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AN ANALYSIS OF THE PERFORMANCE OF THE SUGAR CANE INDUSTRY IN THE DOMINICAN REPUBLIC

By

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ABSTRACT

AN ANALYSIS OF THE PERFORMANCE OF THE SUGAR CANE INDUSTRY IN THE DOMINICAN REPUBLIC

By

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Agriculture is the most important sector in the Dominican economy. Within the Agricultural sector, the sugar cane industry is the most important sub-sector. However, the sub-sector's share of the Gross Domestic Product, employment, and income generation has decreased substantially due to external and internal problems.

The purpose of this research is to analyze the performance of the sugar cane industry in the Dominican Republic. An econometric model using time series from 1970 to 1990 was developed to achieve this objective. The model shows some of the factors affecting sugar supply and demand. Some supply and demand elasticities, such as income and own price elasticities are estimated. Moreover, forecasts of supply and demand for the domestic and export market are made for the near future.

The model shows a decline of supply and export of sugar from the Dominican Republic. This trend in the sugar industry in the Dominican Republic leads the author to believe that in the near future, the country might have to import sugar to fulfill its domestic needs.

A mis padres y hermanos
por haber soportado estos dos años y medio sin mí.

To Audra
You mean much more to me than you can imagine.
I'm sorry Audra, you're very smart.

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CHAPTER I

INTRODUCTION

1.1 Problem Statement

Despite a decline in Agriculture's role in the Gross Domestic Product (GDP), exports, and employment generation in the Dominican Republic, it continues to be the most important sector in the country's economy. Agriculture is not only the main source of foreign currency received by the country in international markets, but also generates employment for a majority of the labor force. For example, in 1986 the country exported agricultural goods valued at US$ 425.6 million, representing 60% of the value of all exports made by the country during that year. As far as employment generation is concerned, Perez-Luna (1984), cited by Rivas (1988), estimated that 58% of the labor force in the Dominican Republic is devoted to activities related to Agriculture.

Within the agricultural sector in the Dominican Republic, the sugar cane industry is ranked as the foremost cash crop. Fluctuation in sugar output and prices are important determinants of economic conditions in the Dominican Republic. Increase in world sugar prices greatly contribute to generating foreign exchange. Conversely, fluctuations in earnings from the sugar sector

have been a destabilizing force in the economy in the Dominican Republic (World Bank, 1977). However, the GNP contribution of the sugar cane industry to the Dominican economy has declined so sharply that much of the land previously cropped to sugar cane production is being diverted to the production of other agricultural products. It is important to understand the domestic and international supply and demand linkages as the U.S. is the major export market for sugar cane.

The decline of the sugar cane industry is primarily due to external factors such as low world market prices and the dependence of the Dominican Republic on the U.S. market for exports. Thus, it is important for policy makers in the country to obtain a good understanding of the variables affecting supply and demand for sugar in the Dominican Republic. The development of an econometric model is a valuable tool for policy decision makers. This model can describe the past performance of the sugar cane industry in the Dominican Republic and form the basis for predicting future trends. Moreover, this study is relevant to the Instituto Superior de Agricultura's (ISA)[1] long-range goals of helping improve the performance of the Dominican public sector.

[1] The Instituto Superior de Agricultura is the main agricultural university in the Dominican Republic and the researcher works for it.

1.2 Objective of the Study

The purpose of this paper is to analyze the performance and current status of the sugar cane industry in the Dominican Republic. To achieve this purpose, the following activities are proposed:

1- To develop an econometric model to analyze the supply and demand trends for sugar in the Dominican Republic.

2- To estimate price and income elasticities for sugar consumption based on econometric modeling.

3- To forecast supply and demand of sugar in the Dominican Republic based on past trends and the current situation.

4- To analyze how the general macroeconomic policy in the country has helped or hindered the sugar cane industry.

CHAPTER II

RESEARCH METHODOLOGY

2.1 Collection of Data

The data for this paper consist mainly of time series trends of production, consumption, and prices as they relate related to the sugar industry both in the Dominican Republic, in the United States, and an aggregate of the rest of the world. Moreover, some economic variables are included as exogenous variables to help explain supply and demand trends. The period covered by the time series is from 1970 to 1990. The kind of data to be used will be annual time series data. Furthermore, this paper includes relevant data on the agricultural sector in the Dominican Republic as the sugar cane industry is the main agricultural activity.

2.2 Analysis of Data

A linear multiple regression analysis was used to determine the relationship among variables. Both supply and demand equations were modelled using this method. This analysis was carried out using the MicroTSP computer software package. This computer software solves the system of equations simultaneously using the Gauss-Seidel algorithm. Projections of the endogenous variables were made for the years 1991 to 1995.

In the process of developing the model, many variables that theoretically affects supply and demand were tested. Some of them were dropped because they were not significant. For example, producer price is supposed to affect area of sugar cane harvested in the Dominican Republic. However, when it was tested, it was not significant.

CHAPTER III

THE AGRICULTURAL SECTOR IN THE DOMINICAN REPUBLIC

3.1 Economic and Social Importance of Agriculture

Agriculture continues to be the most important sector in the Dominican Republic. Its contribution to the economy can be measured in terms of foreign exchange generated, employment, and contribution to the GDP.

The share of the agricultural sector in the total GDP in the Dominican Republic is shown in Table 1. From 1975 to 1991, the total value of agricultural production at 1970 constant prices has ranged from RD$ 262.80 million in 1970 to RD$ 330.60 million in 1983. Although these are the minimum and maximum values of agricultural production, they do not represent the lowest and the highest percentages of the total GDP. The lowest percentage (8.17 %) and the highest percent (11.74) were obtained in 1990 and 1976, respectively (Central Bank, various years). Traditional export crops such as sugar, coffee, cocoa, and tobacco are the ones that have contributed more to the total value of agricultural production. Some other important crops include cereals, vegetables, roots, and tubers.

In spite of the low price of sugar, coffee, and cocoa, and the reduction in the sugar quota by the U.S. market, agriculture continues to be the most

Table 1: Participation of the Agricultural Sector in the GDP in the Dominican Republic

Year	Total GDP (million RD$) (1970 prices)	Share of Agriculture (million RD$) (1970 prices)	Percentage
1975	2,288.90	262.80	11.48
1976	2,442.90	286.80	11.74
1977	2,564.60	286.30	11.16
1978	2,619.50	293.70	11.21
1979	2,738.20	287.90	10.51
1980	2,903.90	297.50	10.24
1981	3,021.90	312.10	10.33
1982	3,069.20	323.80	10.55
1983	3,209.40	330.60	10.30
1984	3,218.10	329.00	10.22
1985	3,134.90	314.80	10.04
1986	3,234.00	312.10	9.65
1987	3,488.60	323.20	9.26
1988	3,512.70	315.10	8.97
1989	3,655.20	317.90	8.70
1990	3,468.40	283.20	8.17
1991	3,441.00	289.70	8.42

Source: Central Bank. Monthly Bulletin.
Dominican Republic. Various years (1975-1991)

important source of foreign currency for the Dominican Republic (Jacc/RD, 1989). According to the Jacc/RD (1989), the export of non-traditional agricultural products such as vegetables, plantain, cassava, yam, and

fruit have compensated, in part, for the decline in foreign currency previously generated by the export of sugar.

The social importance of agriculture in the Dominican Republic can be explained by the number of people who benefit from it. These are mainly people in the rural areas. In 1987, the rural population, that was estimated to be 3.06 million people, benefited directly or indirectly from agricultural activities (Jacc/RD, 1989). In addition to the rural population, many people in the urban areas benefited from agriculture through commercialization, transport, and agro-industries.

Therefore, agriculture, despite a slow growth and reduction of some crops, continues to be the most important sector to generate foreign currency and to produce food for the Dominican population as well as the main source of employment.

3.2 Structure of the Agricultural Sector

3.2.1 Land Use and Availability

The Dominican Republic has a total area of 48,442.23 squared kilometers (18,710.79 squared miles). This is equal to approximately 77,120,141 tareas[2]. According to the national census carried out in 1981, 27.2 % of the total land, which is approximately 20,958,000 tareas, are used for agricultural activities, 24.7 % (19,036,000 tareas) are used for pasture, and the rest is mountain,

[2] 1 tarea (ta) is approximately 1/16 of a Hectare (Ha).

forest, and other. Out of the total agricultural land, 76.5 % (16,039 ta) is in use, 13.6 % (2,843,000 ta) is fallow, and 9.9 % (2,075,000) is idle (Jacc/RD, 1989).

A study carried out by FAO in 1988 on the agricultural sector shows that there are 14,803,345 ta (931.028 Ha) monocropped and 8,357,771 ta (525,646 Ha) intercropped. This makes a total of 23,161,116 ta (1,456,674 Ha). FAO (1980) also states that the crops that use more land in the Dominican Republic are sugar cane, coffee, and cocoa. They use 3,640,225 ta (228, 945 Ha), 2,396,607 ta (150,730 Ha), and 1,991,221 ta (125,234 Ha), respectively. These crops are followed by rice, which uses 1,510,500 ta (95,000 Ha) . Some other important crops are beans, peanuts, cotton, plantain-bananas, coconuts, maize, sorghum, and roots and tubers.

3.2.2 Number and Size of the Farms

The integration that exists between agriculture and animal production in small but numerous subsistence farms in the Dominican Republic makes it difficult to differentiate between these two activities (Jacc/RD, 1989). For this reason, the agricultural census of 1981 groups these two activities by number and size of farms. However, the census separates the area dedicated to each activity.

Between 1971 and 1981, the period between the two national censuses, the number of farms changed from 304,820 to 385,060. This means an increase of 26.3 %. Most of these farms are located in the northern part of the

country. The number of farms in the north is 201,911. Out of this total, 106,420 are located in the northcentral area. In descending order, the southeastern region is located in second place with 104,448 farms, and the southwestern region is in third place with 78,701 farms. Table No. 2 shows a summary of these pieces of information.

Table 2: Number, Area, and Size of the Farms in the Dominican Republic. 1971 and 1981 Censuses.

Region	Number of farms		Area (tareas)		Average size (tareas)	
	1971	1981	1971	1981	1971	1981
Total	304,820	385,060	43,508,888	42,559,639	143	111
North	159,144	201,911	20,191,334	19,064,513	127	94
Northcentral	82,560	106,420	9,618,975	9,922,646	117	93
Northeast	53,889	62,785	7,466,183	5,890,667	139	94
Northwest	22,695	32,706	3,106,176	3,251,200	137	99
Southwest	59,601	78,701	5,404,868	5,565,136	91	71
Southeast	86,075	104,448	17,912,686	17,929,990	208	172

Source: Adapted from Jacc/RD, 1989

According to the 1971 and 1981 censuses, between this period, the land used for agriculture and animal production decreased by 949,249 tareas. However, if only the area used for cropping is considered, there is an increase in 2.93 million tareas. This means that cropping, in fact, was actually growing.

Table 2 also shows that a tendency to small farms has been observed in the last few years. In 1971, the average size of a farm was 143 ta, but in 1981, it decreased to 111 ta.

Table 3 presents the distribution of farms according to their size. Of the

Table 3: Stratification of the Farms in the Dominican Republic. 1981 Census.

Size (tareas)	Number of farms	Percentage	Area (tarea)	Percentage	Average area (tarea)
Less than 8	61,670	16.00	185,994	0.90	3.00
From 8 to 79	252,995	65.70	4,175,710	19.90	16.50
From 80 to 159	32,543	8.50	2,478,420	11.80	76.20
From 160 to 799	30,815	8.00	4,583,301	21.90	148.70
From 800 to 1,599	4,081	1.10	1,512,780	7.20	370.70
From 1,600 to 3,199	1,825	0.50	1,318,399	6.30	722.40
From 3,200 to 7,999	786	0.20	1,200,470	5.70	1,527.30
From 8,000 to 15,999	184	0.00	666,124	3.20	3,620.20
16,000 or more	161	0.00	4,836,444	23.10	30,040.00
Total and average	385,060		20,957,642		54.43

Source: Jacc/RD, 1989.

farms, 81.7 % have less than 80 ta, 16.4 % have between 80 and 800 ta, and only 1.9 % have more than 800 ta. However, farms with less than 80 ta represent only 20.8 % of the total area used for agriculture. The farms between 80 and 800 ta represent 33.7 %, and 1.9 % of the farms with more than 800 ta represent 45.5 % of the agricultural land.

The average farm size is 54.4 ta, but 81 % of the farms have 13.9 ta, which are too small to sustain a rural Dominican family (ONE, 1983). It is worthwhile to mention that within the last category, there are 345 farms with more than 8000 ta, with a total area of 5.50 million ta that belong to government institutions such as the National Sugar Council (CEA), the Land Reform Institute (IAD), and private sugar cane enterprises.

3.2.3 Land Tenure

Recent land tenure information could not be found. The land tenure structure, according to the 1971 census, is shown in Table 4. The 1971 census indicates that 70.81 % of the land used for agriculture had titles. This total included all government and private land. In a study done by Development Associates in 1985, it was estimated that the CEA had titles on 2,750,000 ta (173,000 Ha). In addition, 281,430 ta (17,700 Ha) had been invaded illegally by farmers. The National Cotton Institute (INDA) has 79,500 ta (5,000 Ha). Other government institutions have 69,006 ta (4,340 Ha) for a total of 182,340 Ha (2,899,206 ta)

Government land used illegally by farmers is 3,600,428 ta (226,442 Ha). Moreover, the IAD has 6,232,800 ta (392,000 Ha). Therefore, the government is the owner of a large portion of the agricultural land in the Dominican Republic.

Table 4: Land Tenure in the Dominican Republic. 1971 Census

Tenure	Area (Hectares)	Tareas	Percentage
With titles	1,938.5	30,822.1	70.81
Rented	84.0	1,335.6	3.07
Agrarian Reform	48.1	764.8	1.76
Illegally occupied	208.7	3,318.3	7.62
Combined tenure	400.8	6,372.7	14.64
Others	57.5	914.3	2.10
Total	2,737.6	43,527.8	100.00

Source: Adapted from Development Associates, 1985.

3.3 Institutions Related to the Agricultural Sector in the Dominican Republic

The objective of the different institutions, related to the agricultural sector in the Dominican Republic, is to create the necessary conditions for the production of the food products demanded by the population. Moreover, they try to provide the services needed by producers during the production process.

These institutions, since they were founded, have tried to adapt to the changing conditions in the Dominican Republic to try to solve all agricultural challenges (Jacc/RD, 1989).

The most important institutions within the Dominican agricultural sector are the following:

1- The Ministry of Agriculture (SEA)

This is considered the most important institution dealing with the agricultural sector in the Dominican Republic. The SEA is in charge of creating the necessary conditions to ensure a good supply of food products to the population. All the other institutions, though independent, are linked to SEA because of the nature of this institution.

2- The Agricultural Bank (BAGRICOLA)

This is the main national institution in charge of providing financial assistance to small and medium sized farmers.

3- The Dominican Agrarian Institute (IAD)

This organization is in charge of controlling the land concentration and distribution. It tries to benefit landless people in the rural areas.

4- The National Water Resources Institute (INDRHI)

This institution is in charge of managing the whole irrigation system in the Dominican Republic. All laws and regulations dictated by this institution tend to favor all agricultural producers in the country.

5- The National Institute for Price Stabilization (INESPRE)

This is the official institution in charge of regulating all agricultural marketing and commercialization activities. It is specifically oriented toward protecting small and medium sized farmers in marketing and commercializing their agricultural products. Its main objective is to regulate prices and to avoid speculation with agricultural products. The INESPRE sets the buying and selling price of some agricultural and animal products.

6- Center for the Administration of the National Forest (DGF)

The objective of this institution is to manage and preserve the national forest. In the beginning, it functioned as a dependent of the Ministry of Agriculture. However, it is now a dependent of the military.

CHAPTER IV

A PROFILE OF THE SUGAR INDUSTRY IN THE DOMINICAN REPUBLIC

4.1 Economic and Social Importance of the Sugar Industry

More than any other country, the sugar cane industry is the backbone of the Dominican economy. Within the agricultural sector, sugar cane is the most important subsector. Garcia (1990) states that the sugar agro-industry has been the most important industrial activity in the Dominican Republic for a long time. It generates most of the employment, income, and exports.

Sugar exports from the Dominican Republic have fluctuated through time. Sugar export from 1980 to 1989 reached a maximum level of 956,174 metric tons in 1983. It decreased to 481,473 in 1986, and recovered again in 1987 when the export level reached 587,358 metric tons and 521,356 metric tons in 1989 (Garcia, 1990).

