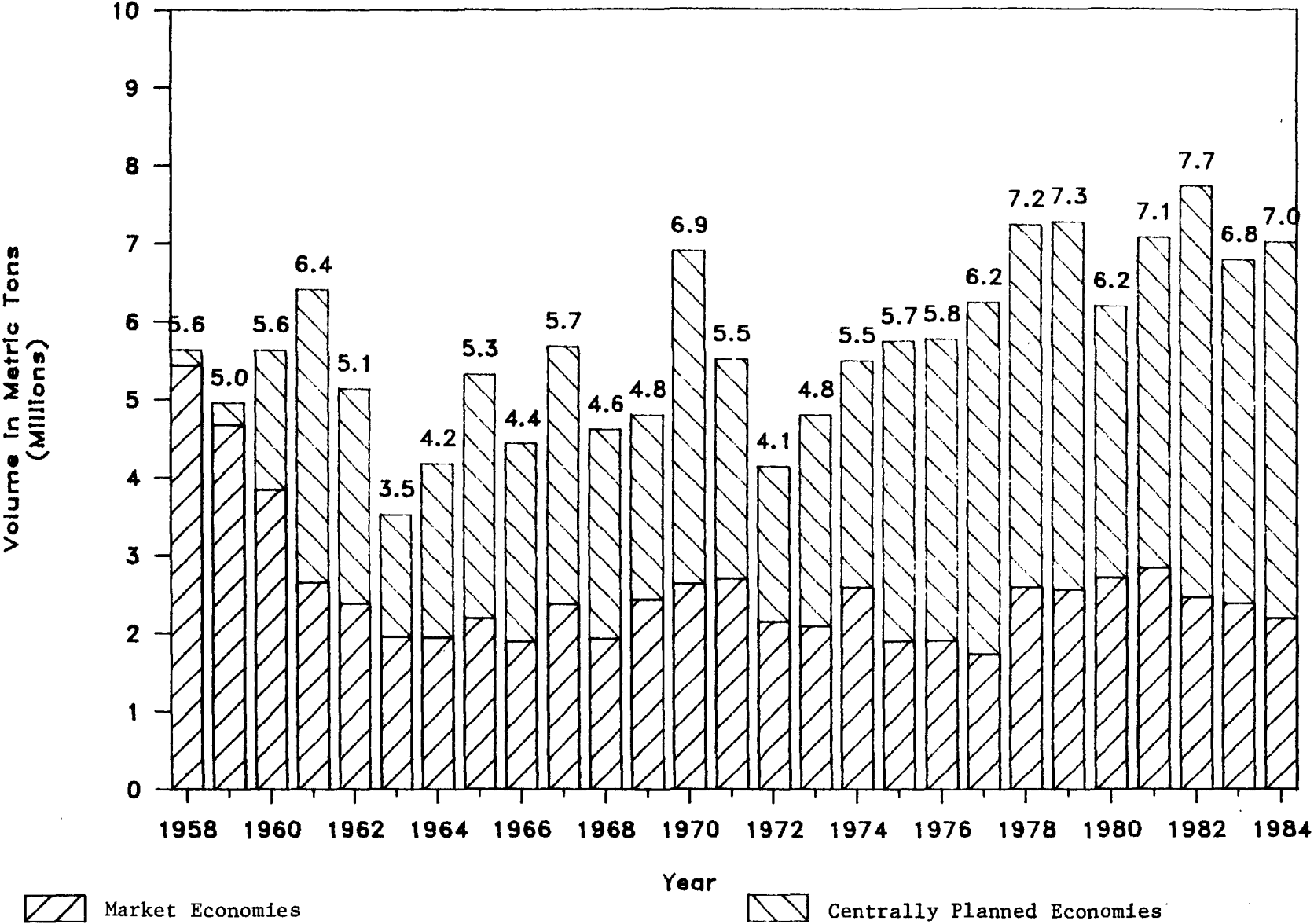
The 1964-66 period saw a return of economic growth to the Cuban economy. This was primarily due to the improved sugar harvest which allowed Cuba to take advantage of the increase in world sugar prices, particularly in 1964. However, higher sugar export earnings led to subsequent worsening of the trade deficit due to higher capital imports from both the CPEs and the market economies. Figure 1 gives the distribution of Cuban sugar exports during the 1958-1984 period from which is seen that exports to the CPEs vary from one-half to two-thirds of total exports. The share of exports to the market economies has varied between one-third and one-half of total exports. Throughout the period, the USSR alone absorbed at least one-third of Cuban sugar exports, except for the years 1963, 1969, 1971 and 1972. Figure 1 shows that although total Cuban sugar exports in 1965 increased in volume terms, the share of exports to the market economies was smaller (about 43% during the period) than that to the CPEs. Details of Cuba's sugar exports to the CPEs (by individual countries) and market economies from 1958 to 1984 are given in Appendix Table A.1, and show that Cuban sugar exports to the USSR hovered around 2.0 to 2.5 million tons.

Re-Centralization Under Castro's Political and Economic Leadership, 1966-70

The debate over development strategies ended in the summer of 1966 with Castro's promulgation of new economic policies extending to 1970 and based on the Maoist-Guevara approach. By the end of 1966, central planning was

Fig. 1: CUBAN SUGAR EXPORTS

(1958-1984)



made redundant by restricting economic decision-making to the political leadership. The state budgeting mechanism was abolished, as collectivization was reactivated in agriculture alongside increased use of the state procurement acopio system. Emphasis was on increased capital accumulation, at the cost of consumption. But resources were not allocated according to investment criteria such as comparison of rates of return among alternatives. The increased investment was therefore not accompanied by increased capital productivity, while the aim of narrowing wage differentials also led to lower labor productivity. The abolition of annual plans together with the non-harmonisation of sectoral plans created bottlenecks of material input shortages that precipitated plant shutdowns and incompletions.

Sugar exports fell from 5.7 million tons in 1967 to 4.6 and 4.8 million tons in 1968 and 1969 respectively. Consequently, the trade deficit worsened to about half-a-billion pesos in 1969. About 80% of this trade deficit was with the USSR which also experienced reduced imports of Cuban sugar because of Cuba's failure to meet the committed sugar deliveries. The share of Cuban sugar exports to the USSR fell from 44% in 1967 to 28% in 1969 with the sugar deliveries account having a cumulative deficit of ten million tons over these years. Some writers have attributed this reduced export share partly to the political dimension of Cuban confrontation with the USSR by adopting the Maoist-Guevara strategy. The retaliation by the USSR to induce Cuban submission is said to be evidenced by the reduced Soviet supply of oil to Cuba from 5.8 million ton in 1966 to 3.7 and 3.8 million tons in 1967 and 1968 respectively (Mesa-Lago, 1981:100). 1/ Cuban-Soviet relations began improving after Cuba supported the USSR in the 1968 Czechoslovakian-USSR confrontation.

1/ Interestingly, from 1968 onwards Soviet trade yearbooks ceased publication of crude petroleum exports data to Cuba and other countries. Instead, export data now refers to combined petroleum and petroleum products exports (Perez-Lopez, 1977:295).

Although the sugar harvest reportedly attained a record 7.5 million tons in 1970, 1/ it nevertheless fell short of the 10 million tons target under the sugar modernization program introduced in the mid-1960s. This failure to attain the set goal was partly due to the leadership's concern with full employment which resulted in disguised unemployment of inefficient workers in the sugar sector--hindering, rather than assisting, sugar harvesting and processing. The non-realization of the 10 million tons sugar output target and the resultant bottlenecks for the rest of the economy once again emphasized the critical reliance of Cuban economic growth on the performance of the sugar sector. It also brought home the inadequacies of the Maoist-Guevara development strategy.

Return to Central Planning with Economic Liberalization, 1971

From 1971 Cuba adopted the Soviet economic reform model which includes elements of economic liberalization. Central planning was reinstated to which mini, sectoral and special plans were made subordinate. Collectivised and private farms were transformed into cooperatives and state farms. The incentive system was introduced by raising state procurement prices and permitting private trading of production surpluses beyond the procurement quotas.

In 1972 payment of the enormous debt with the USSR was postponed and interest cancelled until 1986. By 1985 this debt had grown further and repayment had to be rescheduled.

In 1973 macroeconomic planning was reinstated and Five-Year Plans and long-range plans were instituted. Drafts were drawn up for the first Five-Year Plan for 1976-80, the second Five-Year Plan for 1981-85 and a 20-year Development and Forecast Plan for 1980-2000.

In the mid-1970s, the Soviet style of economic planning and management was introduced via the establishment of the System of Economic

1/ This output actually constitutes production of more than one season since cane-cutting continued throughout that year. The subsequent 1971/72 output decline reflects the smaller volume of cane available for cutting due to intensive cutting in the preceding year.

Management and Planning (SDPE) which was expected to be in full operation by the mid-1980s (Mesa-Lago, 1981:29). To assist the work of the SDPE, a State Committee of Statistics was established in 1977 for the purpose of statistical collection, standardization and publication. Market and financial instruments such as credit, interest rates, taxes, budgeting and monetary control were introduced. Periodic price adjustments were undertaken to ensure rational relative prices so as to enhance the SDPE's role in balancing supply and demand, and to improve overall resource allocation and utilization. State enterprises became decentralized and were now expected to practise quality control and be profitable. To facilitate improvements towards this end, the enterprises were granted authority in the hiring and firing of labor. Retail sales taxation was introduced to balance supply and demand as well as to generate state revenues.

In 1978 the State Budget was reintroduced, with the modification that the budgetary system was to be self-financing. Funds were now provided by the state to state enterprises and farms in the form of repayable loans, with interest rates ranging from 4% to 12%. Recognition of the importance of economic incentives was reflected in the introduction of wage incentive payments based on fulfillment and/or over-fulfillment of work quotas, and on the amount of overtime work. Priority in the allocation of housing and durable consumer goods and paid vacations was granted on the basis of certain skills and productivity. Further use of economic incentives was introduced via the establishment of an Economic Incentive Fund (EIF) for each enterprise in 1979. The size of each EIF was determined by the profitability of the enterprise and the fund was used to provide economic rewards to the workers, jointly and individually.

On December 17, 1975, the first Five-Year Plan for 1976-80 was announced. The Plan called for a 6% growth per annum in sugar output so as to reach the target output level of 10 million tons by 1980. This plan also emphasized industrial development, and introduced the use of the profitability criterion for future performance evaluation of the state-owned enterprises. The plan was followed by the signing of a five-year Cuba-USSR trade pact on February 6, 1976. This trade pact planned to double the volume of trade between the two countries. For 1976 the volume of bilateral trade was expected

to amount to \$3.4 billion. The aid component in this bilateral trade was publicly acknowledged by Castro in a speech on September 26, 1976. This Soviet aid was manifested in (1) paying five times the world price for Cuban sugar and (2) providing Cuba with oil and badly needed capital goods for its manufacturing sector.

The inadequacy of Soviet aid, both quantitatively and qualitatively (because of the Soviet inability to provide the appropriate technology such as for the sugar industry), was revealed in 1977 when the Cuban Foreign Trade Minister openly announced that Cuba would be agreeable to trade sugar, rum, cigars, chrome, copper and nickel for foodstuffs, fertilizers and industrial equipment from the United States. This attempt at rapprochement with the United States also provided Cuba added leverage in negotiations with the USSR (Mesa-Lago, 1977).

The structural imbalances in the Cuban economy which could not be resolved despite the Soviet support meant that the goals of the first Five-Year Plan were not realised in 1980. Crop failures led to food shortages and by 1980 Soviet subsidies were estimated to be at US\$8 million daily. Lack of labor discipline and increased black-marketing were reported and in 1980 Castro tightened his control over the key government ministries. On December 17, 1980, the Second Five-Year Plan for the period 1981-85 was announced; it incorporated some liberalization measures such as allowing peasants more freedom to produce on their private plots of land. In 1981 there was a comprehensive reform of wholesale and retail prices even as rationing continued.

The continued critical dependence on energy, infrastructure and productivity in the sugar industry to provide the impetus for development was reflected in a Cuban press agency report on April 30, 1982. This report stated that Soviet aid during the Second Plan period would facilitate the reconstruction of 21 sugar mills, upgrade the railroad system and assist in the construction of Cuba's first nuclear power plant. This dependence was further acknowledged in January 1983 through the introduction of a system of production incentives for sugar workers. These incentives included the award of consumer goods such as automobiles, washing machines, construction materials and foreign travel.

Despite the various attempts to improve its economic performance, the prospects for attaining the Second Five-Year Plan goals were dim even in early 1983. Thus in January 1983 Cuba sought a rescheduling of its debt repayments with its western creditors. Although interest payments for the then \$3.1 billion debt would continue, deferment and rescheduling of the principal repayment over a 10-year period beginning from 1986 was sought.

The period since 1971 can be differentiated into three sub-periods. During the 1971-75 period, a relatively impressive rate of economic growth was observed as the economy adopted economic reforms that increased capital and labor productivities. The global commodity boom and increased sugar prices in the world market compensated for the lower sugar production and exports during 1971-73. Cuba joined the Council for Mutual Economic Assistance (CMEA) market in 1972, a year after the concerted program of mechanized cane-cutting began. During 1976-80 the economy slowed down as the decline in world sugar prices exacerbated the difficulties which Cuba was experiencing in implementing the new economic strategy. Priority was given to sugar via labor mobilization and modernization of the sugar mills. But potential gains from increased sugar production and exports throughout 1976-77 were offset by declining world sugar prices from 1976 which led to the worsening of Cuba's overall balance of trade, especially during 1976 and 1977. The growing trade deficit with the market economies during this period was mitigated by a positive trade balance with the USSR by increased subsidies via the setting of Soviet prices for Cuban sugar at levels twice to almost five times as high as world prices and Soviet supply of petroleum to Cuba at prices about half the world prices (Mesa-Lago, 1981; Perez-Lopez, 1977). The 1981-85 Second Five-Year-Plan period is characterized by worsening foreign debt, and negotiations for deferment of debt repayments. Despite reform of the price and incentive system under the Five-Year Plan that was aimed at increasing flexibility in the economy, sugar production failed to reach 8 million tons in 1980-85, notwithstanding the 10 million ton target originally set for 1980. As world sugar prices continuously declined after 1980, to an all-time low by mid-1985, the Cuban balances of merchandise trade with the CPEs and market economies worsened. Deferment of debt repayments to the Western and Soviet creditors were thus sought.

A summary of these economic policies and their impact on the sugar industry are summarized by a chronology of developments in the Cuban sugar-based economy in Appendix II.

III. THE SUGAR INDUSTRY IN CUBA

Continued Dependence on Sugar Monoculture

Sugar is the main agricultural crop of Cuba as well as its most important export commodity. The history of Cuban sugar exports may be traced to the early 1800s after the Spanish Government conceded free trade to the colonies. The present organization of the Cuban sugar industry has evolved from around 1860 when the colonial style of production by sugar plantations was gradually converted to production by independent planters and mill tenants whose sugar cane was processed by central sugar mills.

