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EFFECTS OF EXCHANGE RATE CHANGES ON SUGAR AND RICE TRADE
OF THE DOMINICAN REPUBLIC

by

Gertrudys Brito

A thesis submitted in partial fulfillment of
the requirements for the degree

of

MASTER OF SCIENCE

in

Agricultural Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1989

..... dedicated to the memory of my father

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GERTRUDYS BRITO

TABLE OF CONTENTS

iv

	Page
ACKNOWLEDGEMENTS.....	iii
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
ABSTRACT.....	viii

Chapter

I. INTRODUCTION.....	1
Problem Statement.....	4
Purpose of the Study.....	6
Objectives.....	7
Limitation.....	7
Scope of the Study.....	8
II. REVIEW OF LITERATURE.....	10
Economic Situation of the Dominican Republic.....	10
Government Intervention and Dominican Agricultural Trade.....	14
Monetary Policy.....	16
Fiscal Policy.....	18
Exchange Rate Policy.....	21
III. METHODOLOGY.....	25
Objective One.....	26
Objective Two.....	26
Objective Three.....	29
Specification of the Variables Included in the Model.....	29
Data Source.....	31
IV. ANALYSIS AND PRESENTATION OF RESULTS.....	34
Review of Fiscal Policy on Rice and Sugar.....	34
Monetary Policy Review.....	42

	v
Historical Review of Dominican Republic's Exchange Rate Policies.....	46
Empirical Results.....	51
Sugar export demand results.....	51
Rice import demand results.....	61
Simulated Trade Effects.....	68
V. SUMMARY AND CONCLUSIONS.....	69
REFERENCES.....	74
APPENDICES.....	78
Appendix I. Covariance Analysis, Regression Printout of Original Rice Equation, Estimated Equation and Data Used.....	79
Appendix II. Calculation of the Sugar Export Demand and Elasticities Using the Partial Adjusted Model.....	83

LIST OF TABLES

vi

Table	Page
1.1 Dominican Republic: Trade Balance, 1970-1987 (millions of US dollars).....	3
4.1 Dominican Republic: Annual Value of Input Subsidies for Private and IAD Rice Farmers, 1980-1985 (pesos/cwt of polished rice produced).....	35
4.2 Dominican Republic: Effects of Subsidies and/or Taxes to Rice Production 1980-1987 (metric tons).....	37
4.3 Dominican Republic: Total Exports, Value of Sugar Exports, and Share of Total Exports, 1970-1987.....	39
4.4 Dominican Republic: Sugar Prices, 1970-1987 (US cents per pound).....	40
4.5 Dominican Republic: Money Supply, 1970-1987 (millions of pesos).....	44
4.6 Dominican Republic: Evolution of the Exchange Rate, 1970-1987.....	48
4.7 Dominican Republic: Nominal and Real Exchange Rates (pesos per dollar), 1970-1987.....	50
4.8 Sugar: Estimated Coefficients of Export Demand for Dominican Republic Sugar, 1970-1987.....	52
4.9 Dominican Republic: Temporal Own-Price and Exchange Rate Elasticities of Sugar Exports Demand, 1970-1987.....	55
4.10 Average Elasticities of Demand for Sugar.....	61
4.11 Rice: Estimated Coefficients of Rice Import Demand, 1970-1987.....	62
4.12 Simulated Impacts of a 10 Percent Depreciation on the Value of the Dominican Peso in the Short Run.....	68

LIST OF FIGURES

vii

Figures	Page
1.1 Dominican Republic: Total exports vs sugar exports, 1970-1987.....	2
4.1 Dominican Republic: Money supply growth, 1970-1987.....	45
4.2 Estimated short-run own-rice elasticities of sugar export demand, 1970-1987.....	57
4.3 Estimated short-run exchange rate elasticities of sugar export demand, 1970-1987.....	58
4.4 Dominican Republic: Real exchange rate, 1970-1987.....	59
4.5 Dominican Republic: Sugar exports vs real exchange rate, 1970-1987.....	60
4.6 Dominican Republic: Per-capita gross domestic product, 1970-1987.....	65
4.7 Dominican Republic: Per-capita real rice imports (metric tons) vs real per-capita gross domestic product (millions of pesos), 1970-1987.....	66
4.8 Dominican Republic: Rice imports vs domestic rice production in metric tons, 1970-1987.....	67

Effects of Exchange Rate Changes on Sugar and Rice
Trade of the Dominican Republic

by

Gertrudys Brito, Master of Science
Utah State University, 1989

Major Professor: Dr. Herbert H. Fullerton
Department: Agricultural Economics

The present research measures the role of exchange rate changes in explaining variations of sugar and rice trade. As background for this research, monetary, fiscal, and exchange rate policies of the Dominican Republic since 1970 are reviewed.

The theoretical framework describing the relationship between exchange rate changes and sugar and rice trade has been tested empirically using the Dominican Republic's annual data for the period of 1970-1987. Regression analyses on the import of rice and export of sugar are estimated.

The regression results conform with the expectation that exchange rate variance is most influential for rice import demand and less so for sugar export demand. That is to be expected because the trade environment for sugar is more restricted by noneconomic conditions than the trade environment for rice. The estimated exchange rate elasticity

for rice import demand is 1.92, while for sugar export demand it averages 0.098 in the short run and 0.242 in the long run.

Export volume is relatively insensitive to changes in the U.S price for Caribbean sugar but is responsive to changes in the real exchange rate.

Empirical results of this research also indicate that the import demand for rice is highly sensitive to the gross domestic product but less responsive to changes in domestic rice production and exchange rates.

The monetary and fiscal policies review shows that the Dominican government has consistently followed an expansionary fiscal and monetary policy. Over time monetary expansion and increasing government expenditures have resulted in an increasing exchange rate with predicable change in Dominican exports and imports including sugar (exports) and rice (imports), therefore having some effect on sugar and rice trade as well. Dramatic depreciation of the Dominican peso in the past three years relative to the first 15 years of the data period suggests that further research and reestimation of the link of monetary and fiscal policies to exchange rates and commodity trade should be done as the data are available to support them.

CHAPTER I

INTRODUCTION

In the Caribbean Islands the productive sector is overwhelmingly based on agriculture. In the Dominican Republic as well as in Barbados, for example, sugar is one of the most important commodities for foreign exchange earnings. The sugar industry in the Dominican Republic contributed US \$300 million in foreign exchange earnings annually during the period of 1982-87 (figure 1.1). This constitutes more than 30 percent of the total agricultural exports of the Dominican Republic. This pattern of dependence on agricultural exports for foreign exchange holds for most of the insular Caribbean Islands.

The Dominican Republic, like other Caribbean and Latin American countries, produces a few agricultural staples---sugar, coffee, bananas, meat, spices, and rice. However, it does not produce enough to meet its own food needs. This situation leads to food imports to fill the gap of the domestic demand (Bailey).

The Dominican Republic's total imports reached US \$1.6 billion in 1987, while exports produced just US \$723.4 million. Except in 1972, 1973, and 1975, when the world price of sugar rose dramatically, the Dominican Republic has had a negative trade balance (table 1.1).

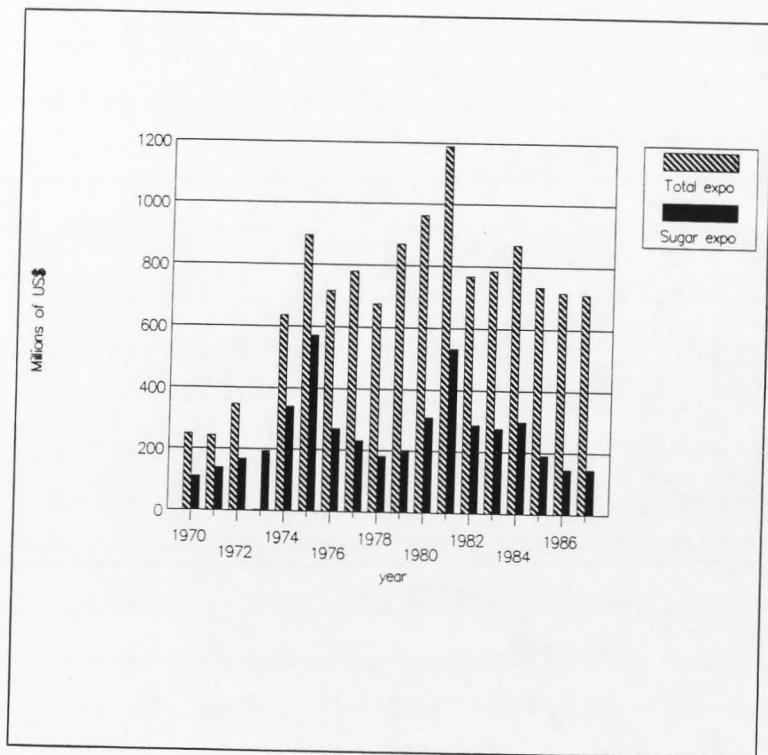


Figure 1.1 Dominican Republic: Total exports vs sugar exports, 1970-1987

Table 1.1 Dominican Republic: Trade Balance, 1970-1987
(millions of US dollars)