According to Garcia (1990), the relative importance of sugar exports compared with total exports had also changed during that decade. In 1982, sugar exports represented 40 % of the total exports. In 1983, this percentage decreased to 23 % and it continued decreasing until 1988.

Despite the decrease in its relative importance, the sugar cane industry continues to be very important for the Dominican economy. It continues to be

a great source of foreign currency generation and it employs more than 80,000 people annually directly in the fields and sugar enterprises plus around 70,000 more people employed by sugar "colonos." The labor force used by the sugar industry reaches 50 % of the labor force used by the manufacturing industry (Garcia, 1990). Moreover, there are many more people in the economy that depend indirectly from the sugar cane industry.

4.2- A Historical Overview of the Sugar Cane Industry in the Dominican Republic

Sugar cane was introduced to America through the Dominican Republic. It was introduced by Christopher Columbus in his second trip to the New World in 1493 (CRC, undated and Garcia, 1990). In the beginning, it was planted in household gardens. It was planted at a commercial level in 1506. The industry was favored by the import of black slaves from Africa to the Dominican Republic (Diaz, 1986). Sugar was produced for the first time on the island in 1509 (INAZUCAR, 1977). Sugar plantations were growing and the Dominican sugar industry was becoming so important that in 1516 the Dominican Republic provided sugar to the Old World. Around 1550, sugar cane was already one of the most valuable crops in the Hispaniola island, which is today the Dominican Republic and Haiti. However, it is not until the end of the XIX century when the sugar industry was truly developed.

During colonial times, despite the excellent soil and climate conditions in the Santo Domingo island, sugar production in the oriental part of the island, which today is known as the Dominican Republic, did not develop very well. The industry declined at the end of XVII century. In Cuba and Haiti, however, the sugar industry developed very well.

The Dominican sugar industry was restored around 1870 and the basis for its future development was set. This new development was supported by the emigration of Cubans after the independence war in their country (CEA, 1991). At that time, sugar mills such as "La Fe", "La Esperanza" (in 1874), and "La Caridad" were established around the capital city, and the "Angelina" was established in the oriental region close to the Higuamo River. This last one is the only one that still remains today.

At the beginning of this century, some foreign companies dedicated to sugar production were established in the Dominican Republic. This fact further contributed to the Development of the industry. These companies sent their production to foreign markets, in higher amounts each time (CEA, 1991).

In this stage, the development of the sugar industry was accelerated. Then, the sugar industry became the main national economic activity. Sugar production increased from 4,380 tons in 1880 to 53,000 tons in 1900, and 178,558 tons in 1920. At that time, the national sugar industry had all the conditions that characterized the Dominican Republic as a "natural sugar exporting" country.

After World War I, the sugar industry greatly influenced the Dominican economy. In 1920, the value of the national exports suddenly increased to nearly US$ 50 million from an average of less than US$ 25 million in the previous five years. This increase in the value of exports was due to an increase in the world price of sugar to more than 22 cents per pound. At that time, sugar cane was named "The Green Gold" of the Dominican Republic. However, the following year, 1921, the disequilibrium in the world supply and demand led to a sharp decrease in price from 22 cents to less than 2 cents per pound. This price decrease greatly affected the Dominican economy that depended almost exclusively on sugar export for its subsistence.

In 1950, a new stage began for the national sugar industry. The dictator Rafael Leonidas Trujillo decided to participate directly in the sugar industry. Trujillo anticipated large benefits as a result of the recovery of the world economy after World War II. He constructed two more sugar mills and acquired two others for his ownership. With this new expansion policy, sugar production increased to more than one million tons annually (Gomez, 1988).

After the dictator was assassinated, the Government took all the properties belonging to the Trujillo family, including 12 sugar mills that produced more than 60 % of the sugar produced in the Dominican Republic. This expropriation divided the industry in two sectors: the public and the private sector. The private sector was represented by the Vicini group and the Gulf and Western Americas Corporation - Central Romana Division. These last two

groups contributed to 28 % and 8 % of the sugar production, respectively. This is the basis for the current structure of the sugar industry in the Dominican Republic.

4.3- Structure and Organization of the Sugar Cane Industry in the Dominican Republic

Within the Dominican sugar industry, there are three main sectors. These sectors are the sugar mills, the institutions dealing with the commercialization process, and the "colonos" (Diaz, 1986). These "colonos" are individual sugar cane producers that have a contract to sell their production to one of the sugar mills. They also receive technical and financial assistance in exchange. Sometimes they own their land, but in some cases, the land is provided to them by the Government.

In 1990, sugar cane was planted in a total area of 200 to 250 thousand Ha (Garcia, 1990). At that time, there were 16 sugar mills in the country. In the two last years, two of those sugar mills were closed, leaving 14. These mills were closed due to low profitability. Moreover, the total area devoted to sugar cane has also decreased. The CEA thought it was more profitable to produce some other agricultural products such as pineapple, oranges, and vegetables.

Ten of the 14 sugar mills are administrated by the CEA and the remaining four are private property. Three of the private ones belong to the Vicini group and the other one belong to the Central Romana Corporation,

which is a foreign company established in the country. The distribution of the sugar mills in the Dominican Republic is presented in Table 5.

Table 5: Daily Processing Capacity of Dominican Sugar Mills.

Sugar mills		Processing capacity (Short Tons)	
Casa Vicini			
Cristobal Colon		1,750	
Caei*		2,300	
Angelina*		1,850	
	Sub-total		5,900
Central Romana Co.			
Central Romana		15,000	
	Sub-total		15,000
Dominican Sugar Council (CEA)			
Consuelo		4,600	
Quisqueya		3,000	
Barahona		5,000	
Boca Chica		3,600	
Rio Haina		13,700	
Catarey*		2,200	
Porvenir		3,600	
Santa Fe		3,000	
Ozama		3,600	
Monte Llano		2,200	
Esperanza*		1,500	
Amistad		500	
	Sub-total		46,500
Total			67,400

* Sugar mills currently closed
Source: Adapted from World Bank, 1988.

In the country, there are also two sugar refineries (Garcia, 1990). One of them belongs to the "Porvenir" sugar mill, which has a nominal capacity of 70 thousand tons of refined sugar. The other belongs to the Central Romana, which has a total capacity of 33 thousand tons.

The sugar enterprises in the Dominican Republic transport the sugar cane by two means: rail and roads. For the latter means, they use oxen and tractors. The rail system has a length of around 1,500 Km (932 miles) (Garcia, 1990).

Garcia (1990) also states that in the country there are also 6 ports for sugar export. These ports are the following: Barahona, Haina, Andres (in Boca Chica), San Pedro de Macoris, La Romana, and Puerto Plata.

4.4- Description of Some of the Institutions Dealing with the Sugar Cane Industry in the Dominican Republic

4.4.1 The National Sugar Council (CEA)

The CEA was created on August 20, 1966 through the Law No. 7. This is one of the most important institutions dealing with the sugar industry in the Dominican Republic. It is also very important for the country as it provides a large portion of the national income and employment (CEA, 1991). This institution is in charge of administrating the sugar mills expropriated to the Trujillo family by the Dominican Government in 1961. Today these land and mills constitute the public sugar sector.

The main responsibilities of the CEA are the following:

1) To dictate all the regulations related to the internal organization of the sugar mills.

2) To set the policies related to production, commercialization, and employment

3) To coordinate all the activities related to the study and provision of land to investors, and to periodically visit all development projects.

4.4.2 The Dominican Sugar Institute (INAZUCAR)

The INAZUCAR was created February 16, 1965 through the Law No. 616. This institution is in charge of making recommendations to the Executive Power about the regulations concerning the national sugar policy, following up on these regulations, and conducting product and marketing research.

Through the Law No. 616 and some other regulations, the INAZUCAR can assign production quotas to the different sugar companies and the placement of sugar in the different markets to which the Dominican Republic has access.

4.5 Commercialization of the Dominican Sugar

4.5.1 The Domestic Market

Approximately 88 % of the domestic raw sugar supply is consumed directly by households. Of the total supply of refined sugar, 39 % is used by industries mainly for the production of non-alcoholic beverages and candy production (Diaz, 1986).

The main government institutions dealing with the domestic market are the following:

a) The National Institute for Price Stabilization (INESPRE)

This institution is in charge of the commercialization and distribution of sugar for domestic consumption.

In the first half of 1986, the domestic quota system established by INESPRE to distribute sugar to wholesalers and retailers was eliminated and private marketing firms were free to purchase sugar directly from the sugar mills.

b) The General Direction for Price Control (DGCP)

This institution belongs to the Ministry of Industry and Commerce. It, along with the INAZUCAR, sets the price for raw and refined sugar in the domestic market.

c) The Dominican Sugar Institute (INAZUCAR)

This institution sets the national policy related to both the domestic and the export market.

As far as domestic price is concerned, in 1985, the INESPRE faced severe liquidity problems and was delayed in paying CEA for its purchases. In October 1985, the retail price of refined sugar increased about 66 % which

resulted in widespread consumer protests, especially in Santo Domingo, the capital city. However, the consumer price of unrefined sugar actually decreased at that time (World Bank, 1988).

For the national sugar industry to stay as a productive activity, it has been necessary to adjust the price of the different kinds of sugar in the domestic market. Due to this fact, there has been a price increase in the last five years. From 1988 to 1991, the prices were as follows: In the second half of 1988, the price for 100 pounds of raw sugar was set at RD$ 50.00 from the producer to the consumer. In 1989, the price increased to RD$ 75.00 and then decreased to RD$ 57.00. This last decrease was ordered by the President. The highest prices from producer to consumer for 1991 were set as follows (CEA, 1991):

Type of Sugar	Price (100 lb)
Raw	RD$ 190.00
Powdered (afinada)	219.00
Refined	277.00

4.5.2 The Export Market

The export market is the most important market for the Dominican sugar. Most of the sugar produced in the Dominican Republic is for export. About 76 % of the domestic production was exported (Diaz, 1986). Moreover, sugar

export has always represented a high percent of the total exports from the Dominican Republic ranging from 20.09 % in 1991 to 55.09 % in 1971 (Table 6).

Table 6: Share of Sugar Export in Total Export from the Dominican Republic.

Year	Total exports (million RD$)	Sugar exports (million RD$)	Percentage
1970	213.60	103.50	48.45
1971	243.00	133.88	55.09
1972	347.60	159.70	45.94
1973	442.10	187.08	42.32
1974	636.80	324.12	50.90
1975	893.80	561.04	62.77
1976	716.40	253.91	35.44
1977	780.50	218.59	28.01
1978	675.50	172.04	25.47
1979	868.60	190.93	21.98
1980	961.90	290.20	30.17
1981	1188.0	513.25	43.20
1982	767.70	265.51	34.59
1983	785.20	263.56	33.57
1984	868.10	271.89	31.32
1985	738.50	158.48	21.46
1986	722.10	133.85	18.54
1987	711.30	127.09	17.87
1988	889.70	123.20	13.85
1989	924.40	157.09	16.99
1990	734.50	142.68	19.43
1991	658.30	132.28	20.09

Source: Central Bank. Monthly Bulletin. Dominican Republic. Various Years (1970-1991).

The export market for the Dominican Sugar is comprised of the U.S. market, which is called the preferential market, and the world market. The U.S.

market works through the quota system. This means that each year the Dominican Republic is assigned a sugar quota to export to the U.S. through the preferential market. The Dominican Republic cannot export all the sugar it wants through this market.

The Dominican Republic depends on the U.S. market to survive (G & W, 1977). Due to this fact, the U.S sugar policy is a very important factor in helping or hindering the Dominican economy. Most of the sugar exports from the Dominican Republic to the U.S. are through this market. The U.S. market offers a higher price compared with the world market (Gomez, 1987). In 1985, 73 % of the sugar exports were directed to this market. Moreover, the price paid in 1985 by the U.S. market for imported sugar was US$ 20.00/100 lb, whereas the price paid by the world market was only US$ 5.00/100 lb (Santana and Ferreiras, 1987).

The U.S. market was called the traditional market for the Dominican Republic because of the linkage that the Dominican Republic had with the U.S. In 1963, the Dominican Republic was a reliable sugar supplier for the U.S. In that year, the Dominican Republic exported 894,000 short tons of sugar. During the 1976 to 1981 period, the Dominican Republic exported an average of 819,500 short tons per year. However, exports from the Dominican Republic to the U.S. were interrupted when the quota system was established in 1982 (Despradel, 1984). Since that time, exports to the U.S. have been decreasing due to a decrease in the sugar quota each year, except in 1983-1984.

The world market is characterized by high price fluctuation. This high price fluctuation affects both producing and consuming countries. Prices in the U.S. market are more stable (Santana and Ferreiras, 1987). However, in the last few years, this market has been so restricted that it has affected both production and exports in the Dominican Republic (Diaz, 1986). Because sugar export is one of the main economic activities in the Dominican Republic, the whole economy has also been affected.

In spite of the instability in the world market price and the restrictions in the U.S. market in the last few years, these two markets continue to be the most important for the Dominican Republic. Until 1984, around 73 % of the Dominican sugar export were to the preferential market and 27 % to the world market (Diaz, 1986).

The reason why prices in the U.S. and the world market are different is because in the world market, prices are set by the supply and demand forces, whereas in the U.S., market prices are set by the U.S. according to its requirements. This price in the U.S. is set such that domestic producers in the U.S. can compete with imported sugar. This is one of the reasons why prices in the U.S. market are higher than in the world market (Diaz, 1986).

The year 1974 is a special case for export prices. In this year, the world market price was US$ 29.98/100 lb. This price was higher than the U.S. price which was US$ 29.49/100 lb. This was because negotiations in the world

market were carried out under the pressure of a high supply due to an unfulfill demand in 1973 (Cerro, 1984).

The low prices in the 1980's made the world market an unattractive market. Price decreased from 18.9 U.S. cents per pound in 1980 to 4.09 in 1985 (CEA, 1991). This price was below the lowest cost of production of any producer in the world. In the following years, prices increased slightly to 6.07 cents in 1986, 6.71 cents in 1987, 10.16 cents in 1988, and 12.79 in 1989. In 1990, the average price of raw sugar was around 13.72 cents per pound and 17.31 cents for refined sugar. Notice that none of these price increase reached the price level in 1980.

4.6- Problems Affecting the Dominican Sugar Industry

There are many problems affecting the Dominican sugar industry. These problems are both external, which are very difficult for the country to solve, and internal, which can be controlled directly by the Dominican Republic.

4.6.1 External Problems

The external problem affecting the Dominican sugar industry are basically marketing problems. The Dominican sugar industry is having problems with both the U.S and the world market. One of the main problems with the U.S market is the quota system. One of the main problems in the world market is the price instability (JACC/RD, 1989).

The main problem with the U.S market is the reduction in the export quota. One of the reasons for the U.S. to reduce the sugar quota is because it wants to protect its domestic producers (Cerro, 1987). This protectionist policy tries to keep the price high enough to domestic producers. Moreover, developed countries like the U.S. are increasing the sources of sweeteners like beet sugar and corn syrup, which makes the country less dependent on cane sugar. Furthermore, it is worth mentioning that people in the U.S. are becoming more health conscious, which tends to decrease their sugar consumption.

As far as the world market is concerned, at the beginning of the 1970's, the world market price was increasing and reached high levels. However, in the 1980's, this price began to decrease, and in 1984 it went down to US$ 4.00/100 pound. This fact shows the instability in the world market price, which greatly affects developing-sugar-exporting countries like the Dominican Republic.

One of the main reasons for a low world market price is the surplus of production over consumption at the world level. For example, in 1984-1985, the world production was estimated to be 100,251 million metric tons raw value, whereas the consumption was only 97,957 million metric tons raw value (Cerro, 1987)

As sugar export is one of the main economic activities in the Dominican Republic, a price change in the world market has a big impact on the

Dominican economy. When price go up, the economic situation in the Dominican Republic improves, but when price go down, the economic situation worsens.

4.6.2- Internal Problems

In addition to external factors, there are many internal factors affecting the Dominican sugar cane industry. These problems rage from production to the final stage of commercialization. These domestic problems make the Dominican sugar industry less competitive compared with other countries.

Most of the studies done on the sugar cane industry in the Dominican Republic are related to production process. However, they do not contribute much to problem solutions. The different companies comprising the sugar subsector carry out separate studies and most of the times, the results of these studies are not published (Gil, 1987).