The Cuban sugar industry began benefiting from US influence when Cuba became a republic in 1902, after the end of the Spanish-American War. There was a large influx of US capital; in particular, construction of the railroad system facilitated the expansion of sugar cultivation to central and eastern Cuba, thus establishing sugar as Cuba's monoculture industry. American influence continued until 1959 when the Cuban revolution established the pro-Soviet Fidel Castro regime. By 1959 Cuba had 161 sugar mills producing about 5.8 million tons of sugar. The larger share of this output was from the larger miller-planter units and the sugar mills in the central and eastern regions.

Upgrading of the Cuban sugar industry was attempted through the two agrarian reforms of 1959 and 1963. In 1965 the sugar industry undertook a US\$1 billion modernization program, aimed initially at replacing the antiquated machinery that had been in place since the 1920s. Subsequent to the 1960 nationalization of the bulk of industry, small shops were nationalized under the 1968 Revolutionary Offensive. Further measures taken in 1975 to raise productivity included streamlining the incentive payments in the industry and mechanizing the cane cultivation. Each sugar mill became associated with an "agro-industrial complex" whereby mill operations and transport arrangements were controlled by a managerial board. Within the transport sector the traditional ox and cart was replaced by a modern system of trucks, wagons and railroads; however, the inadequate road system was not upgraded.

By 1975 ploughing in the cane plantations was fully mechanized while 90% of the ratooning cane was cultivated mechanically. Some 60% of the cane was cut by tractor combines during the 1975 harvest, while all the handcut

cane was lifted and loaded by tractors with grapplers. A Cuban innovation is the cane-conditioning centers or cane-cleaning stations. At these cane-conditioning centers, some 50-60% of the foreign material or extraneous matter is removed from the freshly cut cane before the cane goes to the mills for crushing. The result of the modernization program has been the reduction of labor employed in the sugar industry by about one-half since the 1960s.

Present Industry Domination by State Farms

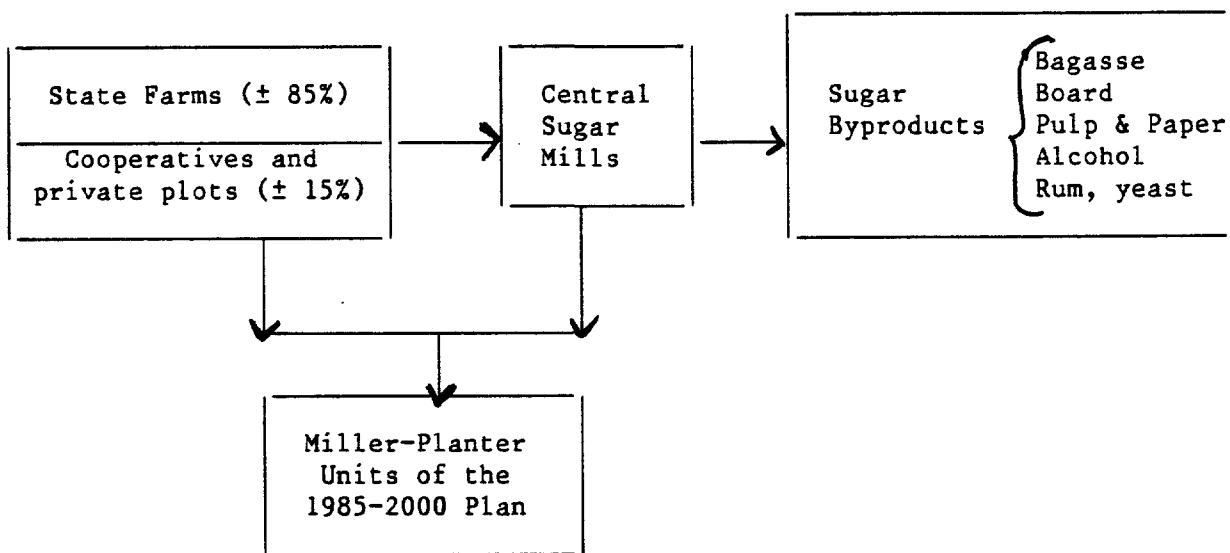
The sugar cane industry in Cuba is classified as a monostructural system where more than 85% of the area under cane is worked, or more than 85% of the cane is processed, by a single type of enterprise (Blume, 1985:192). 1/ The industry consists predominantly of state farms (about 85%), with state-controlled cooperatives forming the balance.

The state farms (or state-controlled planter enterprises) are organized on the basis of blocks, each block consisting of 12 fields. In 1980 the average size of the 144 state farms was 11,520 hectares, with fields averaging about 7.92 ha per field. The state-controlled cooperatives consist of private holdings, with each cooperative consisting of 90 private holdings. In 1980, each private holding averaged 6.8 ha. Thus the Cuban sugar industry may be differentiated into a state sector consisting of larger planters and a private sector consisting of co-operatively organized private peasant holdings. There are also some small private holdings that are not co-operatively organized.

The state farms and cooperatives transport their cane by rail or truck to the central sugar mills. In 1982 the total crushing capacity of the 154 mills was about 610,000 tons per day. About 60% of the mills have crushing capacities ranging from 2,500 to 6,000 tons per day; some 20% of the mills have daily crushing capacities below 2,500 tons while the remaining 20% have daily crushing capacities above 6,000 tons but not exceeding 14,000 tons.

1/ In contrast, a polystructural system is one where the area under cane is worked by more than one type of enterprise or where the processed cane is supplied by more than one type of enterprise. Polystructural systems maybe dominated by planters, or miller-planters.

Apart from producing sugar, these state farms also produce by-products, such as board, pulp and paper (from the bagasse), alcohol, rum and yeast. Efforts are being made to expand the production of sugar-based byproducts for exports, such as alcohol derivatives, chemical derivatives from cellulose and lignine, torula yeast for human consumption, bagasse boards for furniture manufacture, rum, candy and cordials production, furfural, lisine and enzymes for industry use. The present day organization of the Cuban sugar industry is illustrated by the following diagram.



In late 1984, it was reported that a 15-year economic plan aimed at speeding up Cuba's economic growth had been agreed upon between Cuba and the USSR (Latin American Mining letter, 1984). Under the plan, which is intended to improve Cuba's economy to East European standards, the USSR is guaranteeing Cuba expanded markets and development aid for its key export products of sugar, citrus fruits and nickel. In an effort to provide "greater unity between agriculture and industry," (Lodos, 1983) it is planned that the state farms and sugar mills will progressively merge into miller-planter units (David, 1983). The Cuban sugar industry may ultimately become a monostructural system of the miller-planter type, instead of the existing planter type.

Problems of Sugar Harvesting Mechanization

The sugar cane growing areas in Cuba are located within the latitudes 23-21°N where there is relatively high mean annual temperatures of 24-25°C. Throughout the year very different precipitation patterns are observed in the wet and dry seasons. The wet season (May to October) provides about 70% of the annual precipitation of 1,000-1,300 millimeters. In contrast, soil water shortages are experienced in the dry season (November to April). Cuban cane yields are also subject to the periodic strong winds and flooding from excessive rainfall brought by hurricanes; Castro described the damage caused in November 1985 by Hurricane "Kate" the "worst natural catastrophe this century".

Attempts at mechanized harvesting began in 1961 although it was not until 1964 that it became formally implemented. While there had always been an interest in mechanized harvesting, the concerted efforts after 1959 may be attributed to the simultaneous shortage of cane-cutters and reduced labor productivity. The labor shortage stemmed from the manpower exodus from Cuba after the revolution, and was exacerbated by the unwillingness of some rural workers to harvest cane since their livelihoods were now guaranteed by the socialist state. Consequently, labor that was alien to cane-cutting had to be mobilized from elsewhere in the economy, thereby lowering labor productivity.

Mechanisation began in 1961 with the Cuban-made MC-1 harvester for cutting green cane (i.e. without burning) and with grab-loaders. This method had the problem of harvesting weeds, leaves and other trash along with the cane, all of which had to be removed manually before the cane could be milled, thereby reducing the harvesting efficiency. Sugar production is one of the most demanding of agricultural activities in that a disciplined workforce for synchronising the cane-cutting, collection, cleaning and milling stages of production is integral to maximising productivity. Continued experimentation by Cuban technicians towards this synchronisation led to the development in January 1964 of the first prototype sugar harvester that could accomplish all the necessary operations. These operations consist of cutting cane at the ground level, eliminating the tops, cutting the cane stalks into pieces, cleaning the cane and loading them for transport to the mills (Edquist, 1983:45). In the same year Soviet-made loaders were introduced.

In 1964 the Soviet-made KCT-1 harvester was tested and 470 such harvesters were imported in 1965. By 1970, there were 1019 units of KCT-1 harvesters, but only 149 or 14.6% of these were in operation. This was because the KCT-1 harvesters could only harvest in burnt cane fields and at the rate of about 50 tons per day while present day harvesters can cut at the rate of 115-140 tons per day. Furthermore, trash collected by the KCT-1 harvesters amounted to some 13-15% of the cane cut, in comparison with 3-5% trash in the case of manually-cut cane. Such high levels of trash imposed unnecessary demands on transportation.

To overcome this problem of increased extraneous matter which lowered the sugar yield, dry cane cleaning stations (centros de acopio) were installed for removing the trash prior to cane crushing. Although these cleaning centers reduced the problem of trash, it nevertheless remained a limiting factor in mechanised sugar harvesting.

Thus, throughout the 1960s mechanised harvesting attained limited success because the Cuban-made cane harvesters had mechanical problems which could not be overcome even with Soviet technical advice. Soviet engineering experience in designing combine-harvesters precluded designs for the manipulation of a heavy prime material (such as sugar cane), and for operating in difficult terrain over extended time periods. The problem of inadequacy of Soviet technology to meet Cuban industrial needs remains relevant today and is a major factor explaining Cuba's need for hard-currency exports to import non-Soviet technology.

In the 1970s integrated mechanisation of cutting and loading took off with the use of combine-harvesters of different origins; namely the Cuban-Soviet KPT-1 harvester (for details see Edquist 1983:55-56), the Australian-made Massey-Ferguson 201 harvester and the Libertadora 1400 harvester (so named by Castro because it would liberate man from the arduous task of cane-cutting) that is produced in the Federal Republic of Germany, under licence with Cuban design and hybrid components. The numbers of each type of harvester in use during the period 1971-82 are presented in Table 1.

TABLE 1: NUMBER OF CANE HARVESTERS IN OPERATION, 1972-82

YEAR	HENDERSON 1 AND 3	LIBERTADORA 1400	M-F201	KTP-1	TOTAL
1971	148	2 /A	20	2 /A	172 /B
1972	100	19	115	2 /B	236 /B
1973	-	123	249	43	415
1974	-	163	387	180	730
1975	-	167	418	422	1,007
1976	-	162	439	683	1,284
1977	-	166	432	979	1,577
1978	-	166	435	1,405	2,006
1979	-	157	407	1,734	2,298
1980	-	157	365	1,901	2,423

Source: Edquist (1983:54), based on information from the Cuban Ministry of Sugar Industry (MINAZ) and Granma, December 29, 1982 (p.2)

Notes: /A denotes experimental machines;
/B excluding a limited number of KCT-1 and KT-1 in operation.

Extraneous matter continued to be treated at the dry cane-cleaning stations where the manually-cut cane was also detashed. However, the extensive use of mechanical harvesting created the need to modify the processing facilities to avoid (a) slowing down of the milling process because of the need to remove the impurities, and (b) lowering the sugar recovery rates and final product quality. Thus mechanical harvesting precipitated significant technical innovations in industry to provide the necessary machinery and equipment modifications.

While the Libertadora 1400 could cut both green and burnt cane, the use of mechanical harvesters such as the KPT-1 and Massey-Ferguson 201 require the burning of cane prior to their cutting. 1/ Consequently, growing concern over the long-run risks of indiscriminate pre-harvesting burning and the heavy

1/ Australia now has machines that cut the cane green and remove the trash in the field.

costs of attendant irrigation led to a progressive return to green cane harvesting in the late 1970s, resulting in a decline in the combine-harvesting yields. Meanwhile work has been done on improving the KPT-1 harvester, resulting in the KPT-2 prototype harvester that can harvest green cane. Although green cane harvesting results in more trash being generated, the trash provides both the ground cover which helps to conserve moisture in the dry non-irrigated areas and a source of food supplement for the livestock industry. Green cane also yields 7% more sugar per ton of cane milled than burnt cane.

One manifestation of the Cuban-USSR trade relationship is the increased mechanisation of the Cuban sugar industry in the 1970s. As mechanisation extended, a proportionately greater number of Soviet combine-harvesters bought with rubles were used vis-a-vis western combine-harvesters that had to be paid for in hard-currencies. Furthermore, the high fuel-costs associated with the mechanisation program were also paid for in rubles, facilitated by the sugar-oil nexus in the Cuban-USSR trade relationship to be discussed later.

However, mechanisation did solve the problem of labor shortages experienced under manual harvesting. According to Pollitt (1981), the peak cane-cutting labor force exceeded 200,000 in 1971-73, producing 5.2 million tons sugar. By 1977-79 the peak cane-cutting labor force, producing 7.3 million tons sugar, was only 140,000. The increase in productivity during this period was sustained by several means. These include (1) upgrading the cane-cutting labor force so that there was no need to mobilise labor from elsewhere in the economy; (2) the increase in labor productivity as a result of increased cane-burning required by the combine-harvesters; (3) removal of impurities from the manually-cut and mechanically-cut cane at the dry cane-cleaning stations; (4) organising the cane-cutters into higher-productivity work-brigades; (5) using the increasingly pervasive and effective wage incentive system introduced since the late 1970s; (6) using better tillage practices in the private sector because of the high labor intensity per hectare planted and (7) more efficient utilisation of non-labor inputs.

Cuban production yields differ considerably between regions. The highest cane sugar yields are found in La Habana province where the share of state farms is lowest and where the share of irrigated cane area (21%) is second only to the Ciego de Avila province (where 39% of the cane area is irrigated). However, while Cuban sugar yields are comparable to those of other sugar producing countries in the Caribbean, the productivity of the Cuban sugar industry remains low by international standards. Table 2 presents average cane yields, recovery rates and sugar yields during the 1980-84 period for Cuba, Barbados, Dominican Republic, Haiti, Jamaica, the Philippines and Zimbabwe. Aside from Cuba, the other four Caribbean countries are selected for their geographic location and hence similar natural environment. The Philippines is selected as a comparator country since, like Cuba, it is a larger producer in terms of planted area. Furthermore, both countries share the history of being colonies first of Spain and then of the United States, as well as being heavily influenced by the United States in their sugar production techniques and for their sugar market outlets. Finally, inclusion of Zimbabwe--one of the world's most efficient sugar producers--provides an indication of the scope for productivity increases in the Cuban sugar industry. As seen from Table 2, the performance of Cuba's sugar industry is comparable with those elsewhere in the Caribbean. The productivity in the Philippines sugar industry in recent years may not be indicative of its capacity; the return to political stability is likely to impact favorably on the sugar industry in the future.