Year	Exports (f.o.b)	Imports (f.o.b)	Trade Balance ^a
1970	214.0	278.0	-64.0
1971	240.7	309.7	-69.0
1972	347.6	337.7	9.9
1973	442.1	421.9	20.2
1974	636.8	673.0	-36.2
1975	893.3	772.7	121.1
1976	716.4	763.6	-47.2
1977	780.5	849.3	-68.8
1978	675.5	862.4	-186.9
1979	868.6	1137.5	-268.9
1980	961.9	1519.7	-557.8
1981	1188.0	1451.7	-263.7
1982	767.7	1257.3	-489.6
1983	785.2	1279.0	-493.8
1984	868.1	1257.1	-389.0
1985	738.5	1285.9	-547.4
1986	722.1	1266.2	-544.1
1987	723.4	1600.0	-876.6

Source: International Monetary Fund (1988).

^a The trade balance is the difference between exports and imports.

Reductions in international sugar demand, the country's major export, accompanied by low prices for coffee, sugar, ferronickel, cocoa beans, tobacco, and bauxite, reduced exports sharply. This situation, coupled with the rising cost of imports and the shortage of foreign exchange, created a deficit in the trade balance.

Problem Statement

The Dominican economy is commodity dominated, with price-driven expansion and contraction problems inherent to economies that rely heavily on commodity exports. Currently one of the principal problems is the loss in value of the Dominican currency (peso) against the U.S. dollar.

In 1987, the Dominican economy boomed with an 8 percent growth rate in GDP. Despite the fact that this growth, caused principally by a continued public investment program, was impressive, Central Bank of the Dominican Republic statistics indicate inflation was 25 percent. Private sector sources estimate that this inflation was actually around 35 percent. The peso (currency unit of the Dominican Republic) depreciated by 38.2 percent during that year. Those levels of inflation are further explained by some Dominican economists as the consequence of the 1.5 billion peso (US \$1= 4.97 pesos) monetary expansion that has taken place since 1986.

The increase in money supply contributed to fiscal and monetary imbalance, as the central government failed to deposit counterpart pesos with the Central Bank for dollar purchases to pay foreign debt. The sharp increase in public capital spending and monetary growth can undermine projected real growth in gross domestic product (GDP).

In response to high inflation and the decreasing value of the peso, the government imposed strict exchange controls in June 1987 but removed them four months later. The exchange rate policy failed because the Central Bank was unable to deliver dollars for essential imports. As a result the continued decline in the value of the peso created political pressures for a return to some degree of exchange control.

Since 1970, the Dominican Republic balance of payments has suffered larger and larger annual deficits. Between 1978 and 1983 the total deficit reached US \$850 million. There was a small surplus during 1973-77. The deficit has been financed by ever-increasing external debt, a large part of which is short-term, high-cost, commercial bank loans.

Sugar and rice are the major crops in the Dominican Republic. Even though the Dominican Republic produces rice, it is not enough to satisfy domestic demand. This has led to increasing imports as the population has grown.

In addition, sugar exports remain severely depressed, as the United States has cut the Dominican quota, and world prices remain low. The U.S. government's decision to slash its

sugar import quotas for 1988 by about 25 percent has affected most of the countries in the Caribbean and Latin America. This is the fourth consecutive annual reduction. Thus, the 1988 quota is about 75 percent below the 1984 level. As a consequence, the Dominican Republic, the leading sugar exporter to the United States, has seen its exports and primary source of economic expansion drastically reduced.

In 1985, the U.S. Congress set a price support for domestically produced sugar at 18 cents per pound. The law was designed to spare the government the expense of having to buy and store surplus sugar when domestic prices fall too far. The U.S price now averages 21.76 cents a pound, compared with the world price of 7.75 cents.

Purpose of the Study

Changing exchange rates have important implications for trade policy decisions in agriculture. Exchange rate movements can easily swamp or obscure the desired prices, trade, and production effects of any specific agricultural commodity policy. Because of the pervasive impact of exchange rate adjustments on total trade flows and values, it is important to analyze the impacts of exchange rate changes on the agricultural trade of the Dominican Republic. Special emphasis is placed on two predominant commodities, sugar and rice. It is the purpose of this study to review the monetary, fiscal,

and exchange rate policies taken by the Dominican government to reduce pressure placed on the Dominican economy by trade imbalance and exchange rate controls.

Objectives

1. Describe the monetary, fiscal, and exchange rate policies taken by the Dominican government since 1970.
2. Determine the quantitative effects of changes in the exchange rate on rice and sugar trade of the Dominican Republic for the period 1970 to 1987.
3. Identify those policies that favor expansion of exports of sugar and imports of rice.

Limitations

The study country of this research paper is the Dominican Republic. The currency unit of the Dominican Republic, the peso, is measured against the main international medium of exchange, the US dollar and/or Special Drawing Rights (SDR).

The determination of the exchange rate nor the dynamics of exchange rate adjustment are beyond the scope of this research. However, it uses the exchange rate data supplied by accurate sources as the main explanatory variable of concern.

There are alternative methods for estimating the elasticities of demand and supply for import and export. The

selected model, as well as the explanatory variables, is constrained by the scarcity and reliability of data. The lack of data affects the theoretical analysis as well. Many potentially useful analyses can not be subjected to test, because time series data of sufficient duration exist for only a few categories of information. Therefore, the scope of empirical work and results reported here are conditioned by the availability and accuracy of time series data.

Scope of the Study

To address some important issues of the exchange rate a time series analysis of rice and sugar was conducted for the Dominican Republic. This study covers the years from 1970 to 1987 (18 observations). The commodities examined are those that account for a significant share of agricultural export and import. The primary goal of this research is to answer the following questions: Do the changes in exchange rates explain variations in Dominican Rice imports and sugar exports over time, and to what extent do exchange rate changes affect trade in these commodities?

The Dominican Republic is classified by the World Bank as a middle-income country in terms of its level of economic development. The structure of exports consists of a few primary commodities, which account for a significant portion of the gross domestic product (GDP) and government revenue.

The study presents a range of policy action taken by the Dominican government in relation to exchange rate fluctuations. The evaluation of those policies is based on historical performance relative to the expected or target response of the policy action.

The methodology used in estimating sugar export and rice import responses to changes in the exchange rate follows the approach taken by Conway (1985), Chambers and Just (1982), Conway and Hallahan et al. (1985), Boylan and Cuddy (1987), and Christiansen (1987).

CHAPTER II

REVIEW OF LITERATURE

Because there is no one place where all the publications and data on Dominican trade are available, it can be tedious, time consuming, and often a very expensive task to build a literature review that includes all research on the topic. For this reason this review of literature is limited to the integration of previous work related specifically to the stated objectives. In other words, this review of literature considers the subset of the literature pertinent to measurements of effects of exchange rate changes on rice and sugar trade. Also, as background to the empirical work, studies that describe the patterns of Dominican monetary, fiscal, and exchange rates policies are reviewed.

Economic Situation of the Dominican Republic

The Dominican governments of the past and present have expended a great deal of effort in attempting to relieve pressure on the peso at its official parity valuation. As Bell (1981) pointed out, since the bulk of the Dominican exports go to the United States, Dominican exports do not maintain comparative advantage against U.S production despite the fact that the Dominican peso has automatically followed

the downward course of the dollar.

In fact, the United States, as the primary trading partner of the Dominican Republic, supplies about 80 percent of the Dominican's imports and purchases about two-thirds of its exports (Brown). This means that the Dominican Republic's economy is very tightly linked to the U.S economy through trade and, therefore, that economic decisions on trade are severely limited by what happens in the U.S market.