Producing sugar in the Dominican Republic is becoming too expensive compared with the price received. One of the reasons is the high input prices. Therefore, the industry is not so profitable. The cost of production is very high, mainly for the CEA, which produces the highest amount of sugar. In addition to the high cost of production, the CEA has some other problems like obsolete machinery and equipment as well as some administrative problems (Gomez, 1988). Moreover, a large portion of the land planted to sugar cane is the worst land in the country. The only alternative use it is for pasture (Gil, 1987). Gil

(1987) also states that the Dominican Republic has the worst conditions for harvest, piling, and transportation to the factory of the world.

The Dominican sugar industry is also characterized by its low technology. The cane cutting process is not mechanized. One of the reasons for this is possibly because of the high labor supply. However, Dominicans hate to cut cane. Most of the labor comes from Haiti. Many times it is also difficult to contract with Haitians. Currently, because of the political situation in Haiti, Haitians are not participating in the cane cutting process as they used to do. Moreover, the Dominican Republic has been punished by international organizations because of the way Haitians have been treated in the Dominican Republic (CEA, 1991). According to these international organizations, Haitians are treated like slaves in the Dominican Republic.

On the marketing size, the Dominican Republic does not apply a marketing concept for the sugar industry. People dealing with the sugar industry in the Dominican Republic think that marketing is only to try to sell what is already produced. They do not think that it is much better to try to produce just what can be sold or try to have a secure market before producing.

4.7- Future Trends in the Dominican Sugar Industry

Due to all the problems that the Dominican sugar industry is facing, the Dominican Republic is looking for new alternatives. One of the most obvious trends for the sugar industry is "Diversification." Beginning in 1979, the main

objectives of the diversification process were to produce food to be sold to the employees and to increase profitability (Gomez, 1988). At this time, diversification has two meanings. One of the meanings is to try to use some resource, such as land, previously used for sugar production, to produce other more profitable crops, such as oranges, pineapples, sorghum, maize, cassava, beans, and vegetables. Some of these crops can also be exported. A study done by the Dominican Center for Exports Promotion (CEDOPEX) in 1987 showed that sugar cane generates less income that many other export crops (Rodriguez, 1987). These crops are shown in Table 7.

The other meaning of diversification is to try to produce some other products such as alcohol for auto fuel, fiber, and cane juice to feed animals, in addition to sugar. The Central Romana and the Vicini group are currently increasing the animal production capacity as one of the diversification activities. In that sense, they are producing cane juice to feed their animals.

The diversification process has been created due to the U.S. policy toward the Dominican Republic. Because the U.S. is the major market for the Dominican sugar, the U.S sugar policy has a profound effect on the Dominican sugar industry and, consequently, on the whole economy (De Castro, 1992).

De Castro (1992) points out that according to Kryzanek and Wiarda (1988), in the mid 1980's, due to the U.S. self-sufficiency in sugar, pressure by the sugar beet growers, and the fact that the Reagan administration wanted to force the Dominican Republic to diversify its traditionally one-crop economy, the

Table 7: Profitability of Some Export Crops.

Crop	Return/tarea (US$)	Hours/Person/Tarea
Sugar cane	103.0	5.80
Eggplant	763.2	19.75
Green pepper	400.0	20.33
Cucumber	430.0	43.33
Okra	1,294.0	40.00
Salad tomato	1,204.0	53.33
Cabbage	480.0	23.17
Fresh pineapple	878.0	20.00
Melon	1,283.0	20.00
Papaya	1,502.0	20.00

Source: CEDOPEX, 1987

U.S. drastically cut the sugar quota to the Dominican Republic. De Castro (1992) says that this drastic reduction in the sugar quota was one of the major shocks to the Dominican economy that contributed to impulse agricultural diversification strategies.

The diversification process is aimed at establishing a stable sugar production according to requirements. It is not aimed at eliminating the sugar cane industry. The sugar cane industry has been and will continue to be one of the main sources of foreign currency and employment for the country (Morales, 1986).

CHAPTER V

THE MODEL: SUPPLY AND DEMAND OF SUGAR IN THE DOMINICAN REPUBLIC

5.1 Objectives of the Model

The objective of this chapter is to understand the behavior of the sugar cane industry in the Dominican Republic by analyzing the factors affecting supply and demand for sugar in the country. The results of the model analyzed here may be used to make forecasts regarding the effects of these factors on the sugar cane industry in the near future. These results could be very useful in providing information to decision makers about future actions related to this sector of the economy.

5.2 The Supply Model

5.1.1 Specification of the Model

According to economic theory, the factors affecting the supply of a commodity include the expected price of the commodity, the expected price of other commodities competing for the same resources or the same consumers, production costs, availability of land and other natural resources, area planted the previous year, changes in technology, institutional constraints (government policy, for example), and weather (Tomek and Robinson 1990). Because there

is a lack of data on factors, such as data related to other commodities competing for the same resources like land, they will not be included.

The equations included in this supply model are as follows:

1) AREAHAR = f(C, AREAHAR(-1), REGRPH)

2) CANEPROD = (AREAHAR * YIELD)/1000

3) EYIELD = SMOOTHED YIELD

4) SUGAPROD = CANEPROD * SUYIELD

5) TSUPPLY = SUGAPROD + IMPT + BSTOCK

Where variables' names and descriptions are as follows:

AREAHAR = Area of sugar cane harvested (1000 Ha)

C = The constant term

AREAHAR (-1) = Area of sugar cane harvested the previous year (1000 Ha)

REGRPH = Real expected gross return per hectare[3] (RD$)

CANEPROD = Total cane sugar production (1000 MT)

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[3] Real Expected Gross Return per Hectare was calculated by multiplying the world market price (US cents/lb) lagged two years times the exchange rate (US$:RD$) lagged two years times the expected sugar cane yield (Kg/Ha) times the conversion factor from cane to raw sugar. Then that result was divided by CPI at 1980 constant prices

The formula was as follows:

REGRPH= [(WPRICE(-2) * EXRATE * (EYIELD*2.2) * SUYIELD)/100] / CPI

The EYIELD variable was derived by double exponential smoothing the YIELD variable. Notice in this equation that EYIELD was multiplied times 2.2 to convert Kg/Ha to Lb/Ha. Moreover, the result was divided by 100 to transform RD cents to RD$.

YIELD = Actual sugar cane yield (Kg/Ha)

SUGAPROD = Total sugar production (1000 MT raw value)[4]

EYIELD = Expected sugar cane yield (Kg/Ha)

SUYIELD = Conversion factor of cane to raw sugar (in decimal)

TSUPPLY = Total sugar supply in the Dominican Republic (1000 MT raw value)

IMPT = Total sugar import in the Dominican Republic (1000 MT raw value)

BSTOCK = Beginning stock (1000 MT raw value)

The first equation is a behavioral equation which states that the area harvested depends on the area harvested the previous year and the real expected gross return per hectare. Equations 2 to 4 are identities to calculate the total sugar supply in the Dominican Republic. Some other variables that theoretically explain sugar supply, such as producer's price, and domestic retail prices were tested. However, these variables were not significant. Another variable that could have been included in the model was area planted to sugar cane. This variable was not included in the model due to a lack of data.

The area of sugar cane harvested in the Dominican Republic is expected to respond positively to the area harvested in the previous year. That is, an increase in the area harvested last year causes an increase in the area

[4] As can be seen in the CANEPROD equation, this is divided by 1000. This was done to convert the result to 1000 MT and to have all volume variables in the same units. Notice that the YIELD variable is expressed in Kg/Ha.

harvested this year. Thus, the sign of the variable AREAHAR(-1) is expected to be positive. This variable carries the effect of producer response in previous years and represents, along with REGRPH, a geometric lag. In the same way, an increase in the real expected gross return per hectare is supposed to cause an increase in the area of sugar cane harvested. Therefore, the sign is also expected to be positive.

5.1.2 Results

The results of the regression on the area harvested equation to determine total sugar supply in the Dominican Republic are presented in Table 8. The

Table 8: Selected Results of the Regression on the Area Harvested equation to Determine Sugar Supply

VARIABLES	RESULTS OF INDIVIDUAL VARIABLES				RESULTS OF THE REGRESSION			
	COEFF.	STD. ERROR	T-STAT	2-TAIL SIG.	R^2	ADJ. R^2	PROB. F-STAT.	D-WATSON
AREAHAR					0.88	0.86	0.00	2.46
C	8.89	15.66	0.56	0.5782				
AREAHAR(-1)	0.94	0.09	10.63	0.0000				
REGRPH	0.16	0.07	2.23	0.0407				

Source: Constructed by the Author

AREAHAR(-1) is highly significant at less than a 1 percent level. The variable REGRPH was also significant at less than a 5 percent level. The signs of this two variables are as expected. For example, the positive sign of the coefficient of the area harvested the previous year indicates that the area harvested in a specific year responds positively to changes in the area harvested the previous year. In the same way, the positive sign of the real expected gross return per hectare indicates that the higher this return the higher the area harvested as it was expected.

The coefficient of determination (R^2) of 88 percent is very high, indicating a good statistical fit. Thus, if the theoretical specification is correct, it can be deduced that the set of independent variables in the equation explains a high proportion of the changes in the dependent variable. The adjusted R^2 of 86 percent is also very high, which indicates that the number of independent variables is adequate for the time series data used (19 observations). The F statistic is also highly significant at much less than a 1 percent level of significance, which means that the joint hypothesis of all the parameters' coefficients being zero can be rejected with a margin of error of less than 1 percent.

Due to the inclusion of a lagged dependent variable as one of the explanatory variables the Durbin-Watson statistics is not useful in this case. However, a regression of the error term on the error term lagged one year

shows that the error term is not autocorrelated. Therefore, the null hypothesis of no autocorrelation assumed by least square can be accepted.

5.2 The Demand Model

5.2.1 Specification of the Model

In the Dominican Republic, sugar demand has two main components. The first main component consists of demand for domestic consumption. This demand for domestic consumption has almost no influence on the demand for sugar in the Dominican Republic. However, along with production, it has to be analyzed very carefully in order to determine the potential of the country in fulfilling its domestic needs for sugar. The second main component is the demand for exports. An average of than 64 percent of the total sugar supply in the Dominican Republic is exported (Table 9). The demand for exports is also subdivided into two other components, which are U.S. demand and the rest of the world. Table 9 also shows that an average of more than 68 percent of the sugar exported goes to the United States.

It is worth mentioning that the export market in the Dominican Republic has priority over the domestic market. There is a trade off between the export and the domestic market. The domestic market receives only the sugar left over after exports. For this reason, if the export market is good in a specific year and total supply is not so high, it is likely that the domestic supply is going to be low. In this case, Dominican people have to pay the consequences of a

Table 9: Sugar Export from the Dominican Republic

Year	TOTAL SUPPLY (1000 MT)	TOTAL EXPORT		EXPORT TO THE US	
		Volume (1000 MT)	Percent	Volume (1000 MT)	Percent of total export
1971	1,355.00	1,011.00	74.61	665.04	65.78
1972	1,410.00	1,141.00	80.92	692.61	60.70
1973	1,288.00	1,069.00	83.00	677.40	63.37
1974	1,262.00	1,055.00	83.60	742.63	70.39
1975	1,514.00	1,030.00	68.03	703.20	68.27
1976	1,488.00	1,180.00	79.30	881.15	74.67
1977	1,507.00	1,040.00	69.01	884.31	85.03
1978	1,319.00	1,020.00	77.33	665.44	65.24
1979	1,245.00	760.00	61.04	741.14	97.52
1980	1,099.00	900.00	81.89	558.24	62.03
1981	1,198.00	790.00	65.94	690.37	87.39
1982	1,457.00	930.00	63.83	347.64	37.38
1983	1,468.00	900.00	61.31	440.32	48.92
1984	1,427.00	760.00	53.26	610.24	80.30
1985	1,193.00	470.00	39.40	463.09	98.53
1986	1,152.00	570.00	49.48	343.62	60.28
1987	1,113.55	520.00	46.70	312.13	60.02
1988	1,004.78	550.00	54.74	212.14	38.57
1989	913.00	400.00	43.81	286.13	71.53
1990	795.66	435.00	54.67	311.38	71.58
Average			64.59		68.38

Source: Constructed by the Author

good export market. Sometimes, even with a high production for a specific year, the Dominican Republic has to import sugar to meet the domestic demand.

5.2.1.1 The Domestic Demand Model

Some of the economic factors affecting the demand for a commodity are population size and its distribution by age, sex, or geographic area, consumer income and distribution, the availability of other commodities and services, and consumer tastes and preferences (Tomek and Robinson, 1990). According to Tomek and Robinson (1990), sometimes prices and quantities are

simultaneously determined in the market. However, this is not the case in the Dominican Republic. Domestic price does not have much influence on production decisions in the Dominican Republic.

An important factor that is difficult to include in the model but that one has to be aware of when dealing with domestic demand for sugar and other food products in the Dominican Republic is that lately, although food consumption per capita has remained constant, the statistics show an increase in consumption. This fact is mainly due to two factors. First, there is a large increase in the number of illegal Haitians in the Dominican Republic. Food consumed by these people is considered as consumed by Dominicans. Second, due to the higher prices received by retailers in cities adjacent to Haiti, there is an illegal traffic of sugar from the Dominican Republic to Haiti through the border. These problems might overestimate domestic demand for sugar in the Dominican Republic. However, it is very difficult to take account of these factors when formulating the demand equation.

The domestic demand equation included in this model is the following:

PCONS = f(C, DPNDI, DRETPR, PCONS(-1), DV88, DV90)

Where variables' names and description are as follows:

C = The constant term

PCONS = Total sugar consumption per capita in the Dominican Republic (Kg)

DPNDI = National Disposable Income per capita in the Dominican Republic deflated by the CPI at 1980 prices (RD$)

DRETPR= Retail price per pound of refined sugar in the Dominican Republic deflated by the CPI at 1980 prices (DR cents/lb)

PCONS(-1) = Sugar consumption per capita in the Dominican Republic lagged one year (Kg/Ha)

DV88 = Dummy variable equal to 1 in 1988 and 0 otherwise

DV90 = Dummy variable equal to 1 in 1990 and 0 otherwise

As can be seen, two dummy variables were used in the demand equation to correct for the occurrence of unusual events. These two dummy variables were used for 1988 and 1990. These two years were periods in which the Dominican economy was very unstable. Inflation rate was very high and prices were very volatile. In those periods, wholesalers accumulated large inventories for speculation. Moreover, sugar was very scarce in retail establishments. Most of the time, sugar was not sold unless people purchased some of the slow moving items in the store.

All the variables on the right hand side of the equation, except PCONS(-1) which is a lagged dependent variable, are considered exogenous to the model. They help to forecast the dependent endogenous variables. Each

of these exogenous variables were forecast individually, making some assumptions about their future trend by extrapolating over past values.

5.2.1.2 The Export to the U.S. Market Model

The U.S. market is controlled by the quota system, which is imposed according to U.S. requirements. Due to the quota system and some other regulations, this market is so controlled that many of the economic relationships do not work in the way they are supposed to.

In the beginning, some relationships that were trying to include some U.S. market variables to forecast sugar export from the Dominican Republic to the United States were tested. However, they did not work in the way they were expected. Finally, sugar export from the Dominican Republic to the United States was determined using the following equation:

EXPTUS = f(C, DOMPRESS, DVQUOTA)

Where variables' names and descriptions are as follows:

EXPTUS = Total sugar export from the D.R. to the U.S. (1000 MT raw value)

C = Constant term

DOMPRESS = Pressure to export from the Dominican Republic[5]

DVQUOTA = A dummy variable for the quota system imposed by the U.S. in 1981 equal to zero for the period before 1982 and one afterwards

The pressure to export from the Dominican Republic is expected to be positively related to export to the United States. The higher the pressure to export from the Dominican Republic, the higher the export to the United States should be. However, the dummy variable for the quota system is expected to be negatively related to export to the United States, which is the same as sugar import in the United States from the Dominican Republic. The quota system was imposed by the United States to control sugar import and to protect domestic producers. Therefore, this restriction reduces U.S. sugar import.

5.2.1.3 The Export to the World Market Model

Different from the U.S. market, the world market is controlled by the supply and demand forces. Although, price is one of the main variables to consider when analyzing supply and demand, in this specific case, the world market price is not endogenous because the Dominican sugar production and

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[5] The pressure to export from the Dominican Republic was calculated by subtracting the consumption trend in the Dominican Republic as a three year moving average from the total sugar supply. This was done as follows:

DOMPRESS = TSUPPLY -[(CONS(-1)+CONS(-2)+CONS(-3)]/3

export are very low compared with the total world production and exports. The Dominican Republic has to adapt to existing market conditions. Furthermore, the world market price was tested and it was not significant. Instead of the world market price, some other variables were included in the model.