TABLE 2: COMPARISON OF FOUR-YEAR AVERAGES OF SUGAR CANE
YIELDS AND RECOVERY RATES FOR CUBA AND
SOME SELECTED COUNTRIES, 1980-84

COUNTRY	CANE YIELD (TON/HARVESTED HA)	RECOVERY RATE %	SUGAR YIELD (TON/HARVESTED HA)
Cuba	55.13	11.07	5.93
Barbados	60.77	10.62	6.46
Dominican Republic	57.79	11.30	6.50
Haiti	37.50	1.60	0.60
Jamaica	53.09	7.93	4.20
Philippines	45.44	11.85	5.38
Zimbabwe	107.29	12.24	13.13

Sources: FAO; ISO Yearbook (various issues).

Notes: The cane yields, recovery rates and sugar yields are computed from combined use of FAO and ISO data for the 1980-1984 period. Yields and recovery rates were calculated for each year during the 1980-84 period, and the figures presented are averages for the period.

IV. THE CUBA-USSR SUGAR TRADE

Sugar as the Key to Growth

Throughout the first 25 years after the revolution, the Cuban government tried different economic policies with the primary aim of economic diversification from sugar. The checkered economic performance of the period highlights the importance of sugar as not only the foundation of the Cuban economy but also the basis for any economic diversification.

The difficulties for Cuba in identifying appropriate sugar-based diversification policies under its dual aims of internal development and international solidarity have been exacerbated by the volatility of the sugar price in the world market. Thus, Cuba essentially faces the well-known problem of stabilizing and/or maximizing commodity export earnings with fluctuating output and price. It is in this connection that the Cuba-USSR sugar trade arrangement plays an important role, both for Cuba and for the world sugar market. This is because of (1) Cuba's position as the single largest sugar exporter in the world market (prior to the entry of the EEC into the world market in the early 1980s) and (2) Cuba's commitment to date to supply, on a long-term basis, raw sugar to the USSR which is one of the larger sugar producers in the world. A chronology of the various Cuba-USSR sugar agreements is presented in Appendix III.

Since Cuba's sugar sales to the USSR are known to be at prices higher than world free market prices, how are the shares of exports to the USSR (and hence the CMEA bloc of countries) and to the rest-of-the-world determined? An analysis of the determinants of these exports shares provides the basis for assessing the future of the Cuba-USSR special sugar trade arrangement under alternative scenarios.

Beyond the Sugar-Oil Nexus

The marketing of Cuba's sugar exports is conducted by the autonomous government agency Cubazucar which is housed in the Ministry of Foreign Trade. Cubazucar is based in Havana, with offices in London, Geneva and Tokyo. Employees in the overseas offices act as Cubazucar's overseas representatives. All sugar sales, including those under the special trade with the USSR, are

conducted directly from the Havana headquarters or by personal negotiations with the overseas representatives.

Sugar exports from Cuba to the USSR are covered by long-term agreements, typically of five years. While these sugar exports are offset by similar long-term agreements for Soviet supply of petroleum and petroleum products to Cuba, the sugar agreement also provides for compensation in convertible currencies up to 20% of the trade value. This provision was included to allow Cuba to purchase capital goods which the USSR could not provide. In the earlier period of the socialist regime, prices for sugar and oil were fixed at the start of, and for the duration of the agreement. More recently, and after the 1973 oil crisis, the long-term agreement provides only the framework under which the export volumes, shipping schedules and prices are negotiated annually under the annual trade protocol. While the export volume and delivery schedules are negotiated by Cubazucar, price negotiations are conducted at higher levels and cannot be divorced from political considerations.

Basically, Cuban sugar partially fulfills the USSR sugar production-consumption gap. While the recent implementation of the Intensive Cultivation Technique appears to have resulted in productivity gains in the USSR sugar industry, the longer-term trend since the early 1970s has been one of declining productivity. Thus, continuing increases in domestic sugar consumption 1/ is contingent on the ability of Soviet production to regain production levels close to 10 million tons as in 1972 and/or continued Soviet sugar imports. In the short term the gap between Soviet production and consumption is known to fluctuate largely because of inclement weather in the USSR beet sugar regions. Table 3 shows the USSR consumption-production imbalances for the period 1960-84. Throughout the 1960s the imbalances ranged from a surplus of 1.1 million tons to a shortfall of 2.3 million tons. Since 1970 however, the imbalance has trended upwards with the lowest shortfall of

1/ USSR sugar consumption has grown from 6.7 million tons in 1960 to 13.0 million tons in 1983. In per capita terms, USSR sugar consumption has increased from 40 kg in 1960 to 48 kg in 1983. In the Western industrial countries, per capita sweetener consumption is currently about 70 kg per year.

TABLE 3: USSR SUGAR PRODUCTION, CONSUMPTION AND IMPORTS, 1960-1984
(THOUSAND METRIC TONS)

YEAR	PRODUCTION	CONSUMPTION	CONS-PROD IMBALANCE	TOTAL IMPORTS	IMPORTS FROM CUBA
1960	5721	6700	979	1717	1578
1961	6630	8913	2283	3597	3303
1962	6522	7760	1238	2486	2112
1963	5978	8197	2219	1139	973
1964	7643	7973	330	1889	1937
1965	9700	8575	-1125	2293	2456
1966	9019	8951	-68	1843	1815
1967	9188	9396	208	2483	2473
1968	9815	9678	-137	1755	1832
1969	10078	9889	-189	1335	1352
1970	8847	10247	1400	3005	3105
1971	8402	10350	1948	1536	1581
1972	9674	10369	695	1924	1097
1973	9600	11017	1417	2631	1661
1974	8526	11039	2513	1856	1975
1975	8092	11221	3129	3237	3187
1976	6698	11629	4931	3760	3036
1977	8885	11863	2978	4776	3790
1978	9353	12300	2947	3994	3936
1979	7927	12525	4598	4080	3842
1980	7250	12750	5500	4981	2726
1981	6200	12900	6700	5204	3205
1982	7391	12900	5509	7363	4426
1983	8750	13050	4300	5998	3315
1984	8800	13200	4400	5704	3650

0.7 million tons in 1972 and the highest shortfall of 6.7 million tons in 1981. From the export figures for the 1970s, it would appear that the level of Cuban sugar exports to the USSR have been set at about half the potential USSR consumption-production gap.

Table 4 shows that Cuba's share of world exports has been declining, from about 29% in 1961 to 25% in 1984. Although Cuba remains the largest single exporter, it is seen from Table 4 that the EEC has become a sugar exporter of near comparable stature since 1980. Australia and Brazil have also grown as exporters.

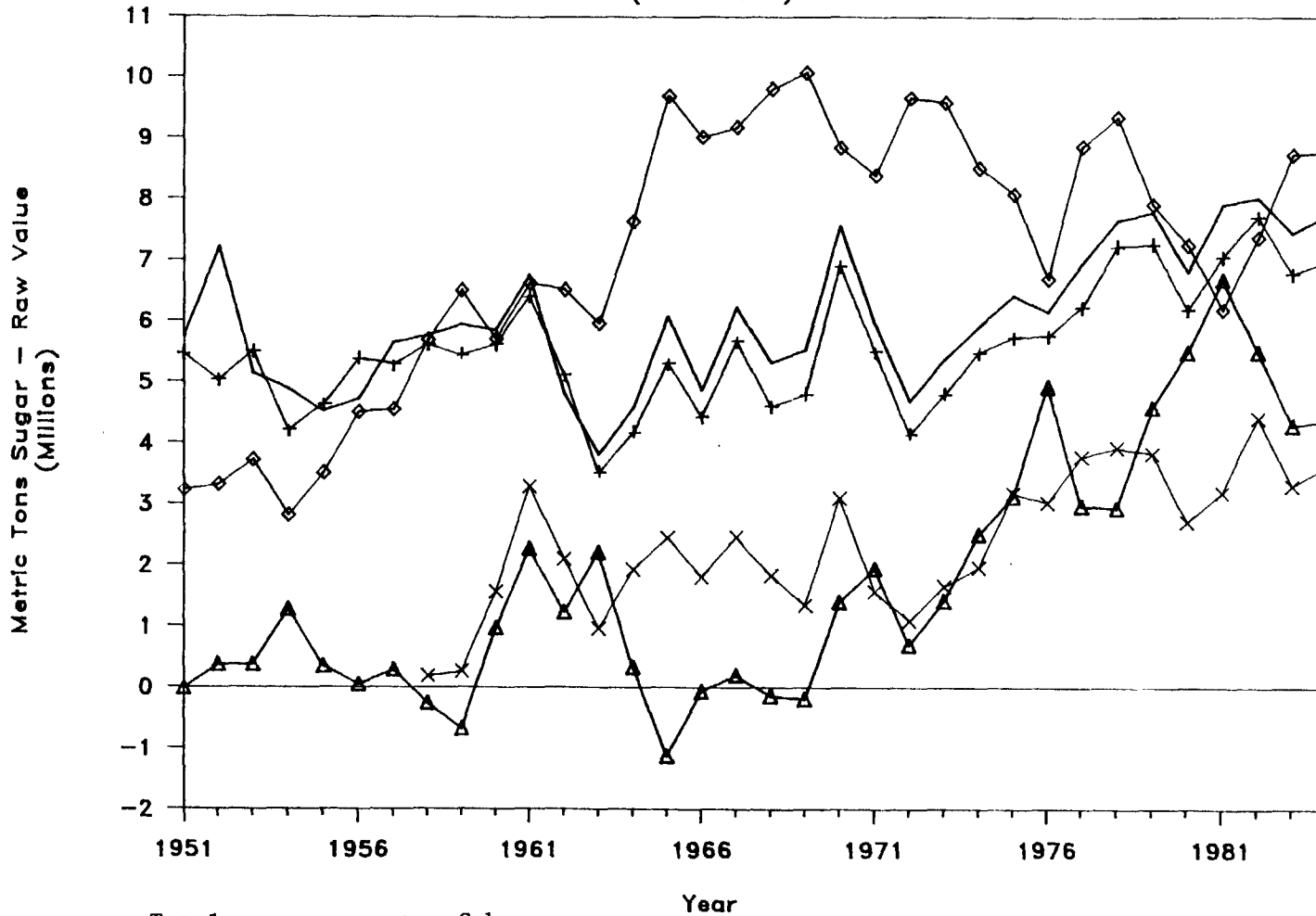
The time paths for Cuban and Soviet sugar production and trade over the 1951-84 period are given in Figure 2, from which the high correlation between Cuban production and exports is clearly seen. The slow growth in Cuban production is in contrast with the impressive growth in Soviet production--at least up to the mid-1960s. With Soviet domestic production in decline since the mid-1960s, there has been a growing consumption-production imbalance. This deficit is largely filled by Soviet imports of Cuban sugar. Figure 2 illustrates the large gap between Cuban exports to the USSR and the deficit in USSR domestic production in 1980 and 1981, alongside the fall in Cuban production and exports in 1980 which was in large part the cause of the 1980 boom in sugar prices. Figure 3 shows the behavior of the sugar price in the world market and the price of Cuban sugar exports to the USSR during the period 1960-84. The movements illustrated in Figure 2 and Figure 3 provide some explanation for the low USSR shares of Cuban exports in the years 1963, 1969, 1971 and 1972 shown in Table 5. As 1963 Cuban production--and hence exports--fell to the lowest level since the 1959 revolution, the world sugar price rose. To allow Cuba to take advantage of the increase in world prices; the USSR intake was reduced by 1.2 million tons from the 1962 intake, despite a worsening USSR domestic supply deficit. In 1969 the reduction in exports to the USSR was due to an improved USSR supply position while Cuban output stagnated at 4.8 million tons. In 1971 and 1972 Cuban production declined sharply after the 1970 harvest of 7.5 million tons. As world sugar prices rose with the commodity boom of this period, the USSR intake was sharply reduced again so as to allow Cuba to build up its foreign currency export earnings. It

TABLE 4: MAJOR EXPORTERS' SHARE OF WORLD SUGAR TRADE FOR SELECTED CROP YEARS, 1961-1984 (PERCENT).

YEAR	CUBA	EEC	BRAZIL	AUSTRALIA	PHILIPPINES AND THAILAND	ALL OTHER	WORLD EXPORTS ('000 MT)
1961	28.63	5.54	3.33	4.00	5.37	53.13	22,401
1962	24.40	5.00	2.28	5.91	5.65	56.76	21,026
1963	18.70	6.39	2.59	6.47	5.96	59.89	18,823
1964	22.16	5.47	1.41	6.94	6.19	57.83	18,844
1965	25.92	5.70	3.99	5.89	5.78	52.71	20,509
1966	22.00	4.48	5.00	7.50	5.66	55.36	20,153
1967	28.51	3.88	5.02	9.27	5.11	48.21	19,935
1968	22.52	5.91	5.27	10.67	4.92	50.72	20,482
1969	25.98	4.22	5.75	8.37	5.39	50.28	18,468
1970	31.79	5.37	5.20	7.64	5.66	44.33	21,723
1971	26.30	6.03	5.87	8.49	7.43	45.89	20,956
1972	19.00	8.42	12.11	10.63	7.80	42.04	21,786
1973	21.34	8.03	13.24	9.45	7.62	40.32	22,478
1974	24.85	4.83	10.42	8.27	9.95	41.68	22,097
1975	27.88	3.38	8.40	9.59	8.13	42.62	20,599
1976	25.29	8.34	5.49	11.50	11.67	37.72	22,794
1977	21.91	9.66	8.73	10.41	14.93	34.36	28,471
1978	28.84	14.30	7.68	7.99	8.66	32.54	25,072
1979	27.98	13.94	7.47	7.71	9.11	33.80	25,985
1980	23.07	16.12	9.92	8.98	8.40	33.51	26,832
1981	24.27	18.58	9.16	10.23	8.35	29.42	29,142
1982	25.43	18.46	9.17	8.23	11.00	27.72	30,417
1983	23.55	17.02	9.71	8.41	8.35	32.96	28,843
1984	24.67	15.45	10.69	9.11	9.30	30.78	28,436

Fig 2: CUBA & USSR SUGAR OUTPUT & TRADE

(1951-1984)



- + Total sugar exports, Cuba
- ◇ Total sugar production, USSR
- △ Consumption less production, USSR
- x Cuban sugar exports to USSR
- Cuban total sugar production, Cuba

Fig. 3: PRICES FOR CUBAN SUGAR EXPORTS

(1957-1984)