Other important problems encountered by the Dominican economy are: 1) a declining economic growth rate, 2) a high current account deficit (US \$163.4 million in 1987), 3) an unsustained public sector deficit (5.2 percent of GDP), and 4) a poor performance of exports due to the decline in the U.S market share and world market sugar prices. According to Lowenthal (1988), the past growth in the public sector, which relied on Central Bank credit, and the policy choices of increased public employment have contributed to the Dominican economy deterioration. In order to improve fiscal deficit the Dominican government took some measures such as decreased government employment. It increased gasoline prices and imposed a tax of 36 percent on traditional exports and 5 percent on nontraditional exports. Furthermore, the International Monetary Fund and the government agreed that the Central Bank would provide no further credit to the public sector. In accomplishing these measures, which appear to impose onerous adjustment conditions on the country, the

economy was driven to recession. Lowenthal (1988, p.B510) reported that:

The government successfully complied with the International Monetary Fund performance targets over 1985 and early 1986, receiving the final IMF disbursement in April 1986. The harsh stabilization program of devaluation, tight monetary policy, and control of public sector expenditures induced a sharp recession. The Central Bank estimates that real GDP declined in 1985 by 1.2 percent; private sector estimates of negative growth rates range as high as 5 percent.

The GDP is estimated at US \$6.5 billion. Annual imports average about US \$1.3 billion, and exports average about US \$0.8 billion. Petroleum and industrial products dominate imports; but sugar, coffee, and few other agricultural products dominate exports.

Another critical issue of the Dominican economy has been the policy objective of self-sufficiency for the basic staples, including rice. Roe and Senauer (1985) called the self-sufficiency policy a policy of autarky, meaning that there is an absence of imports or exports and equality of domestic supply and demand in the food-grain market in a given year. The Dominican government has not been successful in accomplishing the goal of self-sufficiency or import substitution; even though in 1979 the country became self-sufficient for the first time in rice and beans. That self-sufficiency was only temporary. In the view of Carruthers, et al. (1985, p.8):

The crop most affected has been rice, which is grown on about 55 percent of all irrigated land in the

country. The Dominican Republic has consistently encouraged rice production through programs of credit, agrarian reform, improved technical assistance and evermore access to irrigation water. Although production has responded quite well, the overall goal of self-sufficiency still has not been achieved.

The policy objective of self-sufficiency had its major support during the 1930s depression; when World War II and other problems introduced a reorientation of the Dominican's foreign trade policy. However, as Nuñez-Santana and Almeida (1981, p.2) mentioned:

The process of import substitution from which the developed countries took advantage of the Latin America region, makes one feel the need to encourage export growth.

This argument makes one realize that in order to generate the foreign currency required for keeping the import substitution policy and for an expansion of the domestic economy, it is necessary to expand exports.

In addition to a self-sufficiency policy, there has been a desire to raise the nutritional level of the poor, to increase the level and distribution of income in rural areas, to reduce agricultural imports, and to stabilize prices for the basic commodities. The Instituto Nacional de Estabilizacion de Precios (INESPRE), which has been a monopsony purchaser of domestic production and a monopoly supplier of rice consumed, is a government agency that intervenes in the markets for corn, peanuts, rice and beans

(imported crops). Its policy objectives are to reduce intra-year price variation, encourage production, and reduce imports by setting domestic price to encourage domestic self-sufficiency. Erickson (1984, p.377) pointed out that:

INESPRE sets producer prices that are often above import equivalent, although at this time not high enough to guarantee domestic self-sufficiency.

Government Intervention and Dominican Agricultural Trade

Government agricultural policies, internationally, have distorted world production patterns and imposed tremendous costs on consumers and other sectors of the economy. Therefore, changes in the world market lead to uncertainty in the policy direction of a country. The Dominican Republic, for example, has used a range of policies for protecting the economy from the fluctuations of the world agricultural market. However, these policies are subject to modification or cancelation as governments change. The lack of continuance or the reversal of these policies may impose costs on the economy.

The interventionist policies in agricultural product and factor markets that the Dominican government has followed in one way or another under INESPRE include export subsidies and taxes, import tariffs and non-tariff barriers, price supports, input subsidies, and credit subsidies.

Monetary, fiscal, and exchange rate policies influence

agricultural production, consumption, and trade through their impact on relative prices of imports and exports. Even though higher import prices have a positive effect on the demand for domestic output, the net effect depends on the relative size of the imports and exports (Krissoff and Ballenger). As the World Bank (1986) has stated, agricultural policies (export subsidy, taxes, etc.) must be considered in conjunction with macroeconomic policies (monetary, fiscal, and exchange rate policies) in assessing their impacts on the agricultural sector.

In reviewing the literature concerning the agricultural intervention policies of the Dominican Republic, one can note that most of the emphasis of the Dominican government's policies has been on subsidies and taxes on production through input prices. Those policies affect producers as well as consumers. For instance, as the Consejo Nacional de Agricultura (Agricultural National Council) pointed out, the price of rice has been fixed by a government agency (INESPRE) since 1972. If the fixed price is above the world market price, the domestic producers are protected by the government from world competition. On the other hand, if the domestic price is below the world market price, there is a tax on domestic production.

In the case of exports, a lot of concern has been placed on lowering dependence on foreign exchange from traditional export crops such as sugar and coffee. The "Law 69 of

Incentive to Non-Traditional Exports" was created to spur growth in non-traditional exports. This law allows the exporter to import production inputs, free of taxes and to retain a percent of foreign currency from total exports that can be exchanged by the exporter in the parallel market. Another benefit of this law is that the government gives the exporter a deposit certificate (certificado de abono tributario, CAT) in domestic currency that can be used to pay off taxes or other obligations. The CAT can not exceed 25 percent of the total value of exports.

Twenty years ago the primary policy goal of the Dominican government was to expand and diversify the agricultural sector. The primary objective was to reduce the economy's dependence on traditional exports such as sugar, coffee, cocoa, and tobacco (Brown). Today the goals are the same, but the urgency has intensified because the country has accumulated debt. Merchandise imports exceed exports by about US \$500 million a year. As a result, the primary short-term goal of the government is to address this chronic imbalance.

Monetary Policy

The Central Bank of the Dominican Republic is the regulator of the monetary system. It is the center of the banking and credit structure. It controls the financing of all imports and exports, the collection of import and export

taxes and duties, the enforcement of currency conversion policies, and the management of public debt.

The body responsible for policy within the Central Bank is the Junta Monetaria (Monetary Board). It is the responsibility of the Monetary Board, whose chairman is the Governor of the Central Bank, to make decisions concerned with money supply, interest rates, and the ratio of bank reserves to deposits.

The American Embassy Santo Domingo (1988) reported that the monetary supply expanded by 24.3 percent in 1987 and increased by 45.6 percent in 1986. The principal reasons for the increase in the supply of money were 1) the dollar bought by the Central Bank from the exporters to pay the foreign debt (which was calculated at US \$3.7 billion) without receiving the counterpart of pesos from the government for debt services payment and 2) excessive credit and subsidies granted to government enterprises such as the State Sugar Company (CEA), the Dominican Electricity Company (CDE), and the Agricultural Bank.

As reported by the Latin American Newsletters (1988) there has been in the Dominican Republic a monetary expansion of RD \$1.5 billion since 1986. The monetary expansion, as Central Bank officials and some economists argue, influenced the rate of inflation, which has been accelerating in recent years (9.6% in 1986 and 15.9% in 1987).

The monetary policy conducted by the Monetary Board is

aimed at changing the quantity of money or credit available to the banking system. It is said to be an expansionary policy. On the other hand, if the board reduces the funds to the banking system by selling securities it is a restrictive policy.

Caves and Jones (1985, p.439) analyzed the effectiveness of monetary and fiscal policy on internal and external balance. They concluded that:

By setting both the exchange rate and government expenditure simultaneously at the right levels, internal and external balance can be obtained.

The "right" level of exchange and government expenditure is interpreted as the direction for changing the policy instruments in such a way that for each policy one policy instrument can be used to pursue one target. However, the size and not just the signs of the respective internal and external imbalances should be known. In addition, Caves and Jones present a graphical analysis of a combination of policies and their effects on external and internal balance.

Fiscal Policy

The literature dealing with issues of fiscal policy of the Dominican Republic is limited; however, some broad studies can be used to understand the influence of fiscal policies on the economy.

Fiscal policy, together with monetary and exchange rate

policies, can have severe unintended effects on the agricultural sector. Fiscal policy is aimed at adjusting government spending through the use of government expenditure and tax programs. It can be expansionary (when government expenditures rise relative to tax revenues) or restrictive (when government expenditures fall relative to tax revenues).

A recent study by Levy (1987) includes fiscal policy as one of the possible responses to foreign exchange crisis. His analysis considers a fiscal policy that tries to accommodate the crisis through reduction in government expenditures. He found that cuts in government spending are deflationary; increasing the real wage and the value of the currency.