The equations included in this model to determine sugar export from the Dominican Republic to the rest of the world excluding the United States are as follows:

1) WEXPTRES = f(C, WPRESS, DVQUOTA, DV75, AR(1))

2) REXPT = f(C, RPRODS, DV75)

3) EXPT = REXPT * WEXPTRES

4) EXPTREST = EXPT - EXPTUS

Where variables' names and descriptions are as follows:

EXPT = Total sugar export from the Dominican Republic (1000 MT raw value)

REXPT = Ratio of sugar export from the D.R to the rest of the world excluding the U.S.

WEXPTRES = Sugar export by exporting countries excluding the U.S. and the D.R. (1000 MT raw value)

C = The constant term in the behavioral equation

WPRESS = Pressure to export sugar by producing countries excluding the U.S. and the D.R.[6]

DVQUOTA = A dummy variable for the quota system imposed by the U.S. in 1981 equal to zero for the period before 1982 and one afterwards.

DV75 = A dummy variable equal to 1 in 1975 an 0 otherwise[7]

AR(1) = Autoregressive error specification assuming first order autocorrelation

RPRODS = Ratio of sugar production in the Dominican Republic to sugar production in the rest of the world excluding the United States and the Dominican Republic

EXPTREST = Sugar export from the Dominican Republic to the rest of the world excluding the U.S. (1000 MT raw value)

Total world sugar export is expected to be positively related to both pressure to export and DVQUOTA. Therefore, the sign of the coefficients of

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[6] The pressure to export was calculated by subtracting a one year lagged three year moving average of world consumption from world production excluding the United States and the Dominican Republic. This was done as follows:

WPRESS = (WPROD-USPROD-SUGAPROD)-TCONSRES

Where TCONSRES is the one year lagged three year moving average of world consumption

[7] This dummy variable is to take into account that 1974 was the only time the world market price was higher than the U.S. price. This fact might have distorted the market the following year.

these variables is expected to be positive. The rationale for the positive sign of DVQUOTA in this case, is that if the quota system reduces export to the United States, it increases export to the rest of the world.

In the third equation, the ratio of export from the Dominican Republic to export from the rest of the world excluding the United States and the Dominican Republic is expected to be positively related to the production ratio. This means that the higher the production ratio, the higher the export from the Dominican Republic compared with the rest of the world. It is worthwhile to mention that some other variables, such as the beginning stock ratio and the total supply ratio were tested in the third equation. However, they were dropped because they were not significant.

5.2.2 Results

5.2.2.1 The Domestic Demand Model

The results of the regression on the domestic demand equation are presented in Table 10. All variables are highly significant at less than 1 percent level. The signs of all the variables are as expected. For example, the positive sign of the coefficient on DRETPR variable supports the economic theory that states that keeping the other factors constant, the higher the price the lower the amount demanded.

The negative sign on the coefficient of DPNDI variable indicates that sugar consumption in the Dominican Republic decreases when real income per

Table 10: Selected Results on The Domestic Demand Equation

VARIABLES	RESULTS OF INDIVIDUAL VARIABLES				RESULTS OF THE REGRESSION			
	COEFF.	STD. ERROR	T-STAT	2-TAIL SIG.	R^2	ADJ.R^2	PROB. F-STAT.	D-WATSON
PCONS					0.88	0.84	0.0000	2.36
C	55.96	16.36	3.42	0.0041				
DPNDI	-3.25	1.01	-3.21	0.0063				
DRETPR	-7042.44	2015.79	-3.49	0.0036				
PCONS(-1)	0.91	0.13	7.08	0.0000				
DV88	-22.9	2.98	-7.68	0.0000				
DV90	-13.48	2.66	-5.08	0.0002				

Source: Constructed by the Author

capita decreases, which indicates that, apparently, sugar in the Dominican Republic is an inferior good. This fact is different from what happens in most countries. However, it has a logical explanation. In the Dominican Republic, there are many kinds of food consumed by the lower income population that require sugar for their preparation, including different kinds of flours, and including lemonade. These kinds of food are replaced by more expensive kinds when people can afford to buy them. Moreover, these kinds of food are consumed more often by low income people in the rural areas trying to fulfill their energy requirements. Furthermore, the higher income population in the Dominican Republic is more health conscious and prefers to consume less sugar. In addition to this, Geene and Roe (1989, p. 130) show that low income

households in the Dominican Republic spend a higher share of their income in sugar and sweeteners than high income households.

The coefficient of determination (R^2) of 88 percent is high, indicating a good statistical fit. Thus, if the theoretical specification is correct, it can be deduced that the set of independent variables in the equation explain a high proportion of the changes in the dependent variable. The adjusted R^2 of 84 percent is also very high, indicating that the number of independent variables is adequate for the time series data used (20 observations). The F statistic is also highly significant at less than 1 percent level of significance, which denotes that the joint hypothesis that all the parameter coefficients are zero can be rejected with a margin of error of less than 1 percent.

Due to the inclusion of a lagged dependent variable as one of its explanatory variables, the Durbin-Watson statistics is not applicable in this case. However, a regression of the error term on the error term lagged one year showed that the error term is not autocorrelated. Therefore, the null hypothesis of no autocorrelation assumed by least square can be accepted.

From the results of this domestic demand equation, it can be concluded that consumption per capita of sugar in the Dominican Republic tends to decrease as income increases. The estimated income elasticity of demand is -0.91 (Table 15). This means that a percent increase in real income per capita decreases the amount of sugar demanded by 0.91 percent. The retail price

elasticity of demand is -0.45. This implies that an increase in price of one percent decreases the amount of sugar demanded by 0.45 percent.

5.2.2.2- The Export to the U.S. Market Model

The results of the regression on the export to the United States are presented in Table 11. The variables pressure to export from the Dominican Republic (DOMPRESS) and the dummy variable for the quota system

Table 11: Selected Results on the Regression to Determine Sugar Export from the Dominican Republic to the United States

VARIABLES	INDEPENDENT VARIABLES					REGRESSION		
	COEFF.	STD. ERROR	T-STAT.	2-TAIL SIG.	R^2	ADJ.R^2	PROB. F-STAT.	D-WATSON
EXPTUS					0.87	0.84	0.0000	1.89
C	337.89	109.66	3.08	0.0068				
DOMPRESS	0.32	0.09	3.56	0.0024				
DVQUOTA	-264.09	43.96	-6.01	0.0000				

Source: Constructed by the Author

(DVQUOTA) are highly significant at a less than one percent level. The sign of the DOMPRESS variable is expected to be positive. The higher the pressure to export sugar from the Dominican Republic, the higher the export to the United States should be. However, the coefficient of the DVQUOTA variable is

expected to be negative because the quota system was established by the United States to control sugar import and to protect domestic producers.

The coefficient of determination (R^2) of 86 percent is high, indicating a good statistical fit. Thus, if the theoretical specification is correct, it can be deduced that, as in the previous equations, the set of independent variables in the equation explains a very high proportion of the changes in the dependent variable. The adjusted R^2 of 84 percent is also very high, indicating that the number of independent variables is adequate for the time series data used (20 observations). The F statistic is also highly significant at a less than 1 percent significance level, which implies that the joint hypothesis that all the parameter coefficients are zero can be rejected with a margin of error of less than 1 percent. With the Durbin-Watson statistics equal to 1.6, there is evidence to accept the null hypothesis that the error term is not autocorrelated. Moreover, a regression of the error term on the error term lagged one year shows no autocorrelation.

5.2.2.3- The Export to the World Market Model

As shown in section 5.2.1.3, the export to the world market model is comprised of two behavioral equations (equations 1 and 2) and two identities (equation 3 and 4). The results of the first and second equations are presented in Table 12 and 13, respectively.

Table 12: Selected Results on the Regression to Determine Sugar Export from the Rest of the World Excluding the United States and the Dominican Republic

VARIABLES	INDEPENDENT VARIABLES					REGRESSION		
	COEFF.	STD. ERROR	T-STAT.	2-TAIL SIG.	R^2	ADJ.R^2	PROB. F-STAT.	D-WATSON
WEXPTRES					0.89	0.86	0.0000	1.99
C	25036.4	2496.34	10.03	0.0000				
WPRESS	0.17	0.08	2.13	0.0500				
DVQUOTA	2569.68	1626.99	1.58	0.0135				
DV75	-4212.75	1634.9	-2.58	0.0210				
AR(1)	0.83	0.13	6.19	0.0000				

Source: Constructed by the Author

Table 12 shows that the variable pressure to export from the rest of the world excluding the United States and the Dominican Republic (WPRESS) is significant at five percent level. Moreover, the sign of the coefficient is positive as expected. The dummy variable for the quota system established by the United States (DVQUOTA) is not significant at a five percent level, but at 13 percent. However, this variable was left in the equation because it is known that it greatly affects exports to the world market. Restriction in the U.S. markets, which reduces U.S. sugar import, contributes to increasing export to the rest of the world. The coefficients of the dummy variable for 1975 (DV75) is significant at a 5 percent confidence level. Furthermore, as Table 13 shows, this equation was estimated assuming first order serial correlation. The

Table 13: Selected Results on the Regression to Determine the Ratio of Export from the Dominican Republic to Export from the Rest of the World Excluding the Unites States and the Dominican Republic

VARIABLES	INDEPENDENT VARIABLES					REGRESSION		
	COEFF.	STD. ERROR	T-STAT.	2-TAIL SIG.	R^2	ADJ.R^2	PROB. F-STAT.	D-WATSON
REXPT					0.88	0.86	0.0000	1.23
C	-0.01	0.0042	-2.68	0.0151				
RPRODS	3.39	0.3104	10.93	0.0000				
DV75	0.01	0.0050	2.82	0.0114				

Source: Constructed by the Author

coefficient for the correction for serial correlation [AR(1)] is also significant at a less than 1 percent confidence level.

The coefficient of determination (R^2) of 89 percent is very high, indicating that the statistical fit of the equation is very good. Thus, if the theoretical specification is correct, it can be inferred that, as in the previous equations, the set of independent variables in the equation explains a very high proportion of the changes in the dependent variable. The adjusted R^2 of 86 percent is also very high, which means that the number of independent variables is adequate for the time series data used (20 observations). The F statistic is also highly significant at less than 1 percent significance level, which implies that the joint

hypothesis that all the parameter coefficients are zero can be rejected with a margin of error of less than 1 percent.

Table 13 shows that the ratio of production in the Dominican Republic to production in the rest of the world excluding the United States and the Dominican Republic (RPRODS) is highly significant at a less than one percent level. Moreover, the sign of the coefficient is positive as expected. The dummy variable for 1975 (DV75) is also significant at a one percent level.

The coefficient of determination (R^2) of 88 percent is very high, indicating that the statistical fit of the equation is very good. Thus, if the theoretical specification is correct, it can be deduced that, as in the previous equations, the set of independent variables in the equation explains a very high proportion of the changes in the dependent variable. The adjusted R^2 of 86 percent is also very high, which means that the number of independent variables is adequate for the time series data used (21 observations). The F statistic is also highly significant at less than a 1 percent significance level, which implies that the joint hypothesis that all of the parameter coefficients are zero can be rejected with a margin of error of less than 1 percent.

5.3- The Supply and Demand Model

5.3.1 Formulation of the General Model

The supply and demand equations were combined in a general model which used historical data from 1970 to 1990. The model was simultaneously

solved using the MicroTSP computer software package, which uses the Gauss-Seidel algorithm. The edit file for the supply and demand model is presented in Appendix I.

The different equations comprising the general model are the following:

1) AREAHAR = f(C, AREAHAR(-1), REGRPH)

2) CANEPROD = AREAHAR * YIELD

3) EYIELD = SMOOTHED YIELD

4) SUGAPROD = CANEPROD * SUYIELD

5) TSUPPLY = SUGAPROD + IMPT + BSTOCK

6) PCONS = f(C, DPNDI, DRETPR, PCONS(-1), DV88, DV90)

7) EXPTREST = REXPT * WEXPTRES

8) WEXPTRES = f{C, WPRESS, DVQUOTA, DV75, AR(1)}

9) REXPT = f(C, RPRODS, DV75)

10) EXPTUS = f(C, DOMPRESS, DVQUOTA)

5.3.2 Evaluation of the General Model

One of the objectives of building this econometric model was to make forecasts of supply and demand for sugar in the Dominican Republic. Therefore, after building the general model, it has to be evaluated to determine how good its forecasting ability is. This section tries to evaluate the forecasting ability of the general model. The evaluation criteria used are analysis of turning-

point errors and the percent of the square root of the mean of the squared error (Percent RMSE). The percent RMSE was calculated based on the mean of the dependent variable.

Table 14 shows a summary of the number of turning- point error and percent RMSE for the supply and demand behavioral equations. Moreover, Figures 1 to 5 show the actual and forecast values for the sample period.

Table 14: Summary of Turning-point Errors for the Behavioral Equations

EQUATIONS	VALID OBSERVATIONS	TURNING-POINT ERROR	Percent RMSE
AREAHAR	19	7	4.37
PCONS	19	4	15.77
EXPTUS	18	3	18.78
WEXPTRES	19	4	11.35
REXPT	19	3	18.69

Source: Constructed by the Author

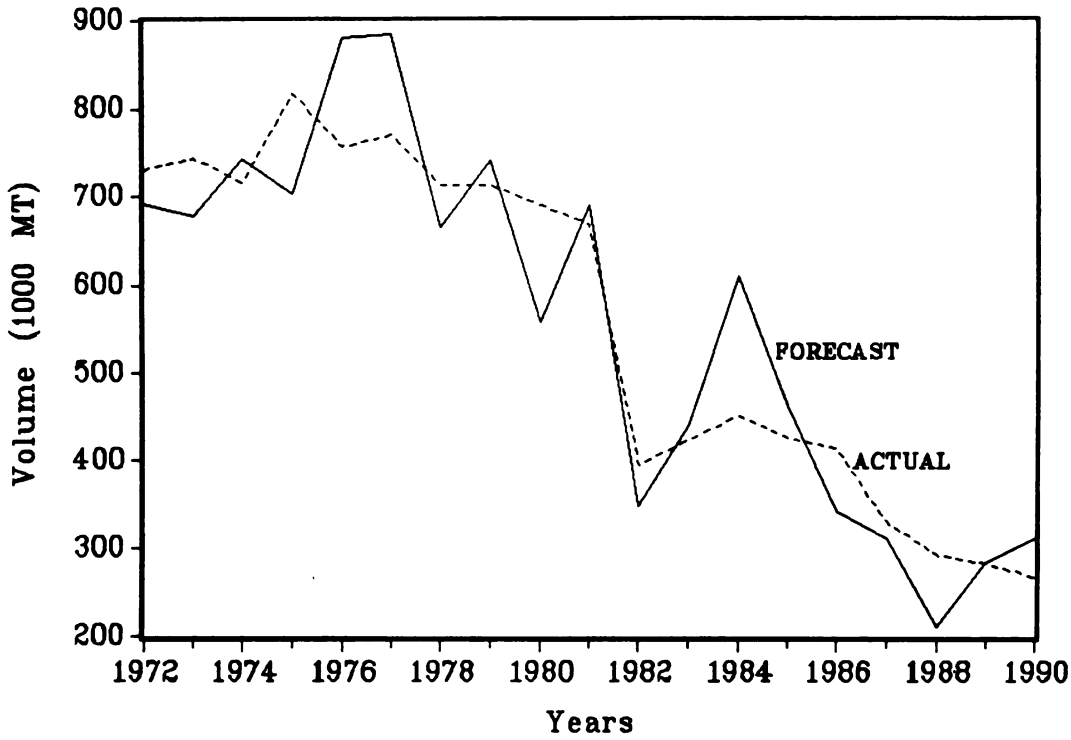

Figure 1: Export to the United States Equation: Actual and Fitted Values for the Sample Period