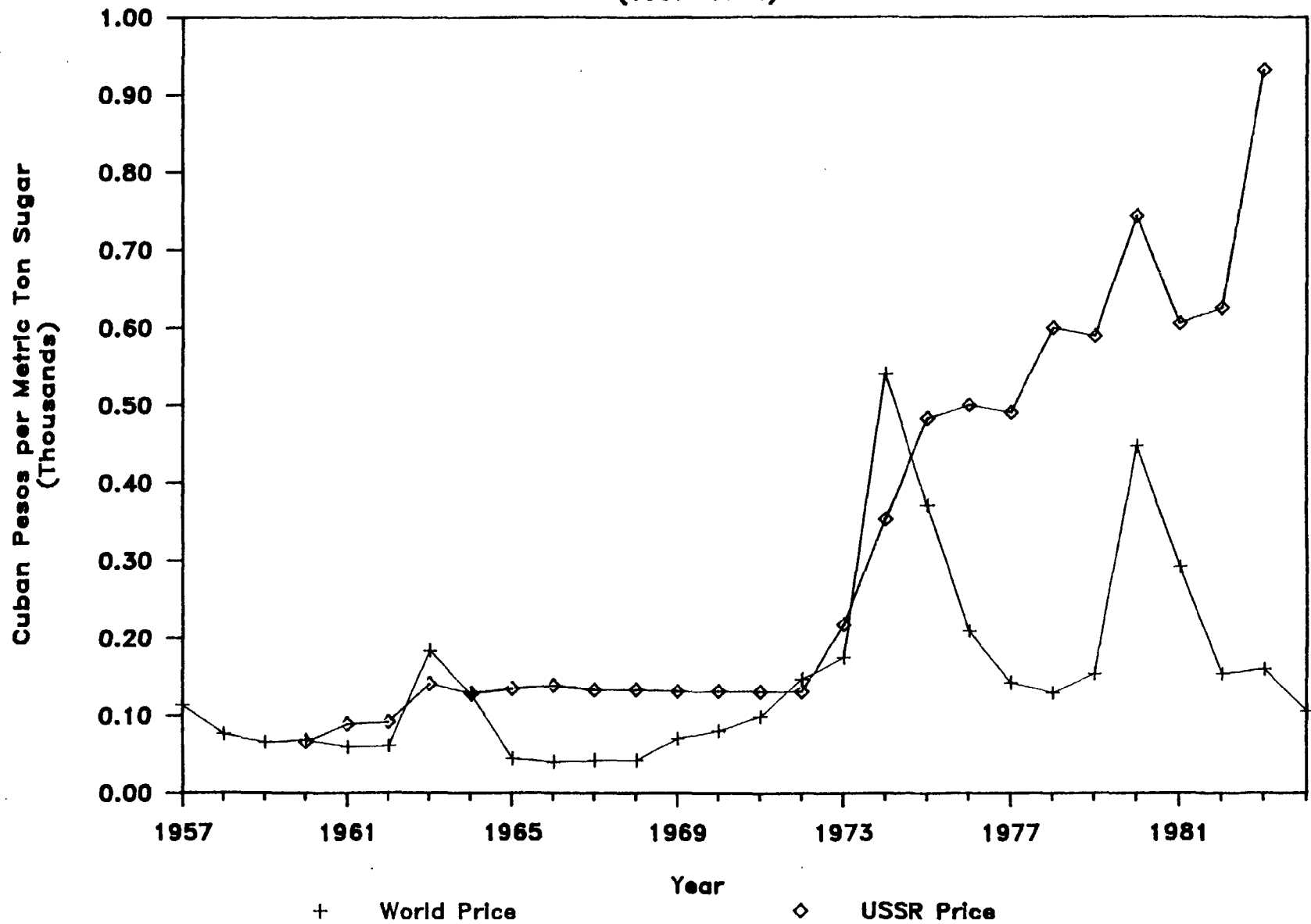


TABLE 5: SHARES OF CUBAN SUGAR EXPORTS TO THE USSR,
CPES AND MARKET ECONOMIES, 1958-1984
(%)

YEAR	USSR	CPES	MARKET ECONOMIES	TOTAL EXPORTS ('000 TONS)
1958	3.3	3.5	96.5	5,632
1959	5.5	5.5	94.5	4,952
1960	28.0	31.8	68.2	5,635
1961	51.5	58.6	41.4	6,414
1962	41.2	53.6	46.4	5,131
1963	27.7	44.5	55.5	3,521
1964	46.4	53.4	46.6	4,176
1965	46.2	58.8	41.2	5,316
1966	40.9	57.3	42.7	4,435
1967	43.5	58.2	41.8	5,683
1968	39.7	58.3	41.7	4,613
1969	28.2	49.3	50.7	4,799
1970	45.0	61.9	38.1	6,906
1971	28.7	51.1	48.9	5,511
1972	26.5	48.0	52.0	4,140
1973	34.6	56.4	43.6	4,797
1974	36.0	52.9	47.1	5,491
1975	55.5	66.9	33.1	5,744
1976	52.7	66.9	33.1	5,764
1977	60.8	72.3	27.7	6,238
1978	54.4	64.2	35.8	7,231
1979	52.9	64.9	35.1	7,269
1980	44.0	56.3	43.7	6,191
1981	45.3	59.9	40.1	7,071
1982	57.2	68.2	31.8	7,734
1983	48.8	64.9	35.1	6,792
1984	52.0	68.7	31.3	7,017

can be seen that in each of these instances Cuba's share of exports to the USSR promptly reverted to one-third or more in the following period, or as soon as the Cuban output situation permitted.

The relative constancy of Cuban export shares to the various regions, in the light of this analysis of its export behavior in the years 1963, 1969, 1971 and 1972, provides some notion of the complexity of Cuba's sugar export

policy. This policy is further complicated by the sugar-oil nexus between Cuba and the USSR. As indicated earlier, the long-term agreements covering Cuban sugar exports to the USSR were paralleled by long-term agreements for Soviet petroleum and petroleum products, with similar pricing methods adopted in each case.

As Cuba does not produce any oil domestically, its dependence on Soviet oil is relatively more critical than Soviet dependence on Cuban sugar. In a study of the net barter terms of trade between Cuban sugar and Soviet oil, Perez-Lopez (1977) shows that price discrimination was applied by the USSR in its supply of oil to the CMEA countries. Although Cuba is considered a developing country within the CMEA, Cuba paid a higher price for this oil than the other developing CMEA countries of Mongolia, Democratic Republic of Korea and Socialist Republic of Viet Nam. Perez-Lopez therefore concludes that the higher oil price charged to Cuba may be related to the higher-than-world-price that the USSR was paying for Cuban sugar and nickel. Thus, while the prices for oil and sugar under these long-term agreements are based on world market prices, they are also determined relative to each other. The net barter terms of trade calculated by Perez-Lopez should therefore be qualified with the caveat that these prices are not independent of each other.

From his calculations, Perez-Lopez concluded that the net barter terms of trade was on the whole favorable to Cuba for the entire 1960-75 period. However, with the shift to annual price fixing after the commodity boom beginning 1971-72 and the quadrupling of oil prices in late 1973, the upward adjustment of Soviet crude oil price from 1975 caused a terms of trade reversal. Hence after 1975 the net terms of trade became unfavorable for Cuba. Since his calculations were restricted to sugar and oil, Perez-Lopez also noted that the "Cuban gains or losses in sugar and petroleum exchanges with the USSR may be compensated for by matching gains or losses in other areas of trade between the two countries." (Perez-Lopez, 1979:294).

On the question of Soviet aid via the Cuba-USSR sugar trade, Radell (1983) has argued that the appropriate comparison of the prices paid by the USSR should be with those paid by the United States in its preferential sugar trade, rather than with the free market world price. In calculations for the 1960-76 period, Radell showed that until 1975 and 1976 Cuba received less for

its sugar exports to the USSR than it would have received if it were still tied to the United States. In the two latter years, the Soviet preferential prices rose to 28.6¢/lb and 27.9¢/lb as against the US preferential prices of 24.5¢/lb and 12.6¢/lb. For 1976 only, the implicit subsidy arising from the differential between the USSR and the United States preferential price amounted to \$1 billion. ^{1/} While the USSR aid may have been higher than implicit US aid, it should perhaps be discounted by the lower level of technology transfer available from the Soviets, compared to what would have been available from the United States.

Given the sugar-oil nexus in the Cuba-USSR trade, a comparison of the Cuban sugar export policy with those of other (cane) sugar producing countries is difficult. This difficulty is reinforced by the presence of two other special arrangements in the world sugar trade. Among the other cane sugar producing and exporting countries, many have access at preferential prices to the United States and/or EEC markets under the US Sugar Program and the Sugar Protocol of the Lomé Convention (between the EEC and the African, Caribbean and Pacific countries) respectively. The world market therefore becomes a residual market for most cane sugar exporters. Thus some writers have argued that, in the case of Cuba, the world market serves as a "perverse" residual market. That is, the world market is in fact the "preferred" market, and the USSR market the residual market (Licht, 1985(a)). The analysis presented here so far suggests that both the USSR and world markets are strongly complementary, if not equally important.

Since the world market does not provide a guaranteed price for Cuban sugar in the way the US Sugar Program and the Lomé Convention does for sugar exports from those countries receiving preferential treatment, the Cuban export preference for the world market should be qualified. In other words, the world market is "preferred" by Cuba only when world prices are above certain levels and when Cuban production is below specific levels. Similarly,

^{1/} From calculations for the 1960-76 period, Radell shows that the Soviet aid (of sugar subsidy plus trade deficits) amounted to \$4.6 billion; this is lower than the \$6.4 billion arrived at by the CIA from calculations using the world market price and the USSR preferential price.

the USSR market is a "residual" market for Cuba only under certain conditions pertaining to world price, Cuban production and the USSR production-consumption imbalance.

It is posited here that in the 1960-83 period, Cuban sugar exports to the USSR (and therefore CMEA) market and the "free" world market are jointly determined. The importance of the USSR market may be considered a corollary to the pro-Soviet socialist economy precipitated by the 1959 revolution and its objective of international solidarity. Given the critical role of the CMEA market for Cuba's cane sugar industry, and the inability of the beet-growing USSR and other CMEA countries to provide Cuba with the machinery and equipment required by the sugar cane industry and the rest of the economy, Cuba's need for hard currency to facilitate appropriate capital goods imports from the non-CMEA countries becomes obvious. Thus Cuba's sugar export policies may be couched in terms of constrained maximisation of its sugar export earnings.

The constrained maximization problem for Cuban sugar export earnings may be written in mathematical terms as follows:-

$$\text{Maximize } ER = P^W X^W + P^C X^C$$

subject to

- i. $P^W X^W = F_{X^W} (BOT^W)$
- ii. $X^C = F_{X^C} (CQIMB, BOT^C, P^W/P^C)$

and

- iii. $X^W + X^C = X^T$

provided that

$$X^T = F_{X^T} (QCCUB) ; X^T < QCCUB$$

where

ER	is the total sugar export revenue;
P^W	is the world price for sugar;
P^C	is the price of sugar exported to the USSR;
X^W	is the volume of sugar exported to the world market;
X^C	is the volume of sugar exported to the CMEA market;
X^T	is the total sugar exports of Cuba;
CQIMB	is the USSR domestic consumption-production imbalance;
QCCUB	is the cane sugar production of Cuba;
BOT^C	is the Cuban balance of merchandise trade with the CPEs;
and BOT^W	is the Cuban balance of merchandise trade with the world market economies.

The constrained maximization problem presented above states that Cuba's objective is to maximize total sugar export revenue subject to the constraints (i)-(iii). Total sugar export revenue (ER) is the sum of revenue from sugar exports to the market economies (X^W) at world prices (P^W), and exports to the CPEs (X^C) at prices (P^C) that are largely determined by sugar export prices granted by the USSR. The distribution of total exports between X^W and X^C is constrained by the twin objectives of resource allocation aimed at internal development and international solidarity, which translates into the constraints of:-

- i. Sugar export revenues from the market economies serving to balance trade with these economies. Hence the hard currency earnings derived from these exports ($P^W X^W$) is a function of the balance-of-trade (BOT^W) with the market economies.
- ii. Similarly X^C is influenced by the balance-of-trade with the CPEs (BOT^C). Furthermore, the manifestation of international solidarity requires Cuba to help remedy the Soviet sugar supply deficit (CQIMB). Since this is compensated by Soviet aid via prices higher than world prices, X^C is also influenced by the ratio of world to Soviet prices (P^W/P^C).
- iii. Lastly, exports X^W and X^C must sum to total exports (X^T), which is itself a function of the Cuban sugar cane crop (QCCUB).

The Langrangean is:-

$$L = P^W X^W + P^C X^C + \lambda_1 (P^W X^W - F_{X^W} \{BOT^W\}) + \lambda_2 (X^C - F_{X^C} \{CQIMB, BOT^C, P^W/P^C\}) + \lambda_3 (X^W + X^C - X^T)$$

The first-order conditions are given by:-

$$\partial L / \partial P^W = X^W + \lambda_1 X^W + \lambda_2 \cdot \partial F_{X^C} / \partial P^W \quad (1)$$

$$\partial L / \partial P^C = X^C - \lambda_2 \cdot \partial F_{X^C} / \partial P^C \quad (2)$$

$$\partial L / \partial \lambda_1 = P^W X^W - F_{X^W} \{ \text{BOT}^W \} \quad (3)$$

$$\partial L / \partial \lambda_2 = X^C - F_{X^C} \{ \text{CQIMB}, \text{BOT}^C, P^W / P^C \} \quad (4)$$

$$\partial L / \partial \lambda_3 = X^W + X^C - X^T \quad (5)$$

Substituting $\lambda_2 = X^C / \frac{\partial F_{X^C}}{\partial P^C}$ from (2) into (1) gives

$$X^W = \left\{ \frac{-\lambda_2}{1 + \lambda_1} \right\} \cdot \frac{\partial F_{X^C}}{\partial P^W}$$

But $X^W = F_{X^W} \{ \text{BOT}^W \} / P^W$ from (3),

and $X^W = X^T - X^C$ from (5).