The Dominican government uses fiscal policy to provide production subsidies, credit, and tax holidays. The incentives are offered to regulate the aggregate level of economic activity. The overall incentive structure strongly favors production for the domestic market as a way to attain self-sufficiency. The government of the Dominican Republic relies heavily on direct control of imports, through use-import licenses. Low rates of taxation, highly subsidized production inputs, and easy access to credit markets are offered to those industries that produce import-substituting goods. Those policies stimulate new industries that provide more jobs. However, taxes are often not paid (Engardio, pp.26 D-J).

Schuh (1968) discusses a set of policies that many

developing countries have followed to accelerate industrialization, which affects agricultural growth. Schuh (p.1286) argues that

countries embarking on forced-draft, import-substituting industrialization tend to abandon almost completely any efforts to increase exports and, instead, direct their efforts both to production for domestic market and to the reduction in imports.

This argument was true for the Dominican Republic in the 1960s; however, that policy has been broadened and refined considerably. Today's policy emphasis places more urgency on substitution of imports and diversification from traditional crops. In addition, a considerable effort has been made to increase exports of non-traditional crops (fruits, vegetables, etc.). The latest policy changes have tightened government control of production, marketing, and consumption (Brown).

The Central Bank forecasts a trade deficit of US \$951 millions in 1988 and a current account deficit of US \$236 millions. Latin American Newsletters (1988, p.8) indicates that:

The Dominican government is now trying to prevent an even worse trade deficit by restricting imports, particularly those of cars and non-essential consumer items.

The country had a foreign debt of US \$4.0 billion and an inflation rate of 40 percent in 1988. Economic analysts in Dominican Republic explain the current economic crisis as a result of problems in the balance of payments, low production levels, and the interest burden imposed by the

external debt (Latin American Newsletters). A 20 percent foreign exchange surtax has been imposed on imports since May 1988. Often the government deficit is financed by international loans and emitting money, which stimulate devaluation and accelerate inflation. The money issue is like a tax that is collected ahead of time. This penalizes the poor who receive a fixed income because the rich evade it by substituting the national currency with dollars.

Exchange Rate Policy

One traditional view of exchange rates among national currencies is simply that they are the price of one nation's money in terms of an other's currency. Another view holds that the exchange rate represents the terms by which domestic prices, costs, and other values for goods and services are transferred from the domestic economy into the broader international scene.

Exchange rates in the Dominican Republic are subject to a good deal of government regulation. Exchange currencies have been rationed through the Central Bank in recent years to limit trade when financial difficulties arise. Currency exchange policies have suffered strong modifications since 1947. At that time all operations in foreign currencies were made under absolute control of commercial banks. Nowadays the Central Bank administers a quota system of annual exchange

allocations that covers 120 categories of imported goods.

The Dominican Republic exchange rate consists of two markets: an official rate pegged to a dominant foreign currency and a free parallel-exchange rate¹. In 1988 the official rate was 4.97 and the parallel rate was 6.23 pesos per U.S. dollar.

The literature dealing with exchange rate is extensive. Chambers and Just (1979, 1982) developed a useful conceptual framework relating to the effect of exchange rate changes on agricultural exports. They pointed out why exchange rate movements should be differentiated from market price movements, stating (1979, p.253):

When exchange rates are inflexible, consumers perceive a devaluation or revaluation as being more permanent than short-term price changes.

Batten and Belongia (1986) provided empirical evidence of the role real exchange rates play in affecting agricultural exports. The important contribution of their approach lies in placing the real exchange rate and its determinants at the center of attention on the debate over agricultural exports.

Empirical verification of the reduction in trade as a result of currency fluctuations includes the work of Konandreas, Bushnell, and Green (1978), who tested the export demand of U.S. wheat for five world regions. Their results

¹ The parallel market rate is a second unofficial exchange rate between the Dominican Republic peso and U.S. dollar that is allowed by the Dominican government.

indicate that the exchange rate has a substantial impact on U.S. wheat exports. Bredahl and Gallagher (1977) have presented an algebraic and a graphic analysis of the effects of devaluation on agricultural trade. Vellianitis-Fidias (1976) provided an extensive empirical work on the effects of exchange rate changes on the level of U.S. agricultural exports. He tested the hypothesis that exchange rate changes have a significant effect on the demand for U.S. agricultural exports.

Conway (1985) and Conway and Hallahan et al. (1985) used a stochastic coefficient approach to empirically estimate the response of export demand to changes in prices and exchange rate. They used the same empirical model as Chambers and Just (1982), with the exception that they excluded some dummy variables used to account for seasonal patterns. The structure of the estimated stochastic coefficient model in vector notation is written as:

$$Y_t = X_t' \beta_t$$

$$\beta_t = \beta + \epsilon_t$$

$$\epsilon_t = \phi \epsilon_{t-1} + \mu_t$$

$$\mu_t \sim WS(0, \Delta\mu),$$

Where:

β = fixed vector of mean values

X_t' = vector of fixed variables

$$(X_t = X_{1t}, X_{2t}, \dots, X_{kt})$$

ϵ_t = stationary stochastic vector

μ_t = residual vector

The variance-covariance matrix of $\underline{\beta}_t$ is:

$E(\underline{\beta}_t - \underline{\beta})(\underline{\beta}_t - \underline{\beta})' = \Gamma$ and the unconditional variance of the dependent variable is:

$$\text{Var}(Y_t) = \underline{X}'_t \Gamma \underline{X}_t$$

where:

$$\text{Vec}(\Gamma) = [I - \Phi \otimes \Phi]^{-1} \text{Vec}(\Delta \mu),$$

and $\text{Vec}(\Gamma)$ is the column stack of the matrix Γ .

As mentioned by Conway (1985), this model has the advantage that difficulties, such as serial correlation and/or heteroskedasticity arising from time series data, are self-corrected.

A few recent studies have estimated the demand and supply equations for agricultural commodities in the Dominican Republic. These studies include Consejo Nacional de Agricultura (1986), Greene and Roe (1989), Roe and Senauer (1985), and Rousslang and Linsey (1984).

CHAPTER III

METHODOLOGY

Currency exchange rate movement is a crucial parameter that has important implications for trade policy decisions concerned with imports and exports of agricultural commodities in the Dominican Republic. This study provides a quantitative analysis of the effects of exchange rate changes on the trade of selected commodities (sugar and rice) of the Dominican Republic. At the same time, a description of the monetary, fiscal, and exchange rate policies taken by the Dominican government since currency fluctuations is included.

The focus of this study will be on two principal commodities of the agricultural sector of the Dominican Republic, sugar and rice. Sugar as an exported commodity, and rice as an imported commodity. The analysis covers the period 1970-1987. The study country, the Dominican Republic, has no significant influence on world market prices in either demand or supply. Therefore, its own export earnings are influenced by fluctuations in world commodity prices and by changes in its domestic output of export commodities. In addition, a short-term increase in the export of some commodities is not always possible. The combination of the above factors usually influences the level of imports and export earnings.

Objective One

The first objective is accomplished by a historical review of monetary, fiscal, and exchange rate policies taken by the Dominican government since 1970.

Objective Two

The effects of exchange rate changes on agricultural trade depend on the magnitude of exchange rate changes and the elasticities of export and import demand of agricultural commodities. Therefore, to accomplish the second objective export and import demand equations for sugar and rice respectively are estimated. From the coefficients of these equations, the corresponding elasticity coefficients are derived.

Some divergences exist in the approaches followed by economists for estimating the elasticity coefficients. Elasticities may be derived either from a constant parameter model or from a stochastic parameter model.

To estimate the export demand equation for sugar in the Dominican Republic, this research adopted the explanatory variables of the stochastic coefficient model used successfully in previous studies of U.S. export elasticities for wheat, corn, and soybeans by Chambers and Just (1982) and Conway (1985). This model is particularly helpful for this study because it incorporates the exchange rate as an

independent explanatory variable. At the same time it permits estimation of exchange rate elasticity coefficients through time as policies change. Moreover, one can estimate the long-run elasticity because of the included lag variable for exports.

A simple specification for the export demand for sugar is

$$SX_t = \beta_{0t} + \beta_{1t}SX_{t-1} + \beta_{2t}DWSP_t + \beta_{3t}RSDR_t + \mu_t$$

where:

SX = sugar exports (metric tons per person)

SX_{t-1} = lagged sugar exports

$DWSP$ = U.S. sugar price for Caribbean sugar (dollars per metric ton) divided by the U.S. consumer price

index.