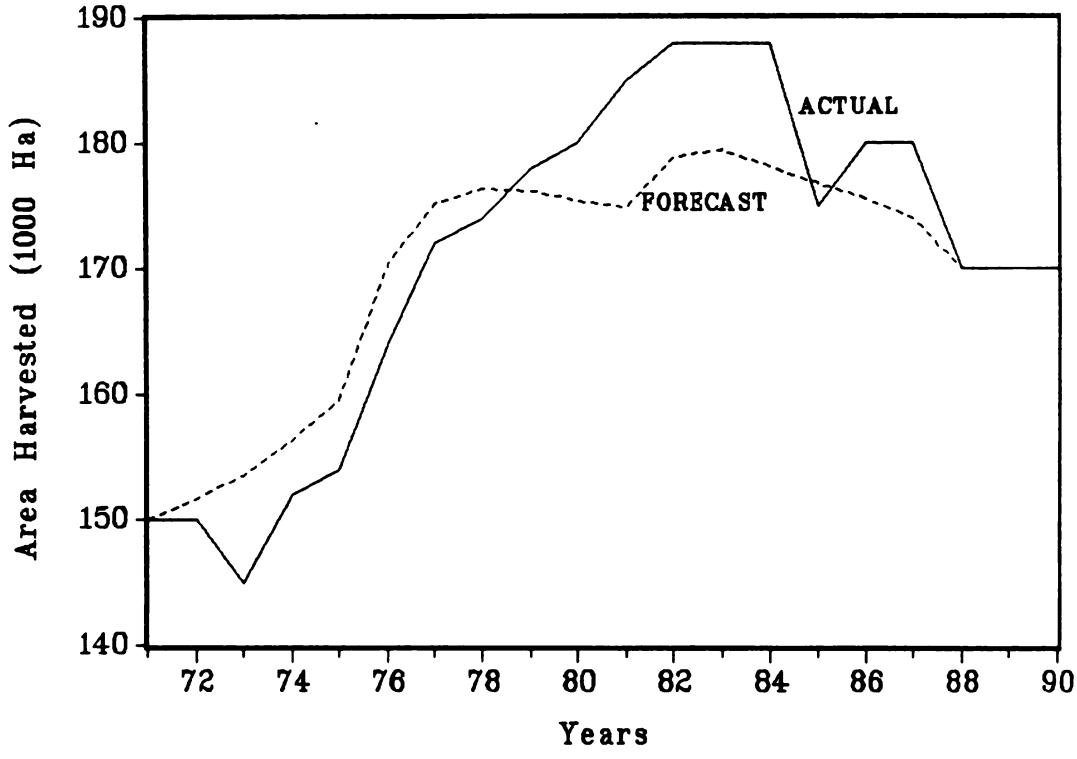

Figure 2: Area Harvested Equation: Actual and Fitted Value for the Sample Period

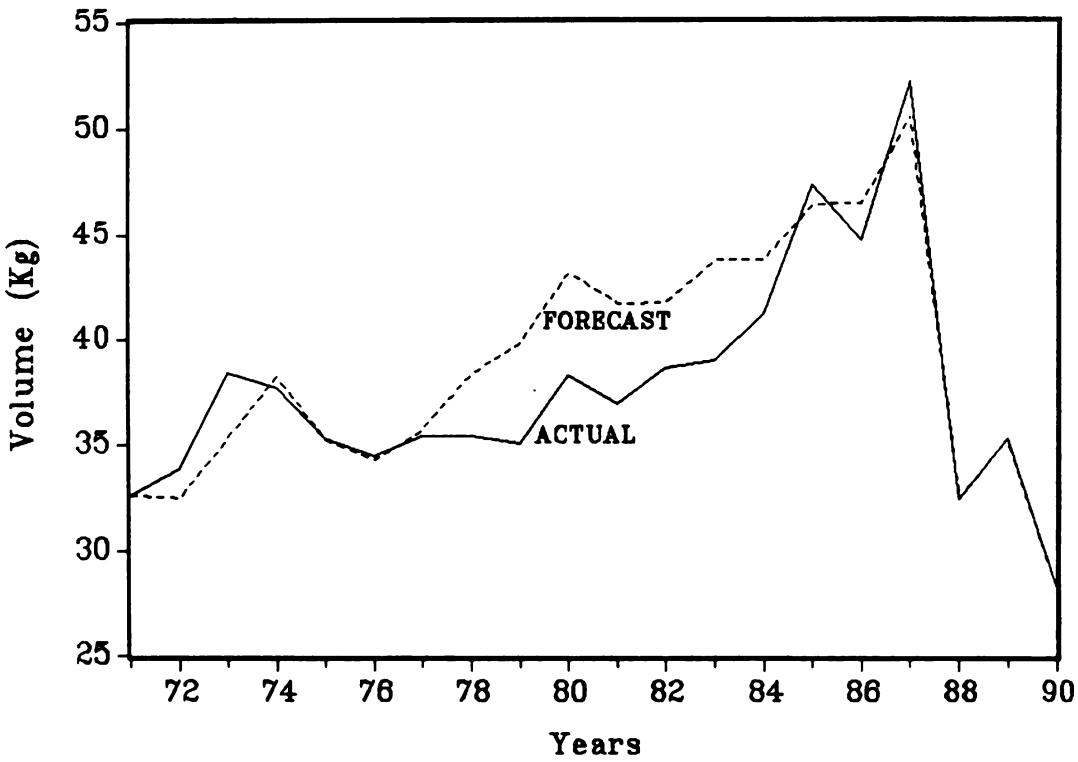

Figure 3: Per Capita Consumption: Actual and Fitted Values for the Sample Period

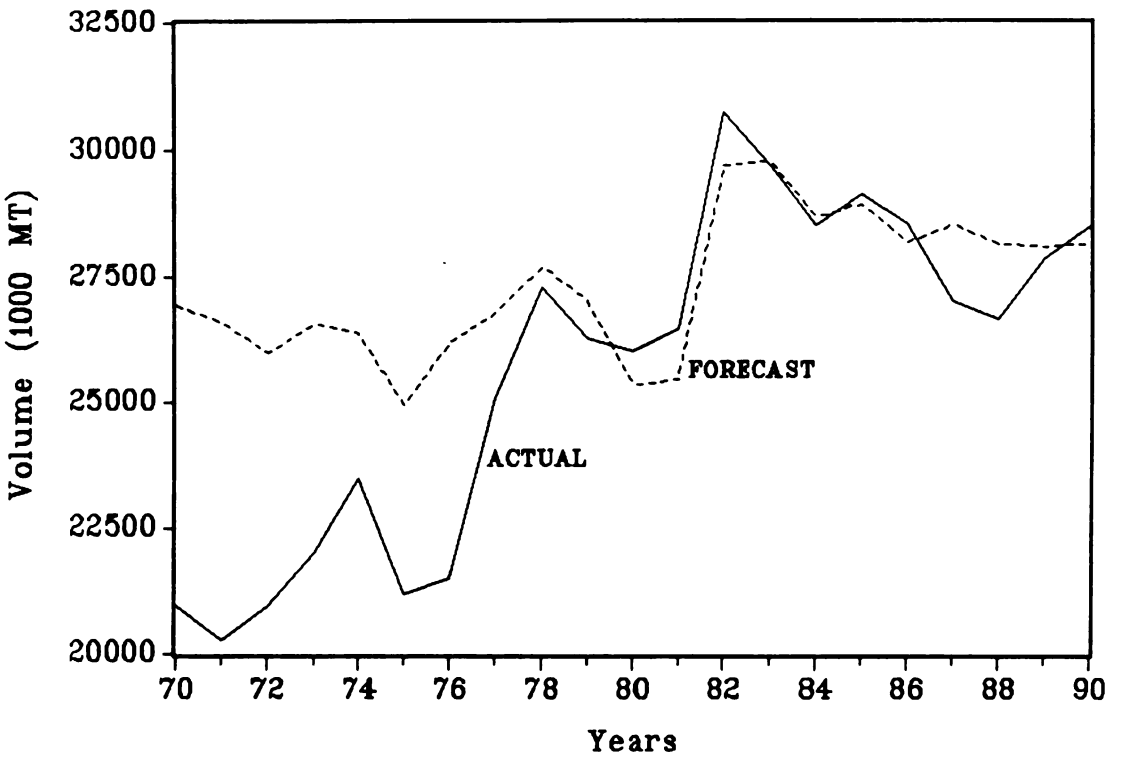

Figure 4: Export from the Rest of the World: Actual and Fitted Values

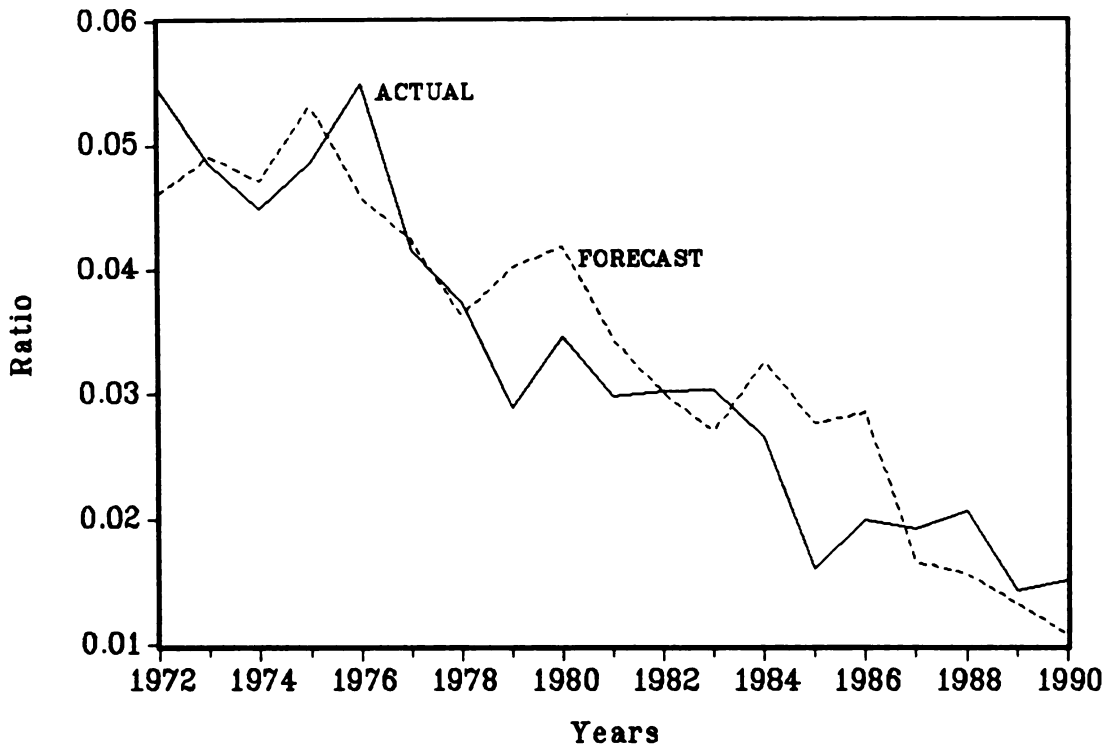

Figure 5: Ratio of Export from the DR and the Rest of the World: Actual and Fitted Values

To evaluate turning-point errors, some specific conventions should be adopted. This analysis of turning-point errors follows the convention adopted by Tomek and Robinson (1990). This convention assumes that one-step-ahead forecasts are being evaluated and uses the current predicted value relative to the previous actual value. In this case, a turning-point error occurs if the sign in the second column is different from the sign in the first column.

As Table 14 shows, the number of turning-point errors is higher for the AREAHAR equation. This could be explained by the fact that, the Dominican Republic did not have very good policies on how to control sugar production. The Dominican Republic just produces sugar because it is the main export crop. People dealing with the sugar cane industry in the Dominican Republic were more interested in the production aspects of the industry. They did not pay much attention to determining how external conditions were changing and how those conditions could affect production decisions. However, in the last few years, the Dominican Republic has been more interested in diversifying its one-crop economy.

The percent RMSE is higher for the EXPTUS and REXPT equations, many theoretical economic relationships, such as supply and stock ratio were tested. However, they were not significant. The only significant one was the production ratio. Logically, this is not the only variable affecting export from the Dominican Republic. The rest of the equations seemed to track better over the historical period. In spite of these few turning-point errors in the equations, the

model seems to accurately forecast what is currently happening with the sugar cane industry in the Dominican Republic in terms of sugar production, supply, and demand. The model forecasts the declining production trend very well and, as a result, the declining export.

5.4- Elasticity Estimates

Elasticities are very important factors for economic inferences and policy analysis. After estimating the supply and demand equations, elasticities were computed at the mean values for some of the independent variables in the

Table 15: Estimated Supply and Demand Elasticities

TYPE OF ELASTICITY	ESTIMATED ELASTICITY
Own price elasticity of demand	-0.450
Income elasticity of demand	-0.912
Gross return elasticity	0.018
World price elasticity	0.016

model. The results of the estimated elasticities are presented in Table 15. These elasticities represent the percent change of the dependent variable due to a percent change in the independent variable assuming that all the other

factors are constant. For example, the -0.45 price elasticity of demand means that an increase in price of one percent decreases the quantity of sugar demanded by 0.45 percent.

Due to the lack of data for some variables which theoretically affect supply and demand, such as sugar substitutes and complements, cross price elasticities cannot be calculated. The only elasticities calculated were income and price elasticities for domestic demand and gross return and world price elasticities for the area of sugar cane harvested. Because the world price was not included directly in the supply equation, this elasticity was calculated indirectly. This was derived by calculating the effect that the world price lagged two years has on the real expected gross return per hectare (REGRPH) and then calculating the effect of this variable on the area harvested.

To determine the precision of these estimated elasticities, they should be compared to some other estimates. However, no study about sugar industry in the Dominican Republic could be found to compare with these estimated elasticities.

As said previously, elasticities should be very important factors for policy decision making. The results of a specific policy depend on how this affects people's decision. If the government policy is to increase income to the sugar industry by increasing the sugar price, it would be an appropriate policy in the domestic market. The quantity demanded does not decrease as much as the price increases.

The estimated gross return and world price elasticity show that Dominican's decision makers seem to ignore changes in price and return when making production decisions. If the country is to maximize income or to be efficient in the use of its resources, it has to consider how profitability is changing. However, they do not appear to respond to changes in price and return.

Sugar production is one of the main economic activities in the Dominican Republic and the export market is the major market. However, if the world price is not so favorable, sugar cane can be replaced by some other more profitable crops. This can improve the efficiency in the use of the scarce resources in the Dominican Republic.

CHAPTER VI

SUPPLY AND DEMAND FORECASTS

6.1- Forecast of Exogenous Variables

Forecasts of supply and demand from the model require some assumptions concerning the rate of change of exogenous variables included in the model. These forecasted values were then inserted into the estimated equations. The system of equations is then solved simultaneously to give the forecasted values of the endogenous variables. The actual and forecast values for the exogenous variables are presented in Appendix II.

In addition to the dummy variables, which represent unusual situations affecting some other variables, the model has eight exogenous variables whose values for the forecast period have to be supplied to the model. Moreover, some of these variables are composed of some other exogenous variables. The values for these variables also have to be forecast outside the model. Some of the variables were forecast using a double exponential smoothing method, and some others were forecast taking into account their average growth over a certain period of time. The criterion chosen depended on which one was the most representative of the actual trend.

6.1.1 Projection of Real Expected Gross Return per Hectare (REGRPH)

As stated previously, the REGRPH is composed of world price (WPRICE), exchange rate (EXRATE), expected sugar cane yield per hectare (EYIELD), the conversion factor of cane to raw sugar (SUYIELD), and the Consumer Price Index (CPI). All these variables were forecast independently. Then, the REGRPH was calculated out of these forecasts.

The WPRICE, YIELD, and SUYIELD variables were forecast using the double exponential smoothing method over the whole sample period (1970-1990). The EXRATE variable was also smoothed in the same way as the world price. However, because the official exchange rate was fixed at US$ 1.00 to RD$[8] 1.00 before 1985, the range used to smooth it was from 1985 to 1992. As can be seen, only three years needed to be forecast. On the other hand, the CPI was forecast using the average percent increase from 1970 to 1990, which is 14.77%.

6.1.2 Projection of Deflated per Capita National Disposable Income (DPNDI)

This variable is equal to the current National Disposable Income (NDI) divided by the population (POP) and then by the CPI. The NPI variable was forecast using the same smoothing technique explained previously over the

[8] RD$ is the currency sign for the Dominican Peso.

whole sample period. The POP variable was forecast assuming a 2.8 percent increase, which is the average percent increase from 1970 to 1990.

6.1.3 Projection of the Deflated Retail Price of Refined Sugar (DRETPR)

Although the deflated retail price is the retail price divided by the CPI, this variable was smoothed by itself as a whole. The reason for this is because smoothing the retail price by itself and then dividing by the CPI overestimates it. In 1991, the average current price of refined sugar in the Dominican Republic was RD$ 3.51. A forecast of the current retail price by itself shows that for 1995, the current retail price would be RD$ 8.46. The price increase is not very likely considering that currently, the Dominican economy is quite stable.