Thus $X^W = G^W \{ P^W, \text{BOT}^W, X^T, X^C \}$

Since $X^C = F_{X^C} \{ \text{CQIMB}, \text{BOT}^C, P^W / P^C \}$

the share of Cuban exports to the market economies can be written as some form of

$$\begin{aligned} (X^W / X^T) &= \phi^W \{ P^W / P^C, \text{BOT}^W / \text{BOT}^C, \text{CQIMB} \} \\ &= \alpha_0 + \alpha_1 (P^W / P^C) + \alpha_2 (\text{BOT}^W / \text{BOT}^C) + \alpha_3 \text{CQIMB} \end{aligned}$$

Similarly, the share of Cuban exports to the CMEA market can be derived as some form of

$$\begin{aligned} (X^C / X^T) &= \phi^C \{ P^W / P^C, \text{BOT}^W / \text{BOT}^C, \text{CQIMB} \} \\ &= \beta_0 + \beta_1 (P^W / P^C) + \beta_2 (\text{BOT}^W / \text{BOT}^C) + \beta_3 \text{CQIMB} \end{aligned}$$

Since these export shares are jointly determined and have remained relatively stable throughout the 1960-83 period, it is a priori expected that

$$\alpha_0 + \beta_0 = 1$$

$$\alpha_1 = -\beta_1 > 0$$

$$\alpha_2 = -\beta_2 > 0$$

$$\alpha_3 = -\beta_3 < 0$$

- where
- i. α_0 and β_0 are the average shares of exports to the market economies and CPEs respectively, during the 1961-83 period and which sum to unity.
 - ii. α_1 is the relative price (P^W/P^C) coefficient influencing the determination of the share of exports to the market economies (X^W/X^T), and is positive (>0). Since the same relative price variable is used in estimating the export share to the CPEs (X^C/X^T), and (X^C/X^T) is inversely related to (P^W/P^C), therefore β_1 is equal but opposite in sign to α_1 ($\beta_1 = -\alpha_1$).
 - iii. α_2 is the coefficient for the balance-of-trade ratio (BOT^W/BOT^C). As the balance-of-trade with the market economies (BOT^W) worsens in relation to that with the CPEs (BOT^C), (X^W/X^T) increases, yielding a positive α_2 -coefficient. Since the same balance-of-trade ratio is used in the estimation of (X^C/X^T), (X^C/X^T) is inversely related to (BOT^W/BOT^C) so that the β_2 -coefficient for the balance-of-trade ratio is now equal but opposite in sign to α_2 ($\beta_2 = -\alpha_2$).
 - iv. α_3 is the coefficient for the variable showing the excess of Soviet consumption over production (CQIMB). The higher the Soviet supply deficit, the lower the share of exports to the market economies (X^W/X^T). Thus $\alpha_3 < 0$ shows that (X^W/X^T) is a negative function of CQIMB. The converse argument holds for the share of exports to the CPEs, so that $\beta_3 > 0$. Hence, $\alpha_3 = -\beta_3 < 0$.

For consistency, and to close the model, two additional conditions are required. The first is the identity that exports to the two markets cannot exceed the total exports; hence

$$X^W + X^C = X^T$$

The second constraint is that total exports are determined by the size of Cuban sugar production and consumption. Since domestic consumption and stockholdings have remained fairly stable at about 10% of total output in the historical period, exports have similarly been a fairly stable share of output that is:

$$X^T = F_{X^T} (QCCUB) < QCCUB$$

V. EMPIRICAL RESULTS FOR CUBA'S EXPORT EQUATIONS

The export functions specified above were estimated using annual data for Cuban sugar exports since 1960. Data for the world price of sugar, Cuban sugar exports to the various regions, and Soviet sugar production and consumption were obtained from the Sugar Yearbook of the International Sugar Organization. Data pertaining to the USSR price for Cuban sugar and Cuba's balance-of-trade with the centrally planned and market economies were obtained from various issues of the Cuban statistical yearbooks, the Anuario Estadístico de Cuba published by the Comité Estatal de Estadísticas, the Economic Report of the Banco Nacional de Cuba, Comercio Exterior de Cuba published by JUCEPLAN, and from Mesa-Lago (1981).

Although the functions for Cuban exports to the CPEs and market economies may be considered the "dual" to each other, the ordinary least squares estimates for both equations are presented in Table 6 for comparison. Equations (1a) and (1b) present estimates for the shares of Cuban exports to the centrally planned economies (X^C/X^T) and to the world market economies (X^W/X^T) respectively. The explanatory variables are the ratios of the world price to the USSR unit import price for sugar (P^W/P^C), the two-year moving average of Cuba's trade balance with the market economies to that with the centrally-planned economies ($\frac{1}{2} \sum_{i=0}^1 \{BOT^W/BOT^C\}_{-i}$), and the level of Soviet sugar consumption-production imbalance relative to the level of Soviet sugar consumption ($CQIMB/C^U$).

The estimates in Table 6 show that throughout the 1960-83 period, the shares of Cuban sugar exports to the CPEs and market economies have averaged about 62% and 38% respectively. Fluctuations in these shares have been affected by fluctuations in the relative price of sugar, the balance-of-trade ratio and the Soviet consumption-production imbalance as a ratio of Soviet consumption. The estimated relative price elasticities of export shares to the CPEs and market economies during this period are 0.11 and 0.16 respectively. However, the use of these price elasticities of export shares should be qualified by the way in which the Soviet price for Cuban sugar is determined by the Cuban balance-of-trade with the CPEs (which is dominated by the oil

TABLE 6: ESTIMATION RESULTS FOR CUBAN SUGAR EXPORT EQUATIONS, 1960-83

EQN	DEPENDENT VARIABLE	CONSTANT	(P ^W /P ^C)	$\frac{1}{2} \sum_{i=0}^1$ (BOT ^W /BOT ^C _{-i})	(CQIMB/C ^U)	(CQIMB/QCCUB)	QCCUB	\bar{R}^2	DW	F
(1a)	(X ^C /X ^T)	0.62 (29.9)	-0.11 (-4.4)	-0.02 (-2.5)	0.11 (2.0)			0.65	1.93	F _{3,19} = 14.67
(1b)	(X ^W /X ^T)	0.38 (18.4)	0.11 (4.4)	0.02 (2.5)	-0.11 (-2.5)			0.65	1.93	F _{3,19} = 14.67
(2a)	(X ^C /X ^T)	0.62 (30.2)	0.11 (-4.4)	-0.02 (-2.5)		0.06 (1.8)		0.64	1.99	F _{3,19} = 14.13
(2b)	(X ^W /X ^T)	0.38 (18.4)	0.11 (4.4)	0.02 (2.5)		-0.06 (-1.8)		0.64	1.99	F _{3,19} = 14.13
(3)	(X ^W /X ^T)	0.38 (16.5)	0.11 (4.6)	0.02 (2.9)	-0.11 (-1.7)			0.65	1.93	F _{3,19} = 14.72
(4)	X ^T	-15.46 (-0.1)					0.92 (21.5)	0.96 ρ(1) = 0.17	1.97	F _{1,22} = 562.02

power of the variables. Furthermore, an examination of the plots for export shares shows that equations (2a) and (2b) fail to capture as many of the turning points as equations (1a) and (1b). Thus equations (1a) and (1b) appear to be the preferred equations for explaining the Cuban sugar export shares.

Equations (1a)-(2b) were estimated by Ordinary Least Squares (OLS) method. These export share equations were re-estimated using the Full-Information Maximum Likelihood (FIML) method with the constraint across equations of $(X^W/X^T) = 1 - (X^C/X^T)$. The estimation results for the (X^W/X^T) equation in equation (3) of Table 6 are similar to equation (1b). An attempt was made to estimate the export share equations without imposing homogeneity on the balance-of-trade variables. However, re-estimating the equations with the balance-of-trade variables entered separately and deflated by Cuban total imports failed to yield significant estimates. One reason for this is that by separating the balance-of-trade variables, it is not possible to compare movements in relative magnitudes of trade balances against those of sugar export trade shares.

Since total Cuban sugar exports are constrained by total production, the estimated equation for total exports as a function of total output is given in Table 6 equation (4). The estimates indicate that throughout the 1960-83 period, total Cuban sugar exports amounted to about 92% of total production, with elasticity of exports with respect to production close to unity.

VI. CUBAN SUGAR TRADE UNDER ALTERNATIVE SCENARIOS

The empirical results substantiate that Cuban sugar exports to the CPEs and market economies have, of necessity, been jointly determined during the 1961-83 period. This joint determination stems from Cuba's attempt to simultaneously attain internal economic development and international solidarity. Internal economic development called for technology transfer and capital goods imports, not only from the CPEs but also from the market economies. Imports from the latter region entail export earnings in hard currencies, and hence impinge on the question of resource allocation dictated by international solidarity concerns.

International solidarity is manifested most conspicuously in the preferential exchange of Cuban sugar for Soviet oil that was, until recently, to Cuba's advantage. The sugar-oil nexus is difficult to untangle. Despite the solidarity motivation, sugar and oil prices are not determined independently of their prices in the world market. As Perez-Lopez (1979) indicated in his study of the terms of trade between Cuban sugar and Soviet oil, their prices could also have been influenced by the exchange of other goods such as foodstuffs, nickel and capital goods. Furthermore, since Cuba needs to import certain basic goods from the market economies, some 20% of the Cuba-CPEs trade has deliberately been made in convertible currencies to facilitate such imports.

With these caveats in mind, the distribution of Cuban sugar exports between the CPEs and the market economies is empirically tested and found to be determined by the ratio of world prices to Soviet prices for sugar, the ratio of Cuba's balance-of-trade with the CPEs to that with the market economies, and the Soviet sugar production-consumption gap. Consequently, future movements in these variables should provide some basis for predicting the outlook for Cuban sugar exports to the world market. Past fluctuations in Cuban sugar production have caused annual variations in its exports to the free market to exceed one million tons. In the world market where only 15 million tons or less are freely-traded annually, such variability strongly influences prices.

Whether the Cuban sugar industry can provide the foundation for economic development hinges in large part on the development strategy Cuba will adopt. 1/ The previously unsuccessful attempts at economic diversification from sugar and towards industrial development have resulted in Cuba granting priority to sugar over foodcrops in the allocation of land. With food production remaining at 1959 levels, the growth in per capita food consumption has been achieved via increased food imports facilitated by Soviet aid in the form of subsidies.

In September 1985 it was reported that the Cuban Ministry of Sugar Industry will be investing US\$177 million to upgrade and modernize the sugar industry (Licht, 1985b). At the same time it was announced that the 1985-86 sugar crop was expected to be only 7.2 million tons. This is not only one million tons less than the 1984-85 crop, but also far from the 10 million tons originally targetted for the 1980 crop. With the damage caused by hurricane

1/ In appraising the suitability of four alternative development models which could conceivably be adopted by Cuba, namely the Soviet reform model, the Hungarian model, the Romanian model and the Bulgarian model, Mesa-Lago (1983) argues that the Bulgarian middle-of-the-road model appears most feasible. This is because both Bulgaria and Cuba are small economies without indigenous fuel resources and are therefore highly dependent on Soviet oil. Bulgaria is also an agriculture-based, non-industrialized country of comparable size. Increased decentralisation of its economic decision-making processes and increased reliance on market mechanisms have been ongoing in Bulgaria since 1977. Both the market mechanism and material incentives have been used to stimulate private production. Furthermore, direct trading between the production units and Western traders has expanded and foreign investment aimed at promoting economic diversification and increasing self-sufficiency in food have occurred with Soviet approval.

The other three alternatives are infeasible or unlikely for various reasons. The Soviet Reform model is premised on a large, fuel-rich economy. The Hungarian model is pragmatic and gives greater weight to economic development than international solidarity. Hungary is also further down the decentralisation road (embarked upon since 1968) and now permits full determination of prices by the market. This extent of decentralization is unlikely to appeal to the current leadership within Cuba. Although the Romanian model--which stresses self-reliance and is based on agricultural development as the key to industrialization--may appear suitable, Romania has the advantage of being endowed with fuel resources, and having access to Western financial support.

"Kate" in November 1985, the current expectation is for a 1985/86 crop closer to six million tons. Whether the 1986/87 crop can recover to seven million tons will depend in part on the extent of root damage caused by the hurricane (which brought little rain and could therefore lead to rotting of the cane roots) and the replanting that may be required. Meanwhile, debt to the market economies is in excess of US\$3 billion, which also raises the question of the outlook for Cuban sugar exports in particular and Cuban economic growth in general.

By extending the four equations presented in Section V to include equations explaining other relevant variables, a model is developed for exploring the impacts of Cuban sugar production and export distribution under alternative scenarios. Such scenarios concern different time paths for Cuban sugar output, Soviet sugar production and per capita consumption--and hence Soviet supply deficit--and Cuban balance of merchandise trade with the CPEs and market economies.

The model consists of twelve equations (equations 1-12) and six identities (equations 13-18). The twelve equations are for explaining the determination of:-

1. The share of Cuban sugar exports to the market economies (X^W/X^T);
2. The share of Cuban sugar exports to the CPEs (X^C/X^T);
3. Total Cuban exports (X^{CUB});
4. Soviet price for Cuban sugar (P^C);
5. World market price for sugar (P^W);
6. Soviet sugar consumption (C^U);
7. Soviet sugar production (Q^U);
8. Rest-of-the-World consumption (C^{ROW});
9. Rest-of-the-World production (Q^{ROW});
10. Rest-of-the-World exports (X^{ROW});
11. Cuba's sugar production (Q^{CUB});
12. World sugar stockholdings (S^W);

where rest-of-the-world denotes world net of Cuba and the USSR.

The six identities required for completing the model concern:-

13. Total Cuban exports (X^T), which is the sum of Cuba's exports to the market economies and the CPEs;
14. Total world exports (X^{WOR}), which is the sum of exports from Cuba and from the rest-of-the-world.
15. World free market exports (X^{WF}), which is estimated at half the total world exports;
16. Cuban sugar consumption (C^C), which is the product of Cuba's population and per capita consumption;
17. Total world consumption (C^W), which is the sum of consumption in Cuba, the USSR and the rest-of-the-world;
18. Total world production (Q^W), which is the sum of production by Cuba, the USSR and rest-of-the-world;

Empirical results for the equations for (X^W/X^T), (X^C/X^T), X^{CUB} and P^C have been discussed in Section V. The empirical results for equations (5)-(12) will now be discussed before the results of model simulations under alternative scenarios are presented.

The world market price (P^W in current dollars) for sugar is determined by the world stock-consumption ratio (S^W/C^W), the rate of inflation as measured by the World Bank's Manufactured exports Unit Value (MUV) index, world price lagged one period (P_{-1}^W) and the ratio of total Cuban exports to the world free market sugar exports (X^T/X^{WF}). Using data for the 1962-83 period, and assuming world free market sugar exports is one-half of total world sugar exports, the estimated equation is given by:-

$$\begin{aligned} \ln P^W = & -5.94 - 5.18 \ln (S^W/C^W) + 1.52 \ln MUV \\ & (-4.7) \quad (-6.4) \quad (7.4) \\ & - 0.98 \ln (X^T/X^{WF}) \\ & (-2.0) \end{aligned}$$

Period: 1963-1984

$$\bar{R}^2 = 0.87; \quad DW = 1.79; \quad F_{3, 17} = 44.35;$$

When the equation was re-estimated with free market exports equal to two-thirds (instead of one-half) of total world exports, equally significant estimates were obtained. The elasticity of world price with respect to the Cuban export share is larger the higher the Cuban share of free market exports. The estimates suggest an elasticity in the range of -0.6 to -0.8.