$RSDR$ = real exchange rate (pesos per dollar)

μ_t = disturbance term

t = time (1970-1987).

To estimate the demand for exports of sugar and importation of rice an ordinary least square (OLS) method with a Cochrane-Orcutt iterative procedure was used.

The basic import demand model for rice used in this study is similar to that used in previous work by Boylan and Cuddy (1987) and Christiansen (1987). The model is specified as follows:

$$\log PRMt_t = \beta_0 + \beta_1 \log PGDP_t + \beta_2 \log PDRP_t + \beta_3 \log RWP + \beta_4 \log RSDR_t + \mu_t$$

where:

PRM_t = per-capita real imports of rice measured in metric tons

$PGDP_t$ = per-capita real gross domestic product (millions of pesos)

$PDRP_t$ = per-capita domestic rice production in metric tons

RWP_t = real import price of rice (dollars per mt, f.o.b., New Orleans)

$RSDR_t$ = real exchange rate (pesos per dollar)

μ_t = random disturbance term.

It is assumed that the level of commodity imports will be positively related to real income and negatively related to price, as noted by Christiansen (1987).

The effects of a change in the exchange rate on the Dominican Republic's export of sugar and import of rice can be estimated by differentiating the export and import demand equations with respect to the exchange rate. This yields:

$$\Delta SX / \Delta SDR * SDR / SX = \eta_s \quad (\text{sugar})$$

$$\Delta M / \Delta SDR * SDR / M = \eta_r \quad (\text{rice})$$

In the case of sugar, average short-run and long-run elasticity are estimated by using the mean value of the coefficients. That is, to determine the elasticities of exchange rate one multiplies the estimated coefficient for exchange rate (β_3) by the mean value of the real exchange rate. In the same way, the own-price elasticity is estimated.

The elasticity coefficient for rice is a fixed value. Elasticity is estimated directly from the rice regression equation because it is presented in log-log form.

The inclusion of a lagged variable in the sugar export demand equation enables finding the long-run elasticity by using the widely used partial adjustment model developed by Marc Nerlove (Appendix 2).

Objective Three

The third objective is accomplished by classifying those policies that favor imports and those that favor exports.

Specification of the Variables Included in the Model

The lagged endogenous variable (SX_{t-1}) is a predetermined variable that measures the effect of past changes in sugar exports on the current exports. The export demand model used in this study assumes that the entire effect of the explanatory lag variable occurs in one time period ($t-1$). More generally, one would account for the fact that economic changes take place gradually over time. Lags involved in the adjustment process become apparent in future years. Therefore, the added explanatory variable could be justified within a Nerlovian framework in which a country's current sugar imports from the Dominican Republic adjust to desired imports only by

a certain proportion within a year.

Lagged sugar exports is a relevant variable in this study since it reflects the continuation of existing patterns in sugar trade. Regardless of the direction of changes in current factors some trade is expected to flow between the Dominican Republic and the U.S because of past established trade connections and trade agreements. The inertia of unilateral trade agreements with exporters and political objectives could prevent a country from reaching the desired level of sugar imports within a year.

The U.S sugar price for Caribbean exports of sugar was included in the model to capture the influence of prices on demand for sugar. This variable was deflated by the U.S consumer price index because the U.S is assumed to be the dominant importer of Dominican sugar. The sign of the coefficient of this variable is expected to be negative because U.S demand for Dominican Republic sugar is expected to be inversely related to sugar prices.

The exchange rate variable (pesos per SDR) is a weighted index of currencies in relation to the Dominican peso. This variable may have more influence on rice imports than on sugar exports because sugar is a restricted trade commodity limited by U.S. import quotas. The exchange rate variable is a relevant variable in this study because it affects the volume of import demand as well as the export demand. If the real domestic exchange rate depreciates it takes more domestic

currency to buy a dollar's worth of goods than in the previous year. This variable was adjusted by a factor reflecting the differential of the rates of inflation between the Dominican Republic and the United States. This adjustment yields a real exchange rate.

The real gross domestic product influences the capacity of the Dominican Republic to import, since it affects the purchasing power of the country. The quantity of rice imports is expected to be directly related to per-capita real GDP.

The imports of rice are influenced by domestic production as well as by population growth. Measures of rice import and domestic production are expressed in per capita terms because population growth is related import growth. The quantity of rice imports may be inversely related to per capita production if imports and domestic production are substitutes.

Data Source

The relevant data required for estimating the import and export demand equations for rice and sugar for the Dominican Republic were gathered from a variety of secondary sources* covering the periods from 1970 to 1987.

* Sugar export: The trend of quantities and value of exported sugar from the Dominican Republic were collected from the Banco Central de la República Dominicana, the Food and Agriculture Organization of the United Nations (1980-85), and

the Centro Dominicano de Promoción de Exportaciones (1978-1987).

* Population: Data were gathered from Urban and Rose (1988) and the International Monetary Fund (1988).

* World market price of sugar and rice: Current and deflated prices for sugar and rice were compiled from the Food and Agriculture Organization of the United Nations (1980-85) and the Instituto Nacional de Estabilización de Precios, *Plan Operativo del INESPRE*.

* Exchange rates: The change in the Dominican peso vis-a-vis U.S dollars. Data were collected from the Banco Central de la República Dominicana and the International Monetary Fund (1988).

* Rice imports: The trend of import rice was gathered from the Oficina Nacional de Estadística (1978-1987) and the Food and Agriculture Organization of the United Nations (1980-1985).

* Gross domestic product: The International Monetary Fund (1988) provided adequate data for this variable.

* Domestic rice production: This was gathered from Cuevas (1985) and the Secretaría de Estado de Agricultura (1986).

* Consumer price index: This variable was compiled on

the basis of data supplied by the International Monetary Fund (1988) and the Banco Central de la República Dominicana.

The author used those data which by common sense and previous knowledge is believed to be the most accurate.

CHAPTER IV

ANALYSIS AND PRESENTATION OF RESULTS

**Review of Fiscal Policy
on Rice and Sugar**

The major policy objective followed by the Dominican government on rice has been self-sufficiency. To accomplish this overall goal a general package of policies has been implemented that includes: 1) subsidy on rice production; 2) export subsidies, 3) tax on agricultural exports, 4) price support, and 5) incentives for production of non-traditional exports.

This study puts special emphasis on the subsidy policy, since rice production in the Dominican Republic depends strongly on the subsidies offered by the government. The subsidy for rice production is oriented through the inputs of water, land, credit, machinery, and seeds. As shown in table 4.1 the estimated total annual input subsidy averages about RD \$8.03 and RD \$2.40 cwt for polished rice produced by IAD and private farms, respectively, for the period 1980 to 1985. Subsidized irrigation water for farmers under the Agrarian Reform Program² was increased by 55 percent while for private

² The Dominican Agrarian Institute through his Agrarian Reform Program allocate state owned land to farmers for its agricultural production, specially for rice production.

Table 4.1 Dominican Republic: Annual Value of Input Subsidies for Private^a and IAD^b Rice Farmers, 1980-1985 (pesos/cwt of polished rice produced)

Year	Water		Land		Credit		Machinery		Seeds		Total	
	IAD Private	Private	IAD Private	Private	IAD Private	Private	IAD Private	Private	IAD Private	Private	IAD Private	Private
1980	1.1	1.1	3.22	0	0.53	0.50	ND	ND	0.05	0.04	4.90	1.64
1981	1.3	1.0	3.53	0	0.59	0.48	ND	ND	-	-	5.42	1.48
1982	1.1	1.1	4.44	0	0.60	0.57	ND	ND	-	-	6.14	1.67
1983	1.0	1.0	5.17	0	1.03	0.92	0.56	0	-	-	7.76	1.92
1984	1.5	1.2	5.93	0	1.30	1.08	0.42	0	0.17	0.14	9.32	2.42
1985	1.7	1.3	7.42	0	3.65	3.05	1.91	0.8	0.09	0.07	14.77	5.26
Average subsidy-----											8.03	2.40

Source: Consejo Nacional de Agricultura (1986, p.40).

^a AID Stands for the Dominican Republic Agrarian Institute, which is a decentralized organization of the Secretariat of State for Agricultural (SEA). IAD is responsible for State-owned land settlements to the farmers.

^b This refers to private sector rice producers enterprise

farmers it was increased only by 18 percent during the period 1980-1985. Through the years the irrigation water subsidies to both private and IAD (Dominican Agrarian Institute) farmers have not varied significantly. Land is the most heavily subsidized of all rice inputs. All subsidy to land resources go to public sector enterprises that are managed by the Dominican Agrarian Institute (table 4.1).