6.1.4 Projection of the Pressure to Export sugar from the World Excluding the United States and the Dominican Republic (WPRESS)

The pressure to export sugar from the world excluding the United States and the Dominican Republic is equal to production in the rest of the world (WPRODRE) minus the consumption trend in the rest of the world (TCONSRES). As the consumption trend is a three year moving average of consumption in the rest of the world (CONSRES), the consumption trend was generated by smoothing consumption and then calculating the moving average. The WPRODRE was smoothed in the same way as consumption.

6.1.5 Projection of Beginning Stock (BSTOCK)

The beginning stock variable was supposed to be endogenous. In the beginning it was treated in this way. However, because of data problems, the results were not as expected. To solve this problem, the beginning stock was considered an exogenous variable.

The beginning stock variable is the same as the ending stock lagged one year. In the same way, the beginning stock forecast was calculating by smoothing the ending stock and lagging it one year. The beginning stock could have been calculated and smoothed directly, but the results of the approach used here were more realistic.

6.2- Forecast of Endogenous Variables

After forecasting the exogenous variables, the model was solved for a period beyond the sample period to forecast the endogenous variables. The forecast of the endogenous variables along with actual values for the supply and demand variables are presented in Appendix III. The actual and forecasted values for total supply, domestic demand, and export demand are presented graphically in Figures 6 to 10.

Figure 6 shows that the area of sugar cane harvested in the Dominican Republic trended upward until 1982. It stayed constant until 1984. After 1984 the area of sugar harvested began to decline. According to the model this

trend is to continue in the future unless there is a major external change that helps to restore the Dominican sugar industry.

Logically, a decline in sugar cane production means a decline in total sugar supply as shown in Figure 7. Moreover, sugar supply also declines due to a decline in the conversion factor from cane to raw sugar. This decline in the conversion factor might be due to obsolete machinery and equipment and the low technology used.

The are many reasons for the decline of sugar cane production in the Dominican Republic. One of the reason is the effect of the quota system established by the United States in 1981. The decline did not began in 1981 or 1982 because of the lag between the event and the time when the planting decision is made. Another reason is the United States policy toward the Dominican Republic. The Reagan administration wanted the Dominican Republic to diversify its one-crop economy. Furthermore, the Dominican Republic realized that there are many other crops that can be planted in the sugar cane land and are actually more profitable than sugar cane.

Figure 8 and 9 also show a declining trend for export from the Dominican Republic to the United States and the rest of the world. The declining trend to the rest of the world is steeper than the decline to the United States. This is logical because the United States is the preferential market. Moreover the U.S. price has always been higher than the world market price except in 1974.

If the trend continues, it is likely that, instead of exporting sugar to the world market, the Dominican Republic is going to export sugar only to the United States to take advantage of the preferential price and import sugar from the world market to meet the domestic consumption requirements. This is exemplified by the fact that the Dominican Republic had to import sugar in 1990 and 1991.

For the domestic consumption side, Figure 10 shows an increasing trend in consumption per capita until 1987. In 1987, consumption per capita dropped sharply. The consumption per capita forecast for the future does not have a specific trend. It increases in the beginning and declines at the end of the forecast period.

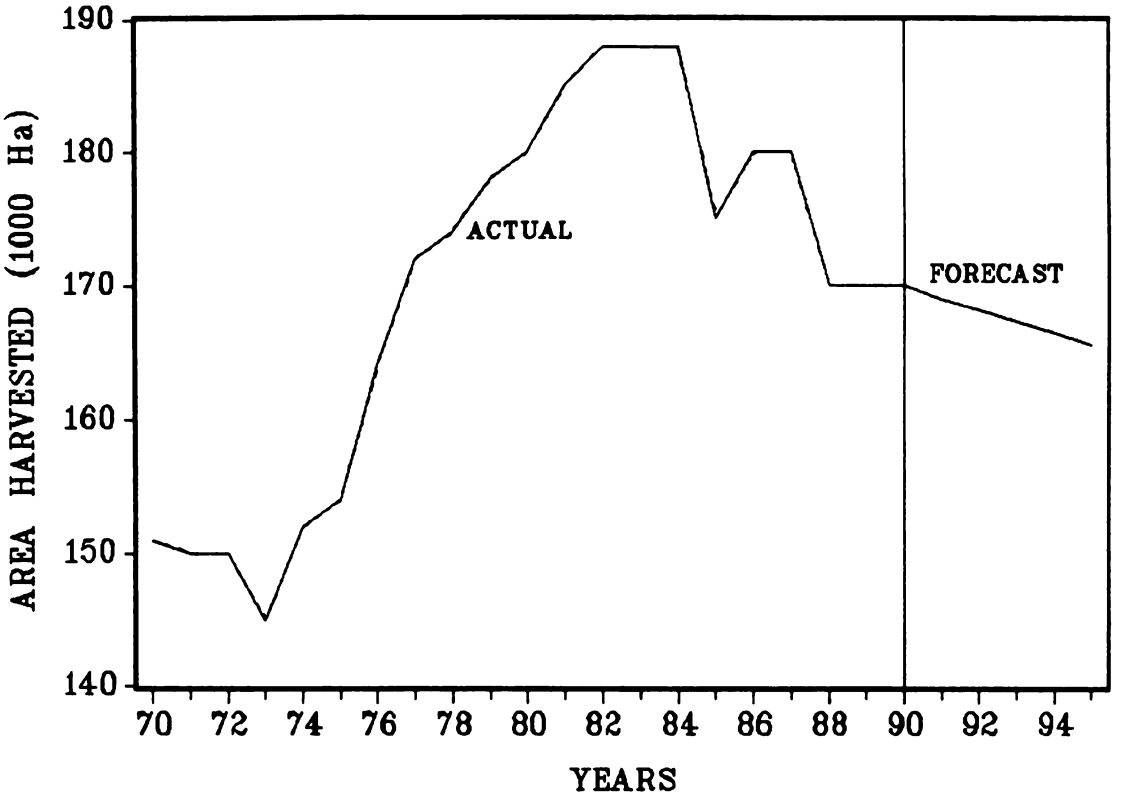

Figure 6: Area Harvested: Actual and Forecast Values

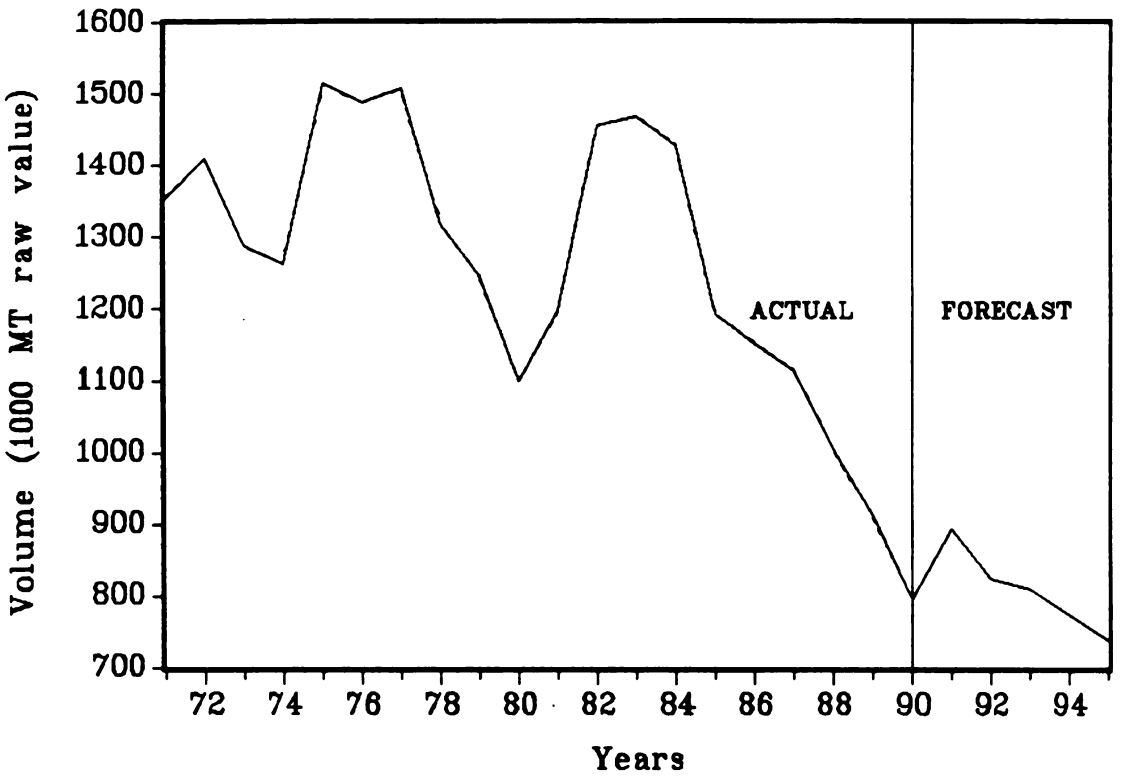

Figure 7: Sugar Supply in the Dominican Republic: Actual and Forecast Value

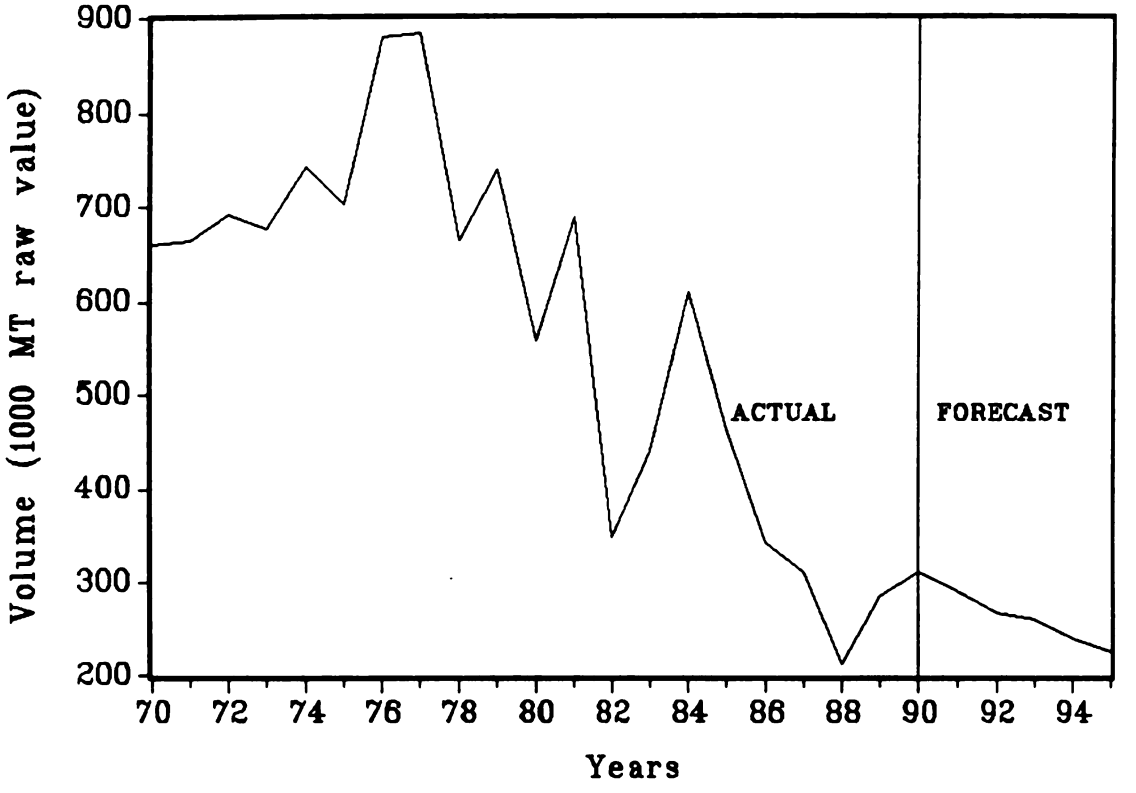

Figure 8: Export to the United States: Actual and Forecast Values

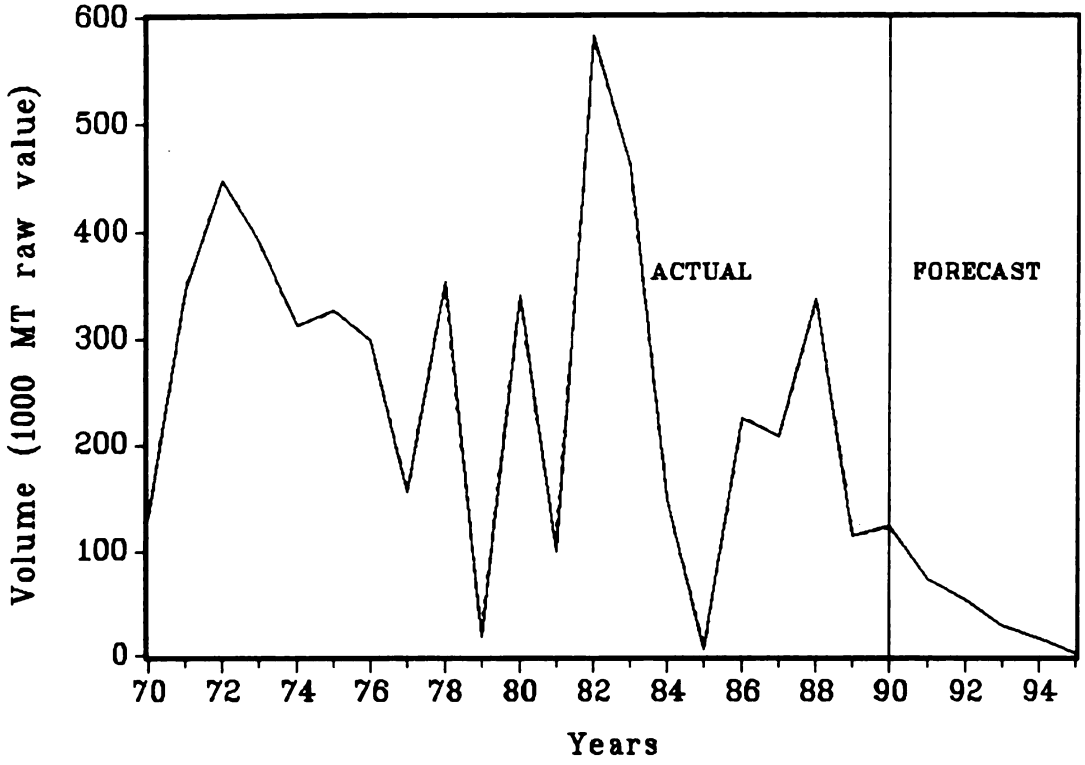

Figure 9: Export from the Dominican Republic to the Rest of the World: Actual and Forecast Values

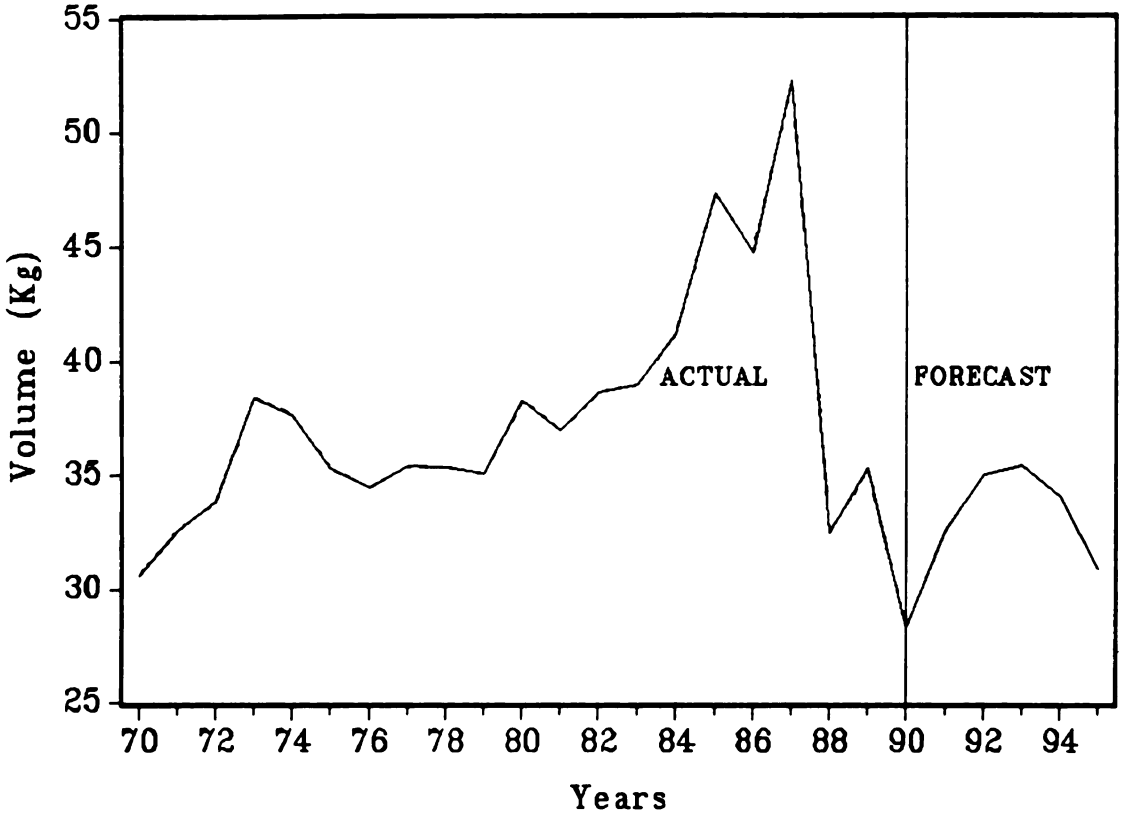

Figure 10: Domestic Consumption per Capita: Actual and Forecast Values

CHAPTER VII

CONCLUSION AND SUGGESTIONS FOR FURTHER STUDIES

7.1 Conclusion

This paper has tried to analyze the performance of the sugar cane industry in the Dominican Republic. The analysis was carried out by developing an econometric model of supply and demand for sugar. This paper showed that the declining trend of the sugar cane industry in the Dominican Republic in recent years is likely to continue. The results can provide policy decision makers in the Dominican Republic with useful information about the different factors affecting the sugar cane industry.