The Soviet consumption equation estimated as a function of total population (POP^U) and one-period lagged consumption (C_{-1}^U), is:-

$$C^U = \begin{matrix} -11401.64 \\ (-3.1) \end{matrix} + \begin{matrix} 74.90 \\ (3.4) \end{matrix} POP^U + \begin{matrix} 0.33 \\ (1.8) \end{matrix} C_{-1}^U$$

Period: 1956-1984

$$\bar{R}^2 = 0.97; \quad DW = 2.96; \quad F_{2, 26} = 535.92;$$

The equation for Soviet sugar production is estimated simply as a function of Soviet production in the previous period (Q_{-1}^U). The estimated equation is:-

$$\ln Q^U = \begin{matrix} 1.22 \\ (2.1) \end{matrix} + \begin{matrix} 0.87 \\ (12.9) \end{matrix} \ln (Q_{-1}^U)$$

Period: 1952-1984

$$\bar{R}^2 = 0.84; \quad DW = 2.10; \quad F_{1, 31} = 165.67;$$

The equation for rest-of-the-world consumption, estimated as a function of lagged consumption and time variable to capture the rising consumption trend, is:-

$$C^{ROW} = \begin{matrix} 12576.27 \\ (2.9) \end{matrix} + \begin{matrix} 0.50 \\ (2.7) \end{matrix} C_{-1}^{ROW} + \begin{matrix} 833.01 \\ (2.6) \end{matrix} T$$

Period: 1961-1984

$$\bar{R}^2 = 0.98 \quad DW = 1.75; \quad F_{2, 21} = 705.95;$$

For rest-of-the-world production, the explanatory variables are production and free market price both lagged one period. The estimated equation is:-

$$\ln Q^{\text{ROW}} = 1.41 + 0.85 \ln Q^{\text{ROW}}_{-1} + 0.05 \ln P^{\text{W}}_{-1}$$

(2.3) (13.9) (2.8)

Period: 1961-1984

$$\bar{R}^2 = 0.95; \quad DW = 2.08; \quad F_{2,21} = 230.28;$$

Bearing in mind the problems of obtaining reliable stocks data, an equation for stocks is estimated using stocks in the previous period (S_{-1}^{W}), current period world production (Q^{W}), and current period world consumption (C^{W}). The estimated stocks identity is:-

$$S^{\text{W}} = 1.04 S_{-1}^{\text{W}} + 0.32 Q^{\text{W}} - 0.27 C^{\text{W}}$$

(16.1) (10.3) (-9.2)

Period: 1962-1984

$$\bar{R}^2 = 0.98; \quad DW = 2.13; \quad F_{3,20} = 434.74;$$

The rest-of-the-world exports equation is estimated as a function of rest-of-the-world production and Cuba's share of the rest-of-the-world exports in the previous period. The rest-of-the-world exports equations is given by:-

$$X^{\text{ROW}} = 8818.37 + 0.20 Q^{\text{ROW}} - 10789.25 (X^{\text{T}}/X^{\text{ROW}})_{-1}$$

(4.3) (8.0) (-2.0)

Period: 1962-1984

$$\bar{R}^2 = 0.74; \quad DW = 1.85; \quad F_{2,20} = 32.14;$$

The equation for Cuba's sugar production was estimated as a function of lagged output, and a time variable to capture the rising trend. A dummy variable for 1970 was used to reflect the extended harvesting season in 1970 which accounts for the high production. Cuba's production equation is given by:-

$$\begin{aligned} \text{QCCUB} = & 2259.03 + 0.24\text{QCCUB}_{-1} + 103.92 \text{ T} \\ & (2.6) \quad (1.3) \quad (3.3) \\ & + 1779.19 \text{ DV1970} \\ & (2.2) \end{aligned}$$

Period: 1961-1984

$$\bar{R}^2 = 0.60; \quad \text{DW} = 1.82; \quad F_{3,20} = 12.59;$$

In summary, the model consists of the following 18 equations and identities:-

1. $(X^C/X^T) = f_1 \{ (P^W/P^C, \frac{1}{2} \sum_{i=0}^1 (\text{BOT}^W/\text{BOT}^C)_{-i}, (\text{CQIMB}/C^U) \}$
2. $(X^W/X^T) = f_2 \{ (P^W/P^C, \frac{1}{2} \sum_{i=0}^1 (\text{BOT}^W/\text{BOT}^C)_{-i}, (\text{CQIMB}/C^U) \}$
3. $X^T = f_3 \{ \text{QCCUB} \}$
4. $P^W = f_4 \{ (S^W/C^W), \text{MUV}, P_{-1}^W, (X^T/X^{WF}) \}$
5. $P^C = f_5 \{ \frac{1}{5} \sum_{i=0}^4 P_{-i}^W, \text{BOT}^C \}$
6. $C^U = f_6 \{ \text{POP}^U, C_{-1}^U \}$
7. $Q^U = f_7 \{ Q_{-1}^U \}$
8. $C^{\text{ROW}} = f_8 \{ C_{-1}^{\text{ROW}}, T \}$
9. $Q^{\text{ROW}} = f_9 \{ Q_{-1}^{\text{ROW}}, P_{-1}^W \}$
10. $X^{\text{ROW}} = f_{10} \{ Q^{\text{ROW}}, (X^T/X^{\text{ROW}})_{-1} \}$
11. $\text{QCCUB} = f_{11} \{ \text{QCCUB}_{-1}, T \}$
12. $S^W = f_{12} \{ S_{-1}^W, Q^W, C^W \}$

13. $X^T = X^W + X^C$
14. $X^{WOR} = X^T + X^{ROW}$
15. $X^{WF} = 0.5 * X^{WOR}$
16. $C^C = POP^C * PCC^C$
17. $C^W = C^U + C^C + C^{ROW}$
18. $Q^W = Q^U + QCCUB + Q^{ROW}$

The model consisting of the above 18 equations and identities can be used to explore the implications for world sugar price of alternative scenarios regarding growth of the Cuban sugar industry, Cuba's balance-of-trade, developments in the Cuba-USSR relationship, and growth in Soviet consumption and/or production. This will allow inference on the long-term development prospects for Cuba, and the Soviet role thereof. Before doing so, the model was first validated for the period 1968-83. Table 7 presents the summary statistics for the key endogenous variables under residual check (R), static (S) and dynamic (D) simulations of the model. Theoretically, the root mean squared percentage errors (RMSPE) are largest under dynamic simulations since for the endogenous variables only actual observed values are used as starting values. Table 7 shows that the price variable (P^W) has the largest RMSPE (30%) under all three types of simulations. From the actual and simulated time paths for P^W presented in Figure 4, it can be seen that the large RMSPEs arises from the inability of the price equation to capture the sharp increases in price that occurred in 1974 and 1980. The simulation errors for P^W affect the performance of the Cuban sugar export share variables (X^C/X^T) and (X^W/X^T), both of which have larger RMSPEs than total Cuban exports (X^T). The other source of high RMSPEs for the Cuban export shares is total Soviet sugar production (Q^U); this variable affects the Soviet supply deficit (CQIMB), which is an explanatory variable for the share of Cuban sugar exports to the USSR.

TABLE 7: SUMMARY STATISTICS FOR KEY VARIABLES UNDER
RESIDUAL (R), STATIC (S) AND DYNAMIC (D)
SIMULATIONS OF THE MODEL, 1968-83

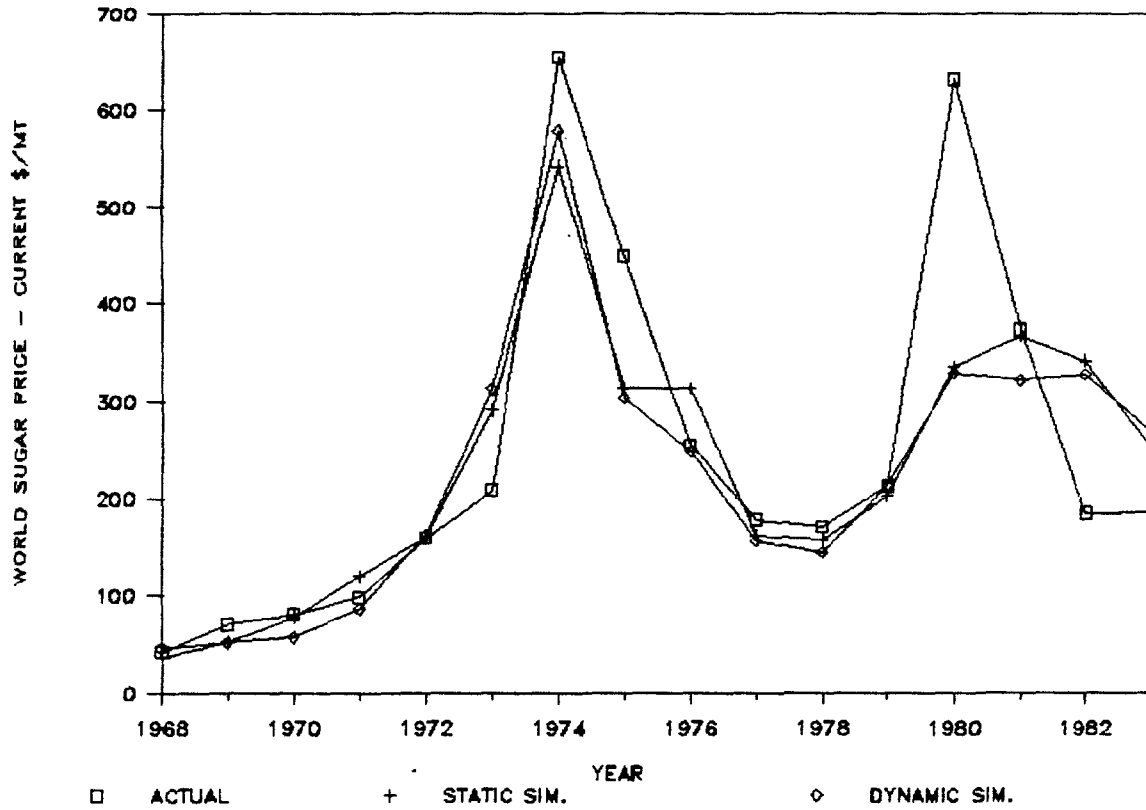
VARIABLE		RMSPE
X ^T	- R	2.9
	- S	2.9
	- D	2.9
X ^C /X ^T	- R	6.9
	- S	12.5
	- D	14.6
X ^W /X ^T	- R	10.8
	- S	18.9
	- D	23.0
Q ^U	- R	12.3
	- S	12.3
	- D	13.6
P ^W	- R	30.7
	- S	30.7
	- D	30.9

Notes: The root mean squared percentage error (RMSPE) of any variable Y, is defined as:

$$\text{RMSPE} = \frac{1}{n} \left[\sum_{t=1}^n \left(\frac{Y_t - \hat{Y}_t}{Y_t} \right)^2 \right]^{1/2} \times 100.0$$

Y_t is the actual value of the dependent variable, \hat{Y}_t is the forecast value of the dependent variable in period t and n is the number of periods for which the forecasts are made. RMSPE is a summary statistic indicating the model's overall performance.

FIGURE 4. ACTUAL & SIMULATED VALUES OF WORLD SUGAR PRICE, 1968-1983 (\$/METRIC TON).



Year	Actual	Static Simulation	Dynamic Simulation
1968	41.90	36.32	36.32
1969	70.60	52.60	52.35
1970	81.10	78.40	57.34
1971	99.20	120.84	86.76
1972	160.30	161.52	163.64
1973	208.30	291.00	312.63
1974	653.90	542.65	578.82
1975	449.10	312.26	304.14
1976	254.90	312.92	248.66
1977	179.00	163.20	157.42
1978	172.00	158.90	145.14
1979	213.00	203.25	213.02
1980	632.00	335.12	329.30
1981	374.00	366.81	322.20
1982	185.60	341.70	327.69
1983	186.70	249.13	267.93

To use the model for exploring the world market outlook under alternative scenarios, assumptions must first be made about the exogenous variables. Because of the major roles played by Soviet consumption and production, these two variables will be made exogenous in the model simulations for the 1985-2000. This is implemented by replacing the estimated Soviet production and consumption equations with projected values under various assumptions. While assumptions about population growth, sugar production and per capita consumption in Cuba and the USSR can be made with relative ease, those about Cuba's balances-of-trade are less easy. This is because of, inter alia, their dependence on the performance of the non-sugar export sectors and which lie beyond the scope of this study. However, this is not a serious constraint since the single-equation results have shown that the balance-of-trade ratios primarily serve to determine the Soviet price for Cuban sugar. Consequently, the present approach is to simulate alternative sets of balances-of-trade that yield different balance-of-trade ratios so as to highlight their impact on Soviet price for Cuban sugar.

The populations of Cuba and the USSR are assumed to grow at the rates of 2% and 0.5% per annum respectively. Sugar production in the USSR is assumed to grow from 8.9 million tons in 1985 to 9.8 million tons in 2000. For the rest-of-the-world, sugar consumption, production and stocks are exogenously projected and assumed unaffected by the alternative assumptions regarding Cuban and Soviet per capita consumption and production. 1/

The rest-of-the-world production is assumed to grow from 83.5 million tons in 1985 to 110.3 million tons in 2000, while consumption increases from 83.7 million tons in 1985 to 110.0 million tons in 2000. Oil price is assumed to increase from \$27 per barrel in 1985 to \$45 per barrel in 2000, and world inflation (as measured by the MUV) increases at about 6% annually during the 1985-1995 period and about 7% annually during the 1995-2000 period. The results of model simulations under alternative scenarios will now be

1/ The partial equilibrium nature of the analysis is an important limitation. Cuba is such a large participant in the world market that there is no doubt that its actions will influence the behavior of others and so influence world production, consumption and stocks.

presented. These results indicate the limits to sugar expansion for Cuba and thus provide an assessment of the efficacy of using sugar exports as a foreign exchange earner to provide the resources required for Cuban economic diversification and development.

Case 1: This scenario assumes that Cuban sugar production will reach 10 million tons in 2000, while per capita sugar consumption in Cuba and the USSR will reach 70 kg and 64.5 kg respectively in 2000. Given the market outlook for sugar and other primary commodities which Cuba exports, the historical trend of balance-of-trade deficits with the market economies and the CPEs are expected to persist. However, the balance-of-trade values used in the model simulations reported here were made to fluctuate between surpluses and deficits so as to highlight their roles in determining the sugar export-shares and the Soviet price for Cuban sugar. The balance-of-trade with the market economies is assumed to fluctuate between -650 million pesos and 150 million pesos during the 1985-2000 period while that with the CPEs is assumed to fluctuate between -925 million pesos and 300 million pesos.

Table 8 presents the simulation results. When Cuban production reaches 10 million tons in 2000, its exports will be 9.1 million tons and total world sugar exports will be 36.0 million tons. With total Cuban exports amounting to 50% of the free market trade in sugar, the world price of sugar reaches \$542/ton (\$261/ton in 1985 dollars) in 2000. The Soviet price for Cuban sugar will increase to 974 pesos/ton in 2000. However, increases in the Soviet price, as a proportion of the world price, vary according to the balance-of-trade (BOT^C and BOT^W) situation. The simulation results show that, in general, higher Cuban balance-of-trade deficits with the USSR will induce higher Soviet price increases. Thus for the trade deficit years of 1985 and 1995, the Soviet prices are 498% and

267% of world prices respectively, while for the trade surplus years of 1990 and 2000, the Soviet prices are 100% and 204% of world prices respectively. The Soviet price is closer to (identical here) the world price in 1990 when there is overall trade surplus. Table 8 also shows a positive correlation between Cuba's share of sugar exports to the CPEs and its balance-of-trade deficit with this group of countries. Thus the share of Cuban sugar exports to the CPEs falls from 63% in 1985 to 54% in 1990, then rises to 61% in 1995 as the balance-of-trade worsens.