The annual credit subsidy fluctuated from RD \$0.53 to RD \$3.69 per 100 pounds from 1980 to 1985 for farmers under agrarian reform. The fluctuation in credit subsidy was smaller for private farmers, ranging from RD \$0.50 in 1980 to RD \$3.05 in 1985. Essentially, through the years the level of subsidy to inputs has continuously increased. The total annual increment on input subsidies averaged approximately 32 percent between 1980 and 1985, implying higher costs to the government (table 4.1).

The government policy towards rice production through input subsidy and price policy provided conflicting producer incentives. An incentive is given to rice farmers to increase rice production through input subsidy, while at the same time the pricing policy discourages growth as the price is fixed below world market price.

Table 4.2 shows the net effect of these two policies. It can be seen that instead of providing positive incentives for rice production the government has taxed farmers for some of

Table 4.2 Dominican Republic: Effects of Subsidies and/or Taxes on Rice Production, 1980-1987 (metric tons)

Year	Import price of rice (c.f.i) RD\$/mt)	Domestic price paid to farmers (c.f.i) (RD\$/mt)	Price difference (1-2)	Subsidy to inputs (RD\$/mt)	Actual subsidy and/or tax (pesos) (4-3)	Production (000 mt)	Net effect on production (1000 mt) (5*6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1980	662	508	154	144.19	-100.1	259.6	-2547
1981	770	535	235	152.12	-176.5	258.9	-13081
1982	596	564	32	172.18	40.16	261.5	36657
1983	638	557	81	213.41	6.34	322.8	42743
1984	1169	773	396	258.82	-291.06	324.4	-28187
1985	1330	1050	280	437.83	-100.04	320.5	50585
1986	1330	1298	32	180.34	147.96	209.6	31092
1987	1311	1300	11	NA	-	317.5	-
Net total annual average effect of input subsidies to rice production--- RD\$/mt 16,751							

Source: Columns 1, 2, and 6 are from the Instituto Nacional de Estabilización de Precios, *Boletines Estadísticos*, 1984 and 1985, and col. 4 calculated based on data from table 4.1. Total input subsidies multiply by 22.046 mt/ctw.

the seven years studied. Only in 1982, 1983, 1985, and 1986, were the subsidies higher than taxes. However, in 1980, 1981, and 1984 the taxes exceeded subsidies. The estimated total annual subsidy to inputs averaged RD \$16,751 over the given seven years.

To some extent the Dominican government subsidizes sugar production. It provides a low level of assistance through a pricing scheme that maintains domestic prices above current world prices. Dominican consumers are taxed by a higher price for sugar sold domestically than for exported sugar.

Although sugar is the most important agricultural export commodity of the Dominican Republic in terms of foreign reserve earnings, its value has been decreasing steadily since 1981. Sugar exports represented a 45 percent share of total exports in 1970. It peaked in 1975 (65%) and reached 20.38 percent in 1986 (table 4.3).

The 65-percent export share of sugar in 1975 came in response to unusually high world market prices in 1974-1975. In November 1975 at Caribbean ports raw sugar cane f.o.b was priced at 45.16 cents per pound when destined for the U.S market and 44.96 cents on the world market. Average yearly prices for Caribbean sugar are shown in table 4.4.

Table 4.3 Dominican Republic: Total Exports, Value of Sugar Exports, and Share of Sugar of Total Exports, 1970-1987

Year	Total Exports (Millions of US\$)	Sugar Exports	Percent Share
1970	214.1	110.8	44.48
1971	240.7	139.1	57.24
1972	347.6	167.9	48.30
1973	442.1	193.9	44.77
1974	636.8	340.2	53.42
1975	893.8	572.2	64.58
1976	716.0	269.3	37.59
1977	780.0	231.6	29.68
1978	675.5	181.0	26.79
1979	868.6	200.9	23.13
1980	961.9	309.9	32.22
1981	1188.0	533.9	44.94
1982	767.7	286.9	37.37
1983	785.2	276.4	35.20
1984	868.1	300.0	34.55
1985	738.5	190.1	25.86
1986	722.1	146.2	20.38
1987	723.4	145.2	20.41

Source: International Monetary Fund (1988, 1985).

Table 4.4 Dominican Republic: Sugar Prices, 1970-1987
(US cents per pound)

Year	World Market price	US Sugar Price for the Caribbean
1970	3.75	8.09
1971	4.52	8.52
1972	7.43	9.11
1973	9.61	10.25
1974	29.99	29.96
1975	20.49	20.50
1976	11.58	11.57
1977	8.11	8.09
1978	7.82	7.84
1979	9.66	9.65
1980	29.02	28.67
1981	16.93	16.89
1982	8.42	8.41
1983	8.49	8.47
1984	5.18	5.20
1985	4.04	4.05
1986	6.05	6.05
1987	6.76	6.76

Source: International Monetary Fund (1988).

There are many reasons behind the declining trend of sugar's share of the Dominican Republic's total exports. One important reason has been the downward trend of the world market sugar price. Sugar prices have continued to sink in the 1980s. From a high of 30 cents per pound in 1974, it had dropped to 4 cents per pound by 1985. Other reasons include:

1) The protectionist policy followed by the United States' government to guarantee its producers a sugar price above the world market price. This U.S policy stimulates the production and development of technology of sugar and/or other substitutes for sugar in the U.S. Similar policy has been followed by the European Community; not only does it support the sugar price, but it subsidizes export of sugar.

2) Continuous reduction of the sugar quota allocated to the Dominican Republic. The U.S quota on the Dominican Republic and other Caribbean countries was begun in May 1981 because the level of protection in the U.S was not sufficient to guarantee the target domestic price.

3) Internally, the government has not established a policy to compensate for this drastic reduction in the share of sugar. Instead, to cope with the loss of foreign reserves due to low world market sugar prices, decreasing quotas, and the protectionist policies of developed countries the Dominican government has establish policy objectives. These policies are designed to provide incentive for the export of non-traditional goods by diverting part of the land used for

sugar cane and relaxing export duties on non-traditional commodities. In addition, 85 percent of the value of such exports may be exchanged at the parallel market rate. It is a difficult task to replace losses in the sugar industry. Traditionally the Dominican sugar industry has provided a very large source of employment, income, and foreign exchange. Recent changes in policy towards the sugar industry have the purpose of reducing dependency upon sugar as a main source of foreign exchange earnings. Moreover, sugar cane's relatively greater ability to withstand flood, drought, hurricanes, pests, and disease than most substitute crops makes diversification away from sugar extremely difficult and most improbable.

Monetary Policy Review

Money supply in the Dominican Republic increased throughout the period studied. Money growth affects the nominal exchange rate and produces changes in relative prices, thereby encouraging imports. The monetary approach to adjustment in the balance of payments holds that fiscal expansion financed by borrowing from the Central Bank affects foreign reserves of the country; thereby negatively affecting the balance of payments. In 1984 the growth of the money supply of the Dominican Republic was 48 percent over the previous year (table 4.5). The excessive money growth

registered during the last four years of the was a result of financing the fiscal deficit. A large part of the fiscal deficit was caused by credit and subsidies granted to the Sugar State Company.

The increased money supply, resulting from financing the public sector deficit by borrowing from the Central Bank in the Dominican Republic, created an excess liquidity in the hands of the public during the period of 1984-1987. This in turn influenced the level of inflation, which increased from 9.6 percent to 15 percent in 1986 and 1987, respectively. The data in figure 4.1 show clearly that the Dominican Republic's monetary policy has been expansionary, even though in some periods the growth of the money supply decreased.

Table 4.5 Dominican Republic: Money Supply, 1970-1987
(millions of pesos)

Year	Money ^a	percent change over previous year
1970	171.7	15.0
1971	188.1	10.0
1972	222.5	18.0
1973	260.1	17.0
1974	364.2	40.0
1975	379.7	4.0
1976	390.4	3.0
1977	460.0	18.0
1978	458.0	-0.4
1979	598.4	31.0
1980	579.6	3.0
1981	660.5	14.0
1982	731.5	11.0
1983	781.4	7.0
1984	1159.5	48.0
1985	1355.2	18.0
1986	1988.7	47.0
1987	2609.4	31.0

Source: International Monetary Fund (1988).

^a The money include currency outside banks and demand deposits.