The factors affecting the sugar are both internal and external. The paper showed that the quota system established by the United States and the low market price of sugar are two of the main factors affecting the Dominican sugar cane industry. The internal problems are somewhat related to the external ones. Policy makers related to the sugar cane industry in the Dominican Republic seem not to be aware of those problems as shown by the low response of production to change in the world price and, as a result, change in the profitability of the sugar industry.

Fortunately, the Dominican Republic is now trying to diversify its one-crop economy by replacing sugar plantations by some other more profitable crops.

Different from sugar cane production, the production decision of some of these crops like vegetables can be more easily changed if the market conditions change. This flexibility can improve the general economic situation of the Dominican Republic.

7.2 Suggestions for Further Studies

To try to predict what is going to happen with the sugar cane industry in a country like the Dominican Republic is really a very challenging task. In addition to the data used in this model, much more data, both quantitative and qualitative, as well as time and economic resources are needed. The variables used in this model are not the only factors affecting supply and demand for sugar in the Dominican Republic.

To try to forecast exports to the rest of the world, what is going on in the different countries which import sugar from the Dominican Republic has to be considered. In the case of export to the United States, sugar import from the Dominican Republic depends on many other factors like sugar and other sweeteners produced in the United States that were not actually included in this study. Research on that scale was beyond the scope of this study.

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APPENDICES

APPENDIX I

EDIT FILE FOR THE SUPPLY AND DEMAND MODEL

APPENDIX I

```
1: AREAHARF=8.888024+.9361912*AREAHARF(-1)+.1562356*REGRPH
2: PCONSF=55.95877-3.249521*DPNDI-7042.442*DRETPR+.9113848*PCONSF(-1)-22.89695*D
V88-13.48383*DV90
3: EXPTUSF=337.8882+.3239224*DOMPRESF-264.0893*DVQUOTA
4: WEXPTREF=25036.40+.167521*WPRESS+2569.6770*DVQUOTA-4212.7513*DV75+[AR(1)=.826
1211]
5: REXPTF=-.0111992+3.3922172*RPRODSF+.0140920*DV75
6: CANEPROF=(AREAHARF*YIELD)/1000
7: SUGAPROF=CANEPROF*SUYIELD
8: TSUPPLYF=SUGAPROF+IMPT+BSTOCK
9: CONSF=(PCONSF*POP)/1000
10: EXPTF=REXPTF*WEXPTREF
11: DOMPRESF=TSUPPLYF-(CONSF(-1)+CONSF(-2)+CONSF(-3))/3
12: RPRODSF=SUGAPROF/WPRODRE
13: EXPTRESF=EXPTF-EXPTUSF
```

APPENDIX II

ALPHABETICAL ORDER AND DESCRIPTION OF THE VARIABLES USED IN THE MODEL

APPENDIX II

AREAHAR = Area of sugar cane harvested (1000 Ha)

AREAHAR (-1) = Area of sugar cane harvested the previous year (1000 Ha)

AR(1) = Autoregressive error specification assuming first order autocorrelation

BSTOCK = Beginning stock (1000 MT raw value)

C = The constant term

CANEPROD = Total cane sugar production (1000 MT)

DOMPRESS = Pressure to export from the Dominican Republic

DPNDI = National Disposable Income per capita in the Dominican Republic deflated by the CPI at 1980 prices (RD$)

DRETPR= Retail price per pound of refined sugar in the Dominican Republic deflated by the CPI at 1980 prices (DR cents/lb)

DVQUOTA = A dummy variable for the quota system imposed by the U.S. in 1981 equal to zero for the period before 1982 and one afterwards

DV75 = A dummy variable equal to 1 in 1975 an 0 otherwise

DV88 = Dummy variable equal to 1 in 1988 and 0 otherwise

DV90 = Dummy variable equal to 1 in 1990 and 0 otherwise

EXPT = Total sugar export from the Dominican Republic (1000 MT raw value

APPENDIX II
(Cont'd)

EXPTREST = Sugar export from the Dominican Republic to the rest of the world excluding the U.S. (1000 MT raw value)

PCONS = Total sugar consumption per capita in the Dominican Republic (Kg)

PCONS(-1) = Sugar consumption per capita in the Dominican Republic lagged one year (Kg/Ha)

REGRPH = Real expected gross return per hectare (RD$)

REXPT = Ratio of sugar export from the D.R to the rest of the world excluding the U.S.

RPRODS = Ratio of sugar production in the Dominican Republic to sugar production in the rest of the world excluding the United States and the Dominican Republic

SUGAPROD = Total sugar production (1000 MT raw value)

SUYIELD = Conversion factor of cane to raw sugar (in decimal)

TSUPPLY = Total sugar supply in the Dominican Republic (1000 MT raw value)

WEXPTRES = Sugar export by exporting countries excluding the U.S. and the D.R. (1000 MT raw value)

WPRESS = Pressure to export sugar by producing countries excluding the U.S. and the D.R.

YIELD = Actual sugar cane yield (Kg/Ha)

APPENDIX III

EVALUATING TURNING-POINT ERRORS

APPENDIX III

Table 16: Evaluating Turning-point errors (AREAHAR)

YEARS	AREAHAR	
	Actual-Actual (-1)	Forecast-Actual(-1)
1971	-1.00	-1.00
1972	0.00	1.74
1973	-5.00	3.60
1974	7.00	11.45
1975	2.00	7.60
1976	10.00	16.37
1977	8.00	11.18
1978	2.00	4.38
1979	4.00	2.20
1980	2.00	-2.60
1981	5.00	-5.13
1982	3.00	-6.11
1983	0.00	-8.52
1984	0.00	-9.91
1985	-13.00	-11.19
1986	5.00	0.52
1987	0.00	-5.97
1988	-10.00	-10.00
1989	0.00	0.00
1990	0.00	0.00

Source: Constructed by the Author

APPENDIX III
(Cont'd)

Table 17: Evaluating Turning-point Errors (PCONS)

YEARS	PCONS	
	Actual-Actual(-1)	Forecast-Actual(-1)
1971	1.99	1.99
1972	1.28	-0.09
1973	4.54	1.46
1974	-0.72	-0.17
1975	-2.38	-2.43
1976	-0.84	-1.03
1977	0.96	1.24
1978	-0.05	2.94
1979	-0.33	4.45
1980	3.25	8.12
1981	-1.35	3.37
1982	1.68	4.78
1983	0.35	5.14
1984	2.20	4.83
1985	6.16	5.25
1986	-2.61	-0.85
1987	7.48	5.89
1988	-19.77	-19.77
1989	2.84	2.84
1990	-7.07	-7.07

Source: Constructed by the Author

APPENDIX III
(Cont'd)

Table 18: Evaluating Turning-point Errors (WEXPTRES)

YEARS	WEXPTRES	
	Actual-Actual(-1)	Forecast-Actual(-1)
1971	-686.54	5628.52
1972	655.82	5700.49
1973	1086.43	5640.11
1974	1461.21	4352.23
1975	-2295.25	1436.33
1976	304.43	5019.52
1977	3569.57	5298.00
1978	2242.82	2645.13
1979	-1025.75	-281.24
1980	-248.00	-932.32
1981	450.79	-577.07
1982	4249.07	3218.63
1983	-1036.50	-950.36
1984	-1157.21	-1015.36
1985	602.75	415.46
1986	-588.14	-963.68
1987	-1527.82	-14.01
1988	-356.29	1118.06
1989	1178.11	1425.10
1990	645.43	312.32

APPENDIX III
(Cont'd)

Table 19: Evaluating Turning-point Error (EXPTUS)

YEARS	EXPTUS	
	Actual-Actual(-1)	Forecast-Actual(-1)
1972	27.57	65.76
1973	-15.21	51.45
1974	65.23	38.56
1975	-39.43	75.45
1976	177.95	53.56
1977	3.16	-111.25
1978	-218.86	-171.74
1979	75.69	47.07
1980	-182.89	-50.32
1981	132.13	110.00
1982	-342.73	-295.17
1983	92.67	75.96
1984	169.93	11.39
1985	-147.16	-184.38
1986	-119.47	-49.39
1987	-31.49	-13.60
1988	-99.98	-19.22
1989	73.99	70.98
1990	25.25	-18.33

Source: Constructed by the Author

APPENDIX III
(Cont'd)

Table 20: Evaluating Turning-point Errors (REXPT)

YEARS	REXPT	
	Actual-Actual(-1)	Forecast-Actual(-1)
1972	0.00	0.00
1973	-0.01	-0.01
1974	0.00	0.00
1975	0.00	0.01
1976	0.01	0.00
1977	-0.01	-0.01
1978	0.00	-0.01
1979	-0.01	0.00
1980	0.01	0.01
1981	0.00	0.00
1982	0.00	0.00
1983	0.00	0.00
1984	0.00	0.00
1985	-0.01	0.00
1986	0.00	0.01
1987	0.00	0.00
1988	0.00	0.00
1989	-0.01	-0.01
1990	0.00	0.00

Source: Constructed by the Author

APPENDIX IV

LIST OF THE EXOGENOUS VARIABLES USED IN THE MODEL

APPENDIX IV

List of Exogenous Variables Used in the Model

YEAR	WPRESS	EYIELD	YIELD	IMPT	REGRPH	DPMDI
1970	11,332.942	66,730.875	61,866.000	0.000	NA	9.099
1971	9,271.582	64,644.133	68,122.000	0.000	NA	9.506
1972	5,603.056	65,072.426	69,893.000	0.000	15.539	10.133
1973	9,157.444	66,011.883	64,564.000	0.000	16.991	9.983
1974	7,954.902	65,090.719	64,562.000	0.000	24.036	8.576
1975	24,418.902	64,423.879	60,610.000	0.000	27.193	11.169
1976	6,959.546	62,705.656	66,700.000	0.000	77.211	11.056
1977	10,439.173	63,359.785	64,766.000	0.000	43.495	10.974
1978	15,911.275	63,295.738	63,683.000	0.000	22.337	10.726
1979	11,830.953	62,944.785	57,823.000	0.000	14.020	11.416
1980	1,821.249	60,862.516	50,309.000	0.000	9.930	11.414
1981	2,461.450	56,935.816	52,049.000	0.000	11.359	11.252
1982	12,471.046	54,536.426	62,793.000	0.000	40.280	11.187
1983	12,949.053	56,168.641	61,277.000	0.000	19.910	10.800
1984	6,373.780	57,012.094	54,633.000	0.000	7.511	10.092
1985	8,007.057	55,616.883	48,111.000	15.000	7.680	9.997
1986	3,372.481	52,542.086	42,750.000	0.000	7.052	9.786
1987	5,530.525	48,557.395	48,733.000	0.000	5.260	10.229
1988	3,168.156	47,478.234	49,265.000	0.000	9.107	10.214
1989	2,874.192	46,912.625	46,212.000	0.000	6.772	10.006
1990	3,264.135	45,605.555	41,176.000	25.000	5.931	9.931
1991	3,799.164	43,102.563	43,102.563	25.000	5.589	10.469
1992	4,604.991	41,888.820	41,888.820	0.000	7.004	11.036
1993	4,376.140	40,675.074	40,675.074	0.000	6.376	11.633
1994	4,147.289	39,461.328	39,461.328	0.000	5.796	12.264
1995	3,918.438	38,247.582	38,247.582	0.000	5.193	12.927

APPENDIX IV
(Cont'd)

YEAR	DRETPR	SUYIELD	BSTOCK	WPRODRE	WPRICE	EXRATE
1970	0.003	0.109	NA	68,042.570	3.680	1.000
1971	0.003	0.111	224.000	68,475.289	4.520	1.000
1972	0.003	0.115	209.000	67,085.609	7.430	1.000
1973	0.003	0.127	95.000	72,576.680	9.610	1.000
1974	0.003	0.124	48.000	73,460.500	29.990	1.000
1975	0.003	0.132	280.000	91,533.961	20.490	1.000
1976	0.003	0.118	201.000	74,848.180	11.580	1.000
1977	0.002	0.113	249.000	79,423.570	8.110	1.000
1978	0.002	0.108	120.000	86,164.141	7.820	1.000
1979	0.002	0.116	45.000	85,201.750	9.660	1.000
1980	0.002	0.115	60.000	78,272.680	29.010	1.000
1981	0.002	0.110	135.000	81,799.539	16.930	1.000
1982	0.002	0.116	83.000	93,256.430	8.420	1.000
1983	0.002	0.106	249.000	94,782.109	4.490	1.000
1984	0.003	0.114	253.000	89,788.430	5.180	1.000
1985	0.002	0.109	257.000	94,013.391	4.040	3.120
1986	0.003	0.116	257.000	91,389.539	6.050	2.890
1987	0.002	0.093	298.000	95,759.914	6.710	3.510
1988	0.002	0.093	228.000	96,102.047	10.170	5.810
1989	0.002	0.088	220.000	98,624.070	12.790	6.350
1990	0.002	0.084	181.000	100,989.375	12.550	8.650
1991	0.002	0.100	141.000	102,391.000	11.035	12.740
1992	0.002	0.100	121.000	106,216.227	11.166	12.750
1993	0.002	0.100	130.523	107,946.875	11.296	14.782
1994	0.002	0.100	117.907	109,677.531	11.427	16.518
1995	0.002	0.100	105.291	111,408.180	11.558	18.254

APPENDIX IV
(Cont'd)

YEAR	CPI	POP	MDI	TCONSRES	CONSREST
1970	37.100	4,060.000	1,370.500	56,709.629	61,515.699
1971	38.700	4,180.000	1,537.700	59,203.703	63,604.699
1972	41.800	4,300.000	1,821.300	61,482.551	65,137.301
1973	48.100	4,430.000	2,127.300	63,419.234	67,774.797
1974	54.400	4,560.000	2,127.300	65,505.598	68,433.102
1975	62.300	4,700.000	3,270.300	67,115.063	67,458.000
1976	67.100	4,840.000	3,590.600	67,888.633	71,062.102
1977	75.800	4,980.000	4,142.600	68,984.398	72,238.500
1978	78.500	5,120.000	4,310.800	70,252.867	76,811.797
1979	85.700	5,305.000	5,190.199	73,370.797	80,304.000
1980	100.000	5,443.000	6,212.500	76,451.430	80,898.461
1981	107.500	5,581.000	6,750.901	79,338.086	81,153.688
1982	115.800	5,744.000	7,440.900	80,785.383	83,447.023
1983	121.300	6,123.000	8,021.099	81,833.055	85,643.227
1984	154.000	6,269.000	9,742.800	83,414.648	88,928.766
1985	211.200	6,416.000	13,546.000	86,006.336	89,479.172
1986	232.200	6,565.000	14,917.100	88,017.055	92,280.234
1987	268.700	6,716.000	18,459.400	90,229.391	97,042.273
1988	388.000	6,867.000	27,213.699	92,933.891	97,927.125
1989	564.300	6,903.000	38,975.949	95,749.875	98,206.328
1990	1,131.900	7,119.000	80,020.406	97,725.242	99,642.047
1991	1,299.105	7,318.000	99,525.625	98,591.836	101,261.000
1992	1,491.009	7,523.000	123,785.305	99,703.125	103,806.820
1993	1,711.261	7,734.000	153,958.359	101,569.953	105,739.039
1994	1,964.049	7,950.000	191,486.188	103,602.289	107,671.258
1995	2,254.179	8,173.000	238,161.547	105,739.039	109,603.477