Case 2: To show the sensitivity of export shares to variations in the balance-of-trade ratios with the two groups of economies, the model was re-simulated with a different series for the balance-of-trade with the market economies (BOT^W), all other exogenous variables remaining unchanged. Table 9 presents the results showing changes in the export shares due to the new BOT^W used. The improvements in BOT^W in 1990 and 1995 lead to a fall in export shares to the market economies in these years. The export shares for individual years do not necessarily move in the expected direction because they are determined by two-year moving averages of the balance-of-trade ratios.

Case 3: The model was simulated with all exogenous variable projections as in Case 1, but with reduced Soviet per capita sugar consumption. Per capita Soviet consumption now grows at a lower rate to 60 kg. by 2000.

Table 10 shows that with 10 million tons Cuban production but lower Soviet consumption in 2000, the share of Cuban exports in the free market trade rises to 51%. Soviet consumption now reaches 18 million tons, instead of 19.3 million tons in 2000, thereby reducing the Soviet supply deficit-consumption ratio by 2-6 percentage points during the 1985-2000 period. The lower

TABLE 8: SIMULATION RESULTS WHERE CUBAN PRODUCTION REACHES
10 MILLION TONS AND SOVIET PER CAPITA
CONSUMPTION REACHES 64.5 KG IN 2000 (CASE 1)

	1985	1990	1995	2000
BOT^W	-20.00	150.00	-650.00	-80.00
BOT^C	-240.00	300.00	-925.00	130.00
PCC^U	48.00	53.50	59.00	64.50
C^U	13.30	15.40	17.50	19.30
$CQIMB/C^U$	0.33	0.40	0.46	0.50
X^T	7.10	6.80	8.00	9.10
$QCCUB$	7.80	7.50	8.80	10.00
PCC^C	66.00	66.50	67.50	70.00
(X^W/X^T)	0.37	0.46	0.39	0.37
(X^C/X^T)	0.63	0.54	0.61	0.63
(X^T/X^{WF})	0.49	0.44	0.47	0.51
Q^{WOR}	100.10	111.30	121.30	130.00
C^{WOR}	97.70	109.70	121.30	130.20
X^{WOR}	28.90	31.20	33.70	36.00
S^W/C^W	0.61	0.52	0.52	0.52
P^W (\$/MT)	71.20	323.90	431.10	542.20
P^W (PESOS/MT)	62.60	285.10	379.30	477.10
P^C (PESOS/MT)	312.30	286.40	1,012.50	973.60

TABLE 9: SIMULATION RESULTS WITH CASE 1 ASSUMPTIONS,
BUT DIFFERENT BOT^W TIMEPATH (CASE 2)

	1985	1990	1995	2000
BOT ^W	-59.20	170.10	-210.00	-300.00
BOT ^C	-240.00	300.00	-925.00	130.00
PCC ^U	48.00	54.50	59.50	65.00
C ^U	13.30	15.70	17.70	19.50
CQIMB/C ^U	0.33	0.42	0.46	0.50
X ^T	7.10	6.80	8.00	9.00
QCCUB	7.80	7.50	8.80	10.00
PCC ^C	66.00	68.00	70.00	75.00
(X ^W /X ^T)	0.37	0.43	0.38	0.37
(X ^C /X ^T)	0.63	0.57	0.62	0.63
(X ^T /X ^{WF})	0.49	0.44	0.47	0.50
Q ^{WOR}	100.10	111.30	121.30	130.00
C ^{WOR}	97.70	110.00	121.50	130.50
X ^{WOR}	28.90	31.20	33.70	36.00
S ^W /C ^W	0.61	0.52	0.51	0.50
PW (\$/MT)	71.20	336.80	484.20	644.20
PW (PESOS/MT)	62.60	296.40	426.10	566.90
PC (PESOS/MT)	312.30	291.80	1,097.90	1,148.40

TABLE 10: SIMULATION RESULTS WITH CASE 1 ASSUMPTIONS,
BUT LOWER PER CAPITA SUGAR CONSUMPTION IN
CUBA AND THE USSR (CASE 3)

	1985	1990	1995	2000
BOT ^W	-20.00	150.00	-650.00	-80.00
BOT ^C	-240.00	300.00	-925.00	130.00
PCC ^U	48.00	51.00	53.50	60.00
C ^U	13.30	14.70	15.90	18.00
CQIMB/C ^U	0.33	0.38	0.40	0.46
X ^T	7.10	6.80	8.00	9.10
QCCUB	7.80	7.50	8.80	10.00
PCC ^C	66.00	66.50	67.50	70.00
(X ^W /X ^T)	0.37	0.46	0.38	0.39
(X ^C /X ^T)	0.63	0.54	0.62	0.61
(X ^T /X ^{WF})	0.49	0.44	0.47	0.51
Q ^{WOR}	100.10	111.30	121.30	130.00
C ^{WOR}	97.70	109.00	119.70	128.90
X ^{WOR}	28.90	31.20	33.70	36.00
S ^W /C ^W	0.61	0.54	0.58	0.65
P ^W (\$/MT)	71.20	268.10	226.40	170.70
P ^W (PESOS/MT)	62.60	235.90	199.20	150.20
P ^C (PESOS/MT)	312.30	231.30	692.10	249.90

Soviet consumption throughout the period will result in a continuous accumulation of world stocks which will increasingly depress world market price throughout the entire period. Thus while price will, in comparison with Case 1, be 17% lower in 1990 (\$268 instead of \$324), it will be 48% lower in 1995 (\$226 instead of \$431) and 69% lower by 2000 (\$171 instead of \$542). The Soviet price also shows an interesting pattern of being proportionately higher than in Case 1 for 1995, and reflects Soviet attempts to increase compensation to Cuba in a situation of low world sugar prices and worsening balance-of-trade. Thus the Soviet price for Cuban sugar is here 347% that of the world price, as compared with 267% in Case 1. Furthermore, as world price continues to fall, slightly higher shares of Cuban exports to the CPEs are allowed in the 1995-2000 period.

Case 4 Table 11 presents the summary results when the model was re-simulated with Cuban sugar production growing faster than in Case 1 to reach 11 million tons by 2000.

With Cuban exports of 10.0 million tons and world exports of 36.5 million tons in 2000, Cuba's share of free market exports increases to 55% (as compared with 51% in Case 1). With world consumption unchanged, the higher world stocks-consumption ratio means lower world prices. By 2000, the free market price is \$268/ton (\$129/ton in 1985 dollars).

Case 5: The role of Soviet per capita consumption in influencing world price is seen from Table 12 which presents the summary results when Cuban and Soviet per capita consumption grows faster to reach 80 kg and 75 kg respectively by 2000. Increased consumption will lead to faster decumulation of stocks and lowering of the stocks-consumption ratio. Consequently, world price will increase faster to \$780/ton (\$376/ton in 1985

TABLE 11: SIMULATION RESULTS WITH CASE 1 ASSUMPTIONS,
BUT HIGHER CUBAN PRODUCTION OF 11 MT IN
2000 (CASE 4)

	1985	1990	1995	2000
BOT^W	-20.00	150.00	-650.00	-80.0
BOT^C	-240.00	300.00	-925.00	130.0
PCC^U	48.00	54.50	59.50	65.00
C^U	13.30	15.70	17.70	19.50
$CQIMB/C^U$	0.33	0.42	0.46	0.50
X^T	7.10	7.80	8.70	10.00
$QCCUB$	7.80	8.50	9.50	11.00
PCC^C	66.00	68.00	70.00	75.00
(X^W/X^T)	0.37	0.46	0.38	0.37
(X^C/X^T)	0.63	0.54	0.62	0.63
(X^T/X^{WF})	0.49	0.49	0.51	0.55
Q^{WOR}	100.10	112.30	122.00	131.00
C^{WOR}	97.70	110.00	121.50	130.50
X^{WOR}	28.90	31.60	34.10	36.50
S^W/C^W	0.61	0.54	0.55	0.58
P^W (\$/MT)	71.20	253.80	276.20	267.80
P^W (PESOS/MT)	62.60	223.30	243.10	235.60
P^C (PESOS/MT)	312.30	218.90	731.10	446.30

TABLE 12: SIMULATION RESULTS WITH HIGH CUBAN AND
SOVIET PER CAPITA CONSUMPTION AND
CUBAN PRODUCTION OF 11 MT IN 2000 (CASE 5)

	1985	1990	1995	2000
BOT ^W	-20.00	150.00	-650.00	-80.00
BOT ^C	-240.00	300.00	-925.00	130.00
PCC ^U	49.00	55.50	61.50	75.00
C ^U	13.60	16.00	18.30	22.50
CQIMB/C ^U	0.35	0.43	0.48	0.57
X ^T	7.10	7.80	8.70	10.00
QCCUB	7.80	8.50	9.50	11.00
PCC ^C	66.00	68.00	70.50	80.00
(X ^W /X ^T)	0.37	0.45	0.38	0.38
(X ^C /X ^T)	0.63	0.55	0.62	0.62
(X ^T /X ^{WF})	0.49	0.49	0.51	0.55
Q ^{WOR}	100.10	112.30	122.00	131.00
C ^{WOR}	98.00	110.30	122.10	133.50
X ^{WOR}	28.90	31.60	34.10	36.50
S ^W /C ^W	0.61	0.52	0.52	0.47
P ^W (\$/MT)	73.60	302.60	379.20	780.30
P ^W (PESOS/MT)	64.70	266.30	333.70	686.60
P ^C (PESOS/MT)	313.40	286.70	905.20	1,127.90

dollars) in 2000. Because of the higher world market price, the increases in Soviet price will be proportionately lower than in Case 1 whenever the balance-of-trade situation improves. In 2000, for example, the Soviet price is now 164% of world price, as compared with 204% in Case 1.

Case 6: As for Case 5, per capita Cuban and Soviet consumption is assumed to reach 80 kg and 75 kg, respectively, by 2000. But Cuban production now rises to 13.5 million tons by 2000, giving exports of 12.5 million tons by 2000, or 66% of world free market exports. As Table 13 shows, world prices plummet to only \$149/ton (\$72/ton) in 2000. If the Soviet price determination process is unchanged, the Soviet price will also be lower.

These simulation results facilitate an assessment of sugar-based development prospects for Cuba. From the free market sugar price equation, it is seen that world price is affected (a) directly by the level of Cuba's sugar production and (b) indirectly by the Soviet capability and willingness' to increase absorption of any increased Cuban output in order to maintain and/or increase the world sugar price.

For a given level of Soviet output, a higher Soviet per capita consumption would mean a higher domestic supply deficit. This will mean increased imports which will in turn reduce world stocks, and the stock-consumption ratio, and hence raise the world sugar price. Although higher per capita consumption in the USSR and the other CPEs may be encouraged for domestic reasons, it may also be precipitated by the trend of Cuba's balance-of-trade with the CMEA countries (BOT^C). The role of Soviet sugar imports from Cuba in helping to raise the world price and Cuban sugar export earnings suggests the possibility of a deliberate Soviet decision to forego growth in the domestic sugar sector in order to facilitate Cuban exports. The simulation results show that while the Soviet price is correlated with the world price, its variation is determined by the BOT^C position. In general, the higher the BOT^C deficit, the higher is the positive Soviet price deviation from world price. The simulation results also indicate that the BOT^C trend can indirectly

TABLE 13: SIMULATION RESULTS WITH HIGH CUBAN AND SOVIET PER CAPITA CONSUMPTION AND CUBAN PRODUCTION OF 13.5 MT IN 2000 (CASE 6)

	1985	1990	1995	2000
BOT^W	-59.20	-170.10	-210.00	-300.00
BOT^C	-240.00	300.00	-925.00	130.00
PCC^U	49.00	55.50	61.50	75.00
C^U	13.60	16.00	18.30	22.50
$CQIMB/C^U$	0.35	0.43	0.48	0.57
X^T	7.10	9.10	10.70	12.50
$QCCUB$	7.80	9.80	11.50	13.50
PCC^C	66.00	68.00	70.50	80.00
(X^W/X^T)	0.37	0.43	0.36	0.41
(X^C/X^T)	0.63	0.57	0.64	0.59
(X^T/X^{WF})	0.49	0.56	0.61	0.66
Q^{WOR}	100.10	113.60	124.00	133.50
C^{WOR}	98.00	110.30	122.10	133.50
X^{WOR}	28.90	32.20	35.10	37.70
S^W/C^W	0.61	0.55	0.60	0.63
P^W (\$/MT)	73.60	192.80	157.30	149.00
P^W (PESOS/MT)	64.70	169.70	138.50	131.10
P^C (PESOS/MT)	313.40	162.10	540.50	150.90

affect world price through the Soviet per capita consumption variable. Movements in the ratio of Cuba's balance-of-trade with the market economies and CPEs (BOT^W/BOT^C) then affect the share of exports to the two markets.

Although the simulations were conducted within a partial equilibrium framework, the rest-of-the-world production and consumption were set at levels believed to be best "guesstimates" for the 1985-2000 period. With these "guesstimates", increases in Cuban production beyond 11 million tons by 2000 would push world price below the current long-run average cost of \$310/ton (1985 dollars) if per capita Soviet consumption only reaches 65 kg in 2000. But world price would be maintained at the \$310/ton level if per capita Soviet consumption goes to 75 kg. in 2000. So far the analysis has focussed on Soviet per capita consumption only. Future increases in per capita sugar consumption in the other CMEA countries may be envisaged. This could reinforce Cuba's role as a tropical products supplier, minimise the fall in world sugar price, and thus minimize Cuba's loss in hard currency sugar export earnings as Cuban exports increase.

Since the 1959 revolution, Cuba has been aiming at a sugar production goal of 10 million tons. Assuming continuation of the existing market structure, where only about 15-20% of world production is freely traded, these simulation results highlight Cuba's dilemma in relying on the sugar sector for the resources required for economic diversification and development. This is because, all things remaining unchanged, increased Cuban sugar exports will reduce world price, and hence limit the scope for increased hard currency export earnings. With little prospect of increased sugar imports by the rest-of-the-world (since there are few signs of import-substitution abating), increased Cuban sugar production could result in increased export earnings--albeit not all in hard currency--only if the USSR and other CMEA countries increase their sugar imports from Cuba. But this would not alleviate the perennial problem of Cuban inability to obtain the technology required for its economic diversification and development. The inability of the CMEA countries to supply the requisite technology and the limitations on foreign exchange to purchase such technology from the market economies leads to consideration of future oil prices and the extent to which the sugar-oil nexus may be exploited for Cuba's gain.