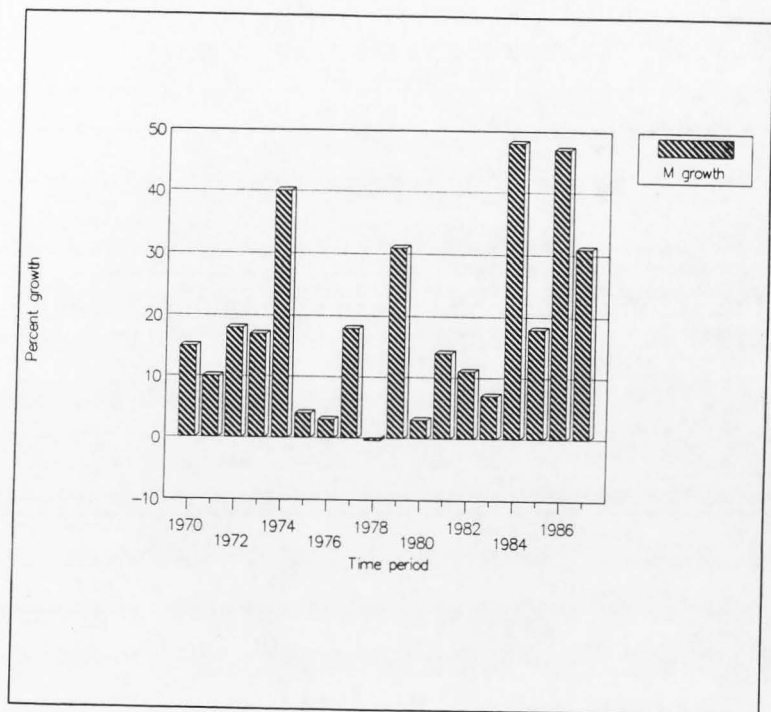


Figure 4.1 Dominican Republic: Money supply growth, 1970-1987

Historical Review of the Dominican Republic's Exchange Rate Policies

The Dominican Republic has a dual exchange rate system, the official market and the parallel market (created in 1967). This dual exchange rate system has quantitative exchange and trade controls in the official market. The exchange rate is freely determined; however, current transactions are conducted in the official market at a managed or fixed rate. In the parallel market illegal foreign exchange transactions develop at a much higher price. The domestic cost of imports is reflected in the foreign exchange rate prevailing in the parallel market.

Historically, the exchange rate policy has experienced some changes. From 1967 to 1982 the official exchange rate for specific international transactions was made at a exchange rate of RD \$1.00= US \$1.00. Through the years more and more merchandise was eliminated from this preferential exchange rate. This was due mainly to the reduction in foreign reserves to sustain a parity rate. In 1985 the fixed official rate and the market determined parallel exchange rate was unified. This unified rate was calculated by the Central Bank with specific operations defined by the official and free market rate.

In June 1987, a strict control of the currency exchange was imposed as a consequence of a high inflation rate and the low value of the currency. Then, in November 1987, the exchange system again suffered strong modifications in the

supply as well in the demand for foreign currency. This brought the unified system to a free market system. This system was characterized by the existence of a segmented exchange rate market: official and free. A decree was created in November 20, 1987, that requires that mineral and sugar export companies make a special contribution when the exchange rate exceeds 4 pesos per dollar. This contribution is used to help compensate for the increase in the petroleum price determined by the increment. Similarly, another decree was created on April 29, 1988, that prohibits the importation of luxury items. The Central Bank then decided to grant foreign exchange at the official rate only for imports of petroleum products. Additionally, non-traditional goods are free of the obligation of changing the foreign currency derived from their operations in the Central Bank. At the same time, exporters of traditional goods were given a preferential rate of 1.48 pesos per dollar for their sales.

The rate of exchange in the parallel market experienced market changes. Rising from an average annual level of 1.2 pesos per dollar in the 1970s to 2.4 pesos per dollar in the 1980s, and increase of about 100% (table 4.6). The intensification of inflationary pressures, the limitations imposed on the supply of foreign exchange at the official rate and the uncertainty caused by difficult negotiations with the

Table 4.6 Dominican Republic: Evolution of the Exchange Rate, 1970-1987

Year	Exch. ^a rate	Exch. rate index	<u>price index</u>		Ratio (3/4)	Parity (RD\$/US\$) (1.26*5)	Exch. Index of over or under valuation ^c
			CPI (1980=100)	CPI ^b			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1970	1.15	91.27	37.10	47.1	78.8	0.99	86.00
1971	1.14	90.48	41.80	49.1	85.1	1.07	94.00
1972	1.12	88.89	48.10	50.8	94.7	1.19	106.00
1973	1.13	89.68	48.10	58.9	81.8	1.03	91.00
1974	1.14	90.48	54.40	59.8	91.0	1.15	101.00
1975	1.18	93.65	62.30	65.3	95.4	1.20	102.00
1976	1.20	95.24	67.10	69.1	97.1	1.22	102.00
1977	1.22	96.83	75.80	73.6	103.0	1.30	107.00
1978	1.25	99.21	78.50	79.2	99.1	1.25	100.00
1979	1.23	97.62	85.70	88.1	97.3	1.23	100.00
1980	1.26	100.00	100.00	100.0	100.0	1.26	100.00
1981	1.28	101.59	107.50	110.4	97.4	1.23	96.10
1982	1.46	115.87	115.80	117.1	98.9	1.25	85.60
1983	1.60	126.98	121.30	120.9	100.3	1.26	78.80
1984	2.83	224.60	154.00	126.1	122.1	1.54	54.40
1985	3.11	246.83	211.80	130.5	162.3	2.05	65.90
1986	2.90	230.16	232.50	133.1	174.7	2.20	75.86
1987	4.96	393.65	269.40	137.9	195.4	2.46	49.60

Source: Banco Central de la República Dominicana and the International Monetary Fund (1988).

^a exch. stands for the exchange rate (pesos per dollar)

^b United States consumer price index

^c The index of under or over valuation of exchange rate is equal to the parity exchange rate divided by the exchange rate (pesos per dollars).

International Monetary Fund (IMF) were responsible for the rise in the parallel market.

In spite of all the adjustment measures, the exchange rate on the parallel market rose on a yearly average from 2.90 pesos per dollar in 1986 to 4.96 pesos per dollar in 1987. In 1978 and 1979 the rate fell slightly to 1.25 and 1.23 pesos per dollar respectively.

By definition, real exchange rate changes are those changes in the nominal rate that cannot be attributed to inflation differentials. Instead, they reflect specific structural differences in real economic performance among countries. The Dominican Republic's real exchange rate increased drastically from 5.05 pesos per dollar in 1986 to 9.67 pesos per dollar in 1987 (table 4.7). This implies that the real purchasing power of imports has decreased. If purchasing power parity were met continuously, the real exchange rate would be a constant. Now it takes more domestic resources to purchase products denominated in dollars.

Table 4.7 Dominican Republic: Nominal and Real Exchange Rates (pesos per dollar) 1970-1987

Year	Nominal (RD\$/US\$)	Relative inflation rate ^a	Real
1970	1.15	0.79	0.91
1971	1.14	0.85	0.97
1972	1.12	0.95	1.06
1973	1.13	0.82	0.93
1974	1.14	0.91	1.04
1975	1.18	0.95	1.12
1976	1.20	0.97	1.16
1977	1.22	1.03	1.26
1978	1.25	0.99	1.24
1979	1.23	0.97	1.19
1980	1.26	1.00	1.26
1981	1.28	0.97	1.24
1982	1.46	0.99	1.45
1983	1.60	1.00	1.60
1984	2.83	1.22	3.45
1985	3.11	1.62	5.04
1986	2.90	1.74	5.05
1987	4.96	1.95	9.67

Source: Calculated in the basis of data gathered from the International Monetary Fund (1988).

^a Relative inflation rate is the ratio of the consumer price index of the Dominican Republic to the consumer price index of the United States.

Empirical Results

Export and import demand functions for sugar and rice, respectively, were estimated by the ordinary least square (OLS) method with an iterative procedure.

Sugar export demand results. The results of the analysis of the sugar export demand model for Dominican Republic for the period of 1970-1987 are summarized in table 4.8. With all the exogenous variables included, the model had an R^2 of 0.35 and was significant at a 5-percent level. This low R-square in the sugar export demand may be explained by exclusion of variables from the model such as levels of changes in Dominican sugar stock. Ideally the stock level would be included in the model, but these data were not available for the time period studied.

Estimated coefficients for the explanatory variables shown in table 4.8, except the price variable, have expected signs, and their statistical significance ranges from a high of 20 percent to a low of 5 percent.

The export price of sugar has an inverse relationship with the quantity of sugar imported by the United States from the Dominican Republic. However, the response of sugar exports to price changes is very small. This behavior may be explained by the existence of trade agreements and quotas that restrain exports more stringently than price. The price variable is not statistically insignificant.