APPENDIX V

ACTUAL AND FORECAST VALUES OF THE ENDOGENOUS VARIABLES USED IN THE MODEL

APPENDIX V

Actual and Forecast Values for the Endogenous Variables

YEARS	AREAHAR	AREAHARF	PCOHS	PCOHSF	EXPTUS	EXPTUSF
1970	151.00	151.00	30.616	30.616	660.17	
1971	150.00	150.00	32.608	32.608	665.04	
1972	150.00	151.74	33.884	32.513	692.61	730.81
1973	145.00	153.60	38.420	35.341	677.40	744.07
1974	152.00	156.45	37.697	38.246	742.63	715.97
1975	154.00	159.60	35.319	35.265	703.20	818.08
1976	164.00	170.37	34.483	34.292	881.15	756.76
1977	172.00	175.18	35.442	35.722	884.31	769.91
1978	174.00	176.38	35.391	38.379	665.44	712.57
1979	178.00	176.20	35.061	39.840	741.14	712.52
1980	180.00	175.40	38.313	43.182	558.24	690.81
1981	185.00	174.87	36.966	41.681	690.37	668.24
1982	188.00	178.89	38.646	41.749	347.64	395.20
1983	188.00	179.48	38.996	43.788	440.32	423.61
1984	188.00	178.09	41.192	43.827	610.24	451.71
1985	175.00	176.81	47.355	46.445	463.09	425.86
1986	180.00	175.52	44.747	46.503	343.62	413.70
1987	180.00	174.03	52.222	50.633	312.13	330.01
1988	170.00	170.00	32.456	32.456	212.14	292.90
1989	170.00	170.00	35.299	35.299	286.13	283.13
1990	170.00	170.00	28.228	28.228	311.38	267.79
1991		168.91		32.617		291.33
1992		168.12		35.000		267.33
1993		167.27		35.456		260.57
1994		166.39		34.047		240.87
1995		165.48		30.832		225.65

APPENDIX V
(Cont'd)

YEARS	CANEPROD	CANEPROF	TSUPPLY	TSUPPLYF	COSS	COSSF
1970	9313.0				124.30	124.30
1971	10200		1355.0		136.30	131.27
1972	10463	9874.4	1410.0	1342.4	145.70	139.80
1973	9372.0	10140	1288.0	1385.7	170.20	156.56
1974	9798.0	10183	1262.0	1309.7	171.90	174.40
1975	9334.0	10282	1514.0	1639.3	166.00	165.75
1976	10932	10683	1488.0	1458.7	166.90	165.97
1977	11140	11099	1507.0	1502.4	176.50	177.90
1978	11094	11164	1319.0	1326.6	181.20	196.50
1979	10304	11091	1245.0	1336.7	186.00	211.35
1980	9056.0	10675	1099.0	1284.8	208.54	235.04
1981	9629.0	9956.4	1198.0	1234.1	206.31	232.62
1982	11805	9756.2	1457.0	1218.5	221.98	239.81
1983	11520	10081	1468.0	1315.7	238.77	268.11
1984	10271	10153	1427.0	1413.5	258.23	274.75
1985	8419.0	9833.7	1193.0	1347.8	303.83	297.99
1986	7695.0	9222.1	1152.0	1329.6	293.76	305.29
1987	8772.0	8450.4	1113.5	1083.6	350.72	340.05
1988	8375.0	8224.9	1004.8	990.85	222.87	222.87
1989	7856.0	8075.0	913.00	932.32	243.67	243.67
1990	7000.0	7796.7	795.66	862.77	200.96	200.96
1991		7280.6	766.00	894.06	235.00	238.69
1992		7042.3		825.23		263.30
1993		6803.9		810.91		274.22
1994		6566.1		774.52		270.67
1995		6329.1		738.20		251.99

APPENDIX V
(Cont'd)

YEARS	EXPT	EXPTF	EXPTREST	EXPTRESF
1970	793.00		132.83	
1971	1011.0		345.96	
1972	1141.0	1197.8	448.39	466.99
1973	1069.0	1305.4	391.60	561.31
1974	1055.0	1241.0	312.37	525.07
1975	1030.0	1327.2	326.80	509.10
1976	1180.0	1200.1	298.85	443.33
1977	1040.0	1133.9	155.69	364.04
1978	1020.0	1005.7	354.56	293.08
1979	760.00	1086.9	18.864	374.35
1980	900.00	1061.3	341.76	370.51
1981	790.00	874.98	99.630	206.74
1982	930.00	894.01	582.36	498.82
1983	900.00	803.30	459.68	379.69
1984	760.00	936.07	149.76	484.36
1985	470.00	799.43	6.9118	373.57
1986	570.00	806.10	226.38	392.40
1987	520.00	474.55	207.87	144.54
1988	550.00	442.54	337.86	149.64
1989	400.00	373.60	113.87	90.475
1990	435.00	305.78	123.62	37.989
1991	410.00	364.94		73.603
1992		320.43		53.100
1993		288.55		27.978
1994		257.80		16.927
1995		228.13		2.4791

APPENDIX V
(Cont'd)

YEARS	DOMPRESS	DOMPRESF	WEXPTRES	WEXPTREF	REXPT	REXPTF
1970			20961	26935	0.03783	
1971	1224.4		20275	26590	0.04987	
1972	1278.9	1213.0	20930	25975	0.05451	0.04611
1973	1152.6	1253.9	22017	26570	0.04855	0.04913
1974	1111.3	1167.2	23478	26369	0.04494	0.04706
1975	1351.4	1482.4	21183	24914	0.04862	0.05327
1976	1318.6	1293.1	21487	26202	0.05492	0.04580
1977	1338.7	1333.7	25057	26785	0.04151	0.04233
1978	1149.2	1156.7	27300	27702	0.03736	0.03630
1979	1070.1	1156.5	26274	27018	0.02893	0.04023
1980	917.77	1089.5	26026	25342	0.03458	0.04188
1981	1006.1	1019.8	26477	25449	0.02984	0.03438
1982	1256.7	992.20	30726	29695	0.03027	0.03011
1983	1255.7	1079.9	29689	29775	0.03031	0.02698
1984	1204.6	1166.7	28532	28674	0.02664	0.03265
1985	953.34	1086.9	29135	28947	0.01613	0.02762
1986	885.05	1049.3	28547	28171	0.01997	0.02861
1987	828.27	790.97	27019	28533	0.01925	0.01663
1988	688.67	676.41	26662	28137	0.02063	0.01573
1989	623.88	646.23	27841	28088	0.01437	0.01330
1990	523.24	598.89	28486	28153	0.01527	0.01086
1991		671.56	26928	28243	0.01523	0.01292
1992		597.45		28378		0.01129
1993		576.60		28339		0.01018
1994		515.78		28301		0.00911
1995		468.80		28263		0.00807

APPENDIX VI

COMPUTER OUTPUT OF THE REGRESSION EQUATIONS

APPENDIX VI

LS // Dependent Variable is AREAHAR
Date: 11-11-1992 / Time: 11:49
SMPL range: 1972 - 1990
Number of observations: 19

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	8.8880242	15.659865	0.5675671	0.5782
AREAHAR(-1)	0.9361912	0.0880725	10.629778	0.0000
REGRPH	0.1562357	0.0701703	2.2265222	0.0407

R-squared	0.880023	Mean of dependent var	171.7368
Adjusted R-squared	0.865025	S.D. of dependent var	13.31182
S.E. of regression	4.890618	Sum of squared resid	382.6903
Log likelihood	-55.48631	F-statistic	58.67917
Durbin-Watson stat	2.463722	Prob(F-statistic)	0.000000

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
	1972	-1.74441	150.000	151.744
	1973	-6.97128	145.000	151.971
	1974	3.60890	152.000	148.391
	1975	-1.43753	154.000	155.438
	1976	-1.12464	164.000	165.125
	1977	2.78117	172.000	169.219
	1978	0.59732	174.000	173.403
	1979	4.02433	178.000	173.976
	1980	2.91850	180.000	177.081
	1981	5.82281	185.000	179.177
	1982	-0.37663	188.000	188.377
	1983	-0.00260	188.000	188.003
	1984	1.93447	188.000	186.066
	1985	-11.0919	175.000	186.092
	1986	6.17667	180.000	173.823
	1987	1.77570	180.000	178.224
	1988	-8.82527	170.000	178.825
	1989	0.90149	170.000	169.099
	1990	1.03290	170.000	168.967

APPENDIX VI
(Cont'd)

LS // Dependent Variable is PCONS
Date: 11-11-1992 / Time: 11:52
SMPL range: 1971 - 1990
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	55.958771	16.358168	3.4208458	0.0041
DPNDI	-3.2495217	1.0129283	-3.2080441	0.0063
DRETPR	-7042.4426	2015.7872	-3.4936438	0.0036
PCONS(-1)	0.9113849	0.1286656	7.0833582	0.0000
DV88	-22.896953	2.9819295	-7.6785694	0.0000
DV90	-13.483636	2.6566514	-5.0755005	0.0002

R-squared	0.881879	Mean of dependent var	37.63626
Adjusted R-squared	0.839693	S.D. of dependent var	5.461741
S.E. of regression	2.186792	Sum of squared resid	66.94881
Log likelihood	-40.46073	F-statistic	20.90451
Durbin-Watson stat	2.363954	Prob(F-statistic)	0.000005

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
	1971	1.20445	32.6077	31.4032
	1972	1.37100	33.8837	32.5127
	1973	1.82977	38.4199	36.5901
*	1974	-3.35535	37.6974	41.0527
	1975	0.55447	35.3191	34.7647
	1976	0.14259	34.4835	34.3409
	1977	-0.45551	35.4418	35.8973
*	1978	-2.73267	35.3906	38.1233
*	1979	-2.05539	35.0613	37.1166
	1980	-0.51341	38.3127	38.8261
	1981	-0.27686	36.9663	37.2432
	1982	1.19291	38.6455	37.4526
*	1983	-1.96326	38.9961	40.9593
	1984	1.73224	41.1921	39.4598
	1985	3.31138	47.3552	44.0438
*	1986	-2.58513	44.7470	47.3321
	1987	3.16902	52.2222	49.0331
	1988	7.1E-15	32.4557	32.4557
	1989	-0.59025	35.2993	35.8895
	1990	5.3E-15	28.2283	28.2283

APPENDIX VI
(Cont'd)

LS // Dependent Variable is EXPTUS
Date: 11-11-1992 / Time: 11:53
SMPL range: 1971 - 1990
Number of observations: 20

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	337.88826	109.65712	3.0813160	0.0068
DOMPRESS	0.3239224	0.0909466	3.5616774	0.0024
DVQUOTA	-264.08931	43.958737	-6.0076638	0.0000

R-squared	0.856604	Mean of dependent var	561.4111
Adjusted R-squared	0.839734	S.D. of dependent var	205.5656
S.E. of regression	82.29464	Sum of squared resid	115130.9
Log likelihood	-114.9597	F-statistic	50.77633
Durbin-Watson stat	1.894840	Prob(F-statistic)	0.000000

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
	1971	-69.4475	665.041	734.489
	1972	-59.5359	692.612	752.148
	1973	-33.8283	677.402	711.230
	1974	44.7778	742.630	697.852
	1975	-72.4391	703.198	775.637
	1976	116.129	881.152	765.023
	1977	112.774	884.308	771.534
	1978	-44.6961	665.444	710.140
	1979	56.6077	741.136	684.528
	1980	-76.9293	558.244	635.173
	1981	26.5876	690.370	663.783
	1982	-133.234	347.644	480.878
	1983	-40.2393	440.317	480.556
	1984	146.233	610.244	464.011
	1985	80.4817	463.088	382.606
	1986	-16.6717	343.616	360.488
	1987	-29.9699	312.125	342.095
	1988	-84.7310	212.143	296.874
	1989	10.2393	286.128	275.889
	1990	68.0921	311.379	243.287

APPENDIX VI
(Cont'd)

LS // Dependent Variable is WEXPTRES
Date: 11-11-1992 / Time: 11:55
SMPL range: 1971 - 1990
Number of observations: 20
Convergence achieved after 5 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	25036.405	2496.3393	10.029247	0.0000
WPRESS	0.1675209	0.0785792	2.1318731	0.0500
DVQUOTA	2569.6770	1626.9866	1.5794088	0.1351
DV75	-4212.7513	1634.9003	-2.5767633	0.0210
AR(1)	0.8261211	0.1334201	6.1918791	0.0000

R-squared	0.894146	Mean of dependent var	25856.90
Adjusted R-squared	0.865919	S.D. of dependent var	3215.596
S.E. of regression	1177.458	Sum of squared resid	20796111
Log likelihood	-166.9242	F-statistic	31.67628
Durbin-Watson stat	1.986329	Prob(F-statistic)	0.000000

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
*:	1971	-1379.94	20274.5	21654.5
*:	1972	172.322	20930.4	20758.0
* :	1973	-386.170	22016.8	22403.0
* :	1974	870.877	23478.0	22607.1
*:	1975	-1343.25	21182.8	22526.0
* :	1976	-1632.36	21487.2	23119.5
*	1977	2166.81	25056.8	22889.9
*:	1978	1025.59	27299.6	26274.0
* :	1979	-412.163	26273.8	26686.0
:*	1980	1299.36	26025.8	24726.4
* :	1981	462.527	26476.6	26014.1
*:	1982	181.299	30725.7	30544.4
* :	1983	-937.405	29689.2	30626.6
*:	1984	-70.6953	28532.0	28602.7
* :	1985	304.476	29134.7	28830.2
* :	1986	220.611	28546.6	28325.8
* :	1987	-1824.04	27018.8	28842.8
* :	1988	-223.759	26662.5	26886.2
* :	1989	970.994	27840.6	26869.6
* :	1990	537.157	28486.0	27948.8

APPENDIX VI
(Cont'd)

LS // Dependent Variable is REXPT
Date: 11-11-1992 / Time: 11:56
SMPL range: 1970 - 1990
Number of observations: 21

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0111992	0.0041698	-2.6857508	0.0151
RPRODS	3.3922172	0.3104155	10.927988	0.0000
DV75	0.0140920	0.0049997	2.8185686	0.0114

R-squared	0.877942	Mean of dependent var	0.033537
Adjusted R-squared	0.864380	S.D. of dependent var	0.013242
S.E. of regression	0.004877	Sum of squared resid	0.000428
Log likelihood	83.60983	F-statistic	64.73518
Durbin-Watson stat	1.232410	Prob(F-statistic)	0.000000

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
: * : :	1970	-0.00152	0.03783	0.03935
: : * :	1971	0.00504	0.04987	0.04483
: : * :	1972	0.00498	0.05451	0.04953
: : *: :	1973	0.00399	0.04855	0.04456
: : * : :	1974	7.5E-05	0.04494	0.04486
: : * : :	1975	0.00000	0.04862	0.04862
: : : *	1976	0.00779	0.05492	0.04713
: * : : :	1977	-0.00102	0.04151	0.04253
: : * : :	1978	0.00136	0.03736	0.03600
* : : : :	1979	-0.00765	0.02893	0.03658
: : *: : :	1980	0.00075	0.03458	0.03383
: * : : :	1981	-0.00305	0.02984	0.03288
* : : : :	1982	-0.00851	0.03027	0.03878
: * : : :	1983	-0.00211	0.03031	0.03243
* : : : :	1984	-0.00652	0.02664	0.03315
* : : : :	1985	-0.00590	0.01613	0.02203
: * : : :	1986	-0.00205	0.01997	0.02202
: : * : :	1987	0.00155	0.01925	0.01769
: : *: : :	1988	0.00441	0.02063	0.01622
: : * : :	1989	0.00173	0.01437	0.01264
: : : * :	1990	0.00666	0.01527	0.00861