In the simulations presented above, the oil price in constant 1985 dollars was assumed to fall from \$27/barrel in 1985 to \$21/barrel in 2000. This would make the diversion of sugar cane to ethanol (alcohol fuel) production unattractive. Recall that under the sugar-oil nexus, sugar and oil are traded between Cuba and the USSR at prices influenced by their corresponding world prices. However, their final determination is based on Soviet consideration of Cuba's balance-of-trade position and Cuba's hard currency foreign exchange gap. In this connection therefore, some Soviet oil exports to Cuba is expressly for Cuban resale for hard currencies. The complex way in which the Soviet price for Cuban sugar is determined is seen from the simulation results. While formal determination of the price of Soviet oil to Cuba is beyond the scope of this study, it suffices to say that the determination of Soviet-Cuba traded prices for oil and sugar are interdependent. With the recent decline in oil price, and the prospect of lower oil prices in future, Cuba's hard currency earnings from oil cannot be maintained without compensating increases in Soviet oil supplies.

The simulation results show that given the long-term sugar market outlook, increased Cuban sugar output per se will not provide the resources required for Cuba's economic development. However, if the USSR is able to maintain the sugar-oil nexus, the simulation results and projected long-term oil prices jointly delineate three conditions upon which successful Cuban economic diversification is contingent. These are: (1) more than compensating increases in Soviet oil supplies for Cuban hard currency resale; (2) the ability and willingness of the USSR and other CMEA countries to absorb higher sugar imports from Cuba so that increased Cuban production will not lead to a net increase in the world stock-consumption ratio and (3) improved Cuban economic management.

TABLE A.1: CUBAN SUGAR EXPORTS TO CPES AND NON-CPES, 1958-84 (TONS PER YEARS).

	1958	1959	1960	1961	1962	1963	1964	1965	1966
ALBANIA	0	0	0	0	10,700	6,419	10,810	11,297	10,490
BULGARIA	0	0	0	57,258	117,796	56,177	87,248	157,692	158,051
CZECHOSLOVAK	0	0	8,988	25,322	155,680	150,105	52,071	244,618	262,098
E. GERMANY	0	0	61,867	111,910	179,343	244,490	81,054	169,878	207,192
HUNGARY	11,234	0	0	0	0	0	0	0	0
N. KOREA	0	0	0	0	14,038	20,000	21,051	21,458	21,335
POLAND	0	0	143,990	261,927	151,285	103,895	32,148	0	52,843
ROMANIA	0	0	0	0	0	0	0	0	0
USSR	187,683	273,776	1,577,683	3,302,865	2,112,245	973,423	1,936,798	2,456,144	1,814,930
VIETNAM, SOC.	0	0	0	0	10,490	13,373	10,542	65,997	13,077
TOTAL CPES	198,917	273,776	1,792,528	3,759,282	2,751,577	1,567,882	2,231,722	3,127,084	2,540,016
TOTAL WORLD	5,631,592	4,951,874	5,634,513	6,413,561	5,130,940	3,520,505	4,176,051	5,315,630	4,434,639
USSR/WORLD	3.3%	5.5%	28.0%	51.5%	41.2%	27.7%	46.4%	46.2%	40.9%
CPES/WORLD	3.5%	5.5%	31.8%	58.6%	53.6%	44.5%	53.4%	58.8%	57.3%
MKT ECONS/WORLD	96.5%	94.5%	68.2%	41.4%	46.4%	55.5%	46.6%	41.2%	42.7%

	1967	1968	1969	1970	1971	1972	1973	1974	1975
ALBANIA	4,235	17,098	0	10,807	23,278	15,108	13,855	12,850	14,171
BULGARIA	194,671	186,431	205,308	231,170	210,655	154,257	212,634	190,144	185,728
CZECHOSLOVAK	214,884	193,490	224,356	226,605	189,638	151,132	163,018	160,484	55,745
E. GERMANY	249,623	243,656	252,508	352,666	338,096	243,028	259,488	276,003	169,195
HUNGARY	16,730	16,574	16,663	16,304	59,396	38,069	52,422	51,369	41,762
N. KOREA	83,346	74,910	154,851	149,110	196,704	119,233	135,576	55,305	50,441
POLAND	22,327	20,713	28,134	24,177	30,313	22,247	55,124	28,278	43,100
ROMANIA	0	53,552	69,143	99,178	109,312	72,583	78,174	77,953	11,224
USSR	2,473,305	1,831,727	1,352,329	3,105,030	1,580,988	1,097,406	1,660,681	1,974,761	3,186,724
VIETNAM, SOC.	45,510	49,777	60,129	56,512	76,106	75,633	75,910	78,018	86,918
TOTAL CPES	3,304,631	2,687,928	2,363,421	4,271,559	2,814,486	1,988,696	2,706,882	2,905,165	3,845,008
TOTAL WORLD	5,682,872	4,612,923	4,798,817	6,906,286	5,510,860	4,139,556	4,797,337	5,491,247	5,743,711
USSR/WORLD	43.5%	39.7%	28.2%	45.0%	28.7%	26.5%	34.6%	36.0%	55.5%
CPES/WORLD	58.2%	58.3%	49.3%	61.9%	51.1%	48.0%	56.4%	52.9%	66.9%
MKT ECONS/WORLD	41.8%	41.7%	50.7%	38.1%	48.9%	52.0%	43.6%	47.1%	33.1%

	1976	1977	1978	1979	1980	1981	1982	1983	1984
ALBANIA	13,169	8,370	20,997	24,649	17,069	12,143	15,946	15,698	14,673
BULGARIA	232,042	218,585	189,623	218,223	234,112	249,851	277,678	331,485	360,107
CZECHOSLOVAK	109,172	67,374	84,850	99,060	98,775	99,871	134,892	144,648	226,489
E. GERMANY	194,868	228,940	200,717	223,100	209,900	254,770	213,461	280,922	278,773
HUNGARY	70,007	51,416	58,424	72,414	34,152	76,216	72,903	0	0
N. KOREA	21,999	18,452	11,838	21,621	10,897	27,559	17,079	22,511	21,262
POLAND	16,642	31,099	60,209	63,660	63,128	70,154	0	0	0
ROMANIA	39,303	25,868	0	39,017	46,754	138,820	89,663	221,454	272,088
USSR	3,035,566	3,790,424	3,936,133	3,842,211	2,726,339	3,204,475	4,425,519	3,314,985	3,649,996
VIETNAM, SOC.	124,538	67,680	82,468	111,498	41,841	102,613	24,155	77,134	0
TOTAL CPES	3,857,306	4,508,208	4,645,259	4,715,453	3,482,967	4,236,472	5,271,296	4,408,837	4,823,388
TOTAL WORLD	5,763,652	6,238,162	7,231,219	7,269,429	6,191,074	7,071,445	7,734,283	6,792,093	7,016,510
USSR/WORLD	52.7%	60.8%	54.4%	52.9%	44.0%	45.3%	57.2%	48.8%	52.0%
CPES/WORLD	66.9%	72.3%	64.2%	64.9%	56.3%	59.9%	68.2%	64.9%	68.7%
MKT ECONS/WORLD	33.1%	27.7%	35.8%	35.1%	43.7%	40.1%	31.8%	35.1%	31.3%

SOURCE: INTERNATIONAL SUGAR ORGANIZATION

APPENDIX II

CHRONOLOGY OF DEVELOPMENTS IN CUBAN SUGAR INDUSTRY

- 1818 : Spanish government conceded free trade to the Spanish colonies. Cuba started exporting sugar which became the most important export crop.
- 1860 : Colonial style of sugar plantations gradually converted to a system of central sugar mills supplied by independent planters and/or mill tenants.
- Early 1900s : Start of US involvement after the Spanish-American War. Huge influx of US capital, including construction of a railway system for sugar cane transportation. The railway system prompted large expansion of Cuban sugar cane industry to central and eastern Cuba. Sugar cane monoculture in Cuba was established
- 1959 : Cuban revolution and the start of agricultural collectivization. At the time, 161 sugar mills produced about 5.8 million tons sugar, of which 2.9 million tons (or 59%) were exported to the United States to supply about 35% of US domestic sugar consumption. The grinding capacity of the sugar mills was limited and production quotas had to be set for the industry to avoid cane over-supply. The crop year lasted 120 days, and only 65% of the available cane was milled.
- 1960 : Collectivization almost completed, and Central Planning Board (JUCEPLAN) established. US-Cuban conflict over oil refining led to the cut of 0.7 million tons of Cuba's US sugar quota, and subsequent nationalization of US-owned banks and industries in Cuba.

- 1961 : Cuba and the United States severed diplomatic relations, leading to the total loss of trade with the United States. This trade had previously accounted for two-thirds of Cuba's foreign trade.
- 1961-63 : Introduction of Soviet style command economy in the pre-economic reform phase, with emphasis on heavy industrialization. Sugar cultivated area and production declined.
- 1964-66 : Debate over and test of alternative Socialist economic models, à la Liberman, and à la Mao-Guevara. Both models simultaneously applied, albeit in different parts of the economy. Sugar and foreign trade were conducted under the Liberman model. Sectoral planning adopted, with sectoral plan for sugar being most important and emphasis on sugar industry as the key to overall Cuban industrialization.
- 1966-70 : Adoption of Maoist-Guevarist model with increased state control of all sectors of the economy. Economic planning substituted with decision-making by the political leadership, with emphasis on egalitarianism. Increased sugar production attained through resource allocation that prejudiced remaining sectors.
- 1971 : Worsening foreign debt and shift to Soviet Economic Reform Model. Central planning reinstated and economic liberalization introduced via increases in state procurement prices, allowing farm surplus to be marketed in free markets, and wage incentive payments according to productivity.
- : Mechanized cane-cutting formally began.
- 1972 : Cuba joined the Council for Mutual Economic Assistance (CMEA).
- 1971-75 : Stagnant sugar production fortuitously compensated by increases in world sugar prices.

- 1975 : Announcement on December 17 of the First Five-Year Plan for 1976-80.
- 1976 : A five-year Cuba-USSR economic (trade) and technical agreement was signed on February 6.
- 1977 : Cuba's Foreign Trade Minister publicly acknowledged that trade with the United States would be welcomed.
- 1980 : Castro publicly admitted on December 17 that the goals of the First Five-Year Plan were not reached. The Second Five-Year Plan for 1981-85 introduced in the spirit of a New Economic Policy aimed at increasing the flexibility of Cuba's economic system.
- 1981 : Comprehensive reform of the wholesale and retail prices.
- 1982 : Press agency report that Soviet aid for 1981-85 would provide investment goods for the sugar and railroad sectors as well as construction of the first nuclear power plant in Cuba.
- 1983 : New system of material incentives introduced in sugar industry. Deferment and rescheduling of \$3.1 billion debt repayment to western creditors until 1986 over a 10-year repayment period.
- 1985 : Rescheduling of \$726.7 million debt payment due in 1985. Debt with western creditors and CPEs now total about \$3.3 billion and \$22 billion respectively.

CHRONOLOGY OF CUBA-USSR SUGAR AGREEMENTS

- 1960 : First bilateral trade and payments agreement covering 425,000 tons sugar during 1960, in addition to the 575,000 tons that were already purchased. Over the period 1961-64 the USSR purchased 1 million tons annually. 80% of the sugar was to be paid for in rubles at world prices, with 20% paid in convertible currency, machinery and equipment, wheat, petroleum and petroleum products, and fertilizers.
- 1964 : Second trade agreement, stipulating the new schedule of Cuban sugar deliveries to the USSR during the period 1965-70 at the fixed price of 6.11¢/lb throughout.
- 1972 : Third trade agreement setting the sugar price at 12.34¢/lb for 1973 deliveries.
- 1974 : Cuban official publication indicated that agreed delivery price for Cuban sugar to the USSR was 19.64¢/lb for 1974 and 30.0¢/lb for the period 1975-80.
- 1975 : Modification of intra-CMEA trade pricing method, from price fixing at beginning of each five-year trade agreement to price fixing annually.
- 1976 : Cuba-USSR five-year trade agreement for 1976-80 signed on February 6. USSR exports of petroleum to Cuba in exchange for sugar, with the oil price related to the sugar price.

- 1977 : USSR deferred Cuban payment of debt (principle plus interest) incurred in 1960-75 period until 1986, with amortisation period extended until 2011.
- 1984 : Agreement signed on October 31 to postpone the repayment of debt with the USSR from 1986 to 1990.
- : Agreement signed on December 5 for a 15-year Cuba-USSR co-operation program towards economic, scientific and technical development. The agreement acknowledged the critical importance of Soviet material inputs for Cuban economic development.
- 1985 : Trade agreement signed on May 30 providing for an annual trade turnover exceeding 8 billion rubles. Cuban imports from the USSR consist mainly of foodstuffs, petroleum and petroleum products and capital goods.

REFERENCES

- Ashbrook, Arthur G. Jr. (1983) Cuba: Economic Effects of US Trade and Financial Embargo, (mimeograph), Washington DC.
- Banco Nacional de Cuba (1985) Cuba's Financial Crisis, published by The Cuban American National Foundation Inc., as Paper No. 12.
- Blasier, Cole and Carmelo Mesa-Lago (eds.) (1979) Cuba in the World, University of Pittsburgh Press.
- Blume, Helmut (1985) Geography of Sugar Cane, published by Verlag Dr. Albert Bartens, Berlin, Federal Republic of Germany.
- Edquist, Charles (1983) "Mechanization of Sugarcane Harvesting in Cuba", Cuban Studies, vol. 13 (2:41-64).
- Latin American Mining Letter (1984) Cuba-USSR Relations, 28 November, 1984.
- Licht, F.O. (1985a) "Cuba/Soviet Sugar Trade: A Substantial Revision in Trading Stand?", April 10, 1985.
- _____ (1985b) "Cuban: Sugar Industry Investment", September 24, 1985.
- Lodos, J. (1983) "ICINAZ: The Cuban Institute for Sugar Research", International Sugar Journal, Volume 85, Supplement.
- Mesa-Lago, Carmelo (1979a) "The Economy and International Economic Relations", in Blasier and Mesa-Lago (eds.) pp. 169-198.
- _____ (1979b) "The Economics of US-Cuba Rapprochement", in Blasier and Mesa-Lago (eds.) pp. 199-224.
- _____ (1981) The Economy of Socialist Cuba: A Two-Decade Appraisal, University of New Mexico Press.
- _____ (1983) "The Cuban Economic Model in the 1980s: Ideology/Pragmatism Conflicts and Possibilities for Change" (mimeograph).
- Perez-Lopez, Jorge F. (1979) "Sugar and Petroleum in Cuban-Soviet Terms of Trade", in Blasier and Mesa-Lago (eds.).
- Pollitt, Brian (1981) "Revolution and the Mode of Production in the Sugar Cane Sector of the Cuban Economy, 1959-80--Some Preliminary Findings", Institute of Latin American Studies Occasional Paper No. 35, University of Glasgow.
- Radell, Willard W. Jr., (1983) "Cuban-Soviet Sugar Trade, 1960-1975: How Great was the Subsidy?" The Journal of Developing Areas, volume 17 (3:365-382).
- Theriot, Lawrence H. (1982) Cuba Faces the Economic Realities of the 1980s, US Government Printing Office, Washington D.C.