Table 4.8 Sugar: Estimated Coefficients^a of Export Demand for Dominican Republic Sugar, 1970-1987

Independent Variable	Coefficient
Constant	411611.02 (2.10)
SX_{t-1}	0.5948 (2.696)
DWSP	-3.0739 (-0.014)
RSDR	357226.36 (-1.748)
R-Square	0.349
F-Statistic	1.61
Durbin-Watson Stat.	1.56
Number of observations	17

Note: the "t" statistic is in parenthesis beneath each coefficient. The critical value of the t statistic at 5% and 20% levels of significance and a degree of freedom equal to 13 are $t_{0.025,13} = 2.16$ and $t_{0.10,13} = 1.35$, respectively.

^a The coefficients shown in the table are numerical coefficients rather than elasticities.

SX= sugar exports (metric tons) which represents the dependent variable

SX_{t-1} = lagged sugar exports by one period

DWSP= U.S sugar price for Caribbean sugar (dollars per metric tons) divided by the U.S CPI.

RSDR= real exchange rate (pesos per dollar).

The exchange rate coefficient in absolute value is higher than the price coefficient. This suggests a highly elastic response in exports to changes in the exchange rate. It is noted that the export demand for sugar has a more elastic response to changes in exchange rates than to changes in price. The exchange rate is statistically significant at a 20 percent significance level (two-tail test).

The lagged dependent variable is statistically significant at a 5 percent level of significance. Because of existing trade agreements and political affiliation, this variable was expected to be significant for the U.S demand for Dominican sugar. The lagged coefficient is used to derive the coefficient of adjustment (K' menta). The adjustment process is represented by:

$$SX_{it} - SX_{it-1} = \delta_{it}(SX_{it} - SX_{it-1}), \text{ such that } 0 < \delta \leq 1$$

Where δ_{it} is the adjustment coefficient that describes the speed of adjustment of actual to desired sugar export level, $SX_{it} - SX_{it-1}$ = actual export change, and $SX_{it} - SX_{it-1}$ = desired change. The estimated adjustment coefficient ($\delta_{it}=1-0.5948$) is equal to 0.4052, which means that 41% of the discrepancy between the desired and the actual sugar exports is eliminated in a year.

Table 4.9 provides own-price and exchange rate elasticities computed from the estimated data of table 4.8 and Appendix 2 over the period 1970-1987. These elasticities

were computed using the same estimated mean coefficient of each variable over time.

The export demand own-price elasticity is inelastic, which suggests small substitution possibilities for importers. This seems plausible given the rigidity of bilateral trade agreements between the United States and the Dominican Republic.

The export demand exchange rate elasticity also shows an inelastic response but less so than own-price elasticity. This implies that neither exchange rates nor price have a substantial impact on the Dominican Republic's sugar exports. However, the exchange rate impact on sugar exports has been greater than the impact of price changes.

Table 4.9 Dominican Republic: Temporal Own-Price and Exchange Rate Elasticities of Sugar Export Demand, 1970-1997

Year	Variables	
	Own-Price	Exchange Rate
1970	-0.000911	-0.042564
1971	-0.007270	-0.338014
1972	-0.000644	-0.034472
1973	-0.000989	-0.032029
1974	-0.002690	-0.036580
1975	-0.001793	-0.042096
1976	-0.000967	-0.042733
1977	-0.000589	-0.040971
1978	-0.000772	-0.048968
1979	-0.000890	-0.042841
1980	-0.003090	-0.056131
1981	-0.001614	-0.052272
1982	-0.000763	-0.062167
1983	-0.000653	-0.062287
1984	-0.000341	-0.148780
1985	-0.000833	-0.274806
1986	-0.001966	-0.401632
1987	-0.002809	-0.588183

Source: Table 4.8 and Appendix 2.

Figure 4.2 shows the patterns followed by the own-price export elasticities over the time period. The elasticities show a trend towards an increasing response. Even though own price is inelastic over the time profile there are periods of high response, i.e., 1971-1973 and 1980-1982. This high elasticity in these two periods may be explained by the high world market sugar price and the shortfall of world supply of sugar.

Figure 4.3 illustrates the time profile for exchange rate elasticities of sugar exports. The coefficients show a relatively stable trend over the period 1972-1983. During that period the foreign exchange rate was very stable (figure 4.4).

From 1984 to 1987 the exchange rate elasticity of sugar exports had a more elastic response. Sugar exports during that period declined sharply, and domestic currency depreciated at a higher rate (figure 4.5).

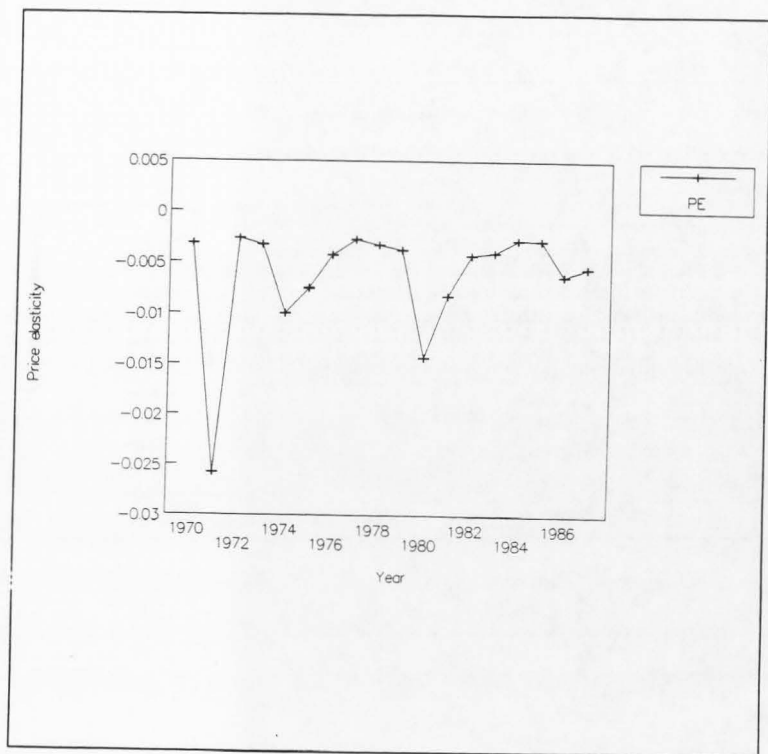


Figure 4.2 Estimated short-run own-price elasticities of sugar export demand, 1970-1987

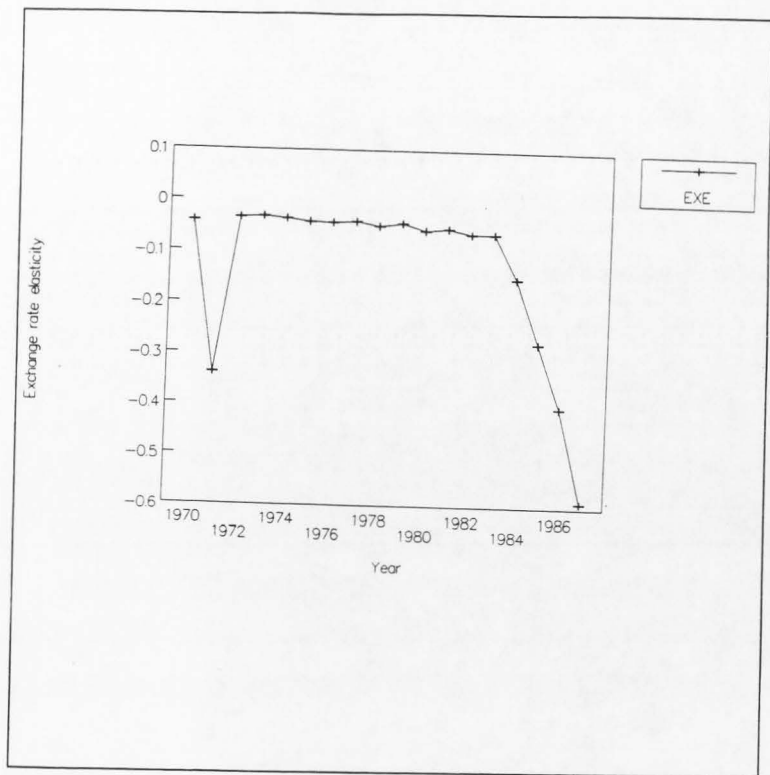


Figure 4.3 Estimated short-run exchange rate elasticities of sugar export demand, 1970-1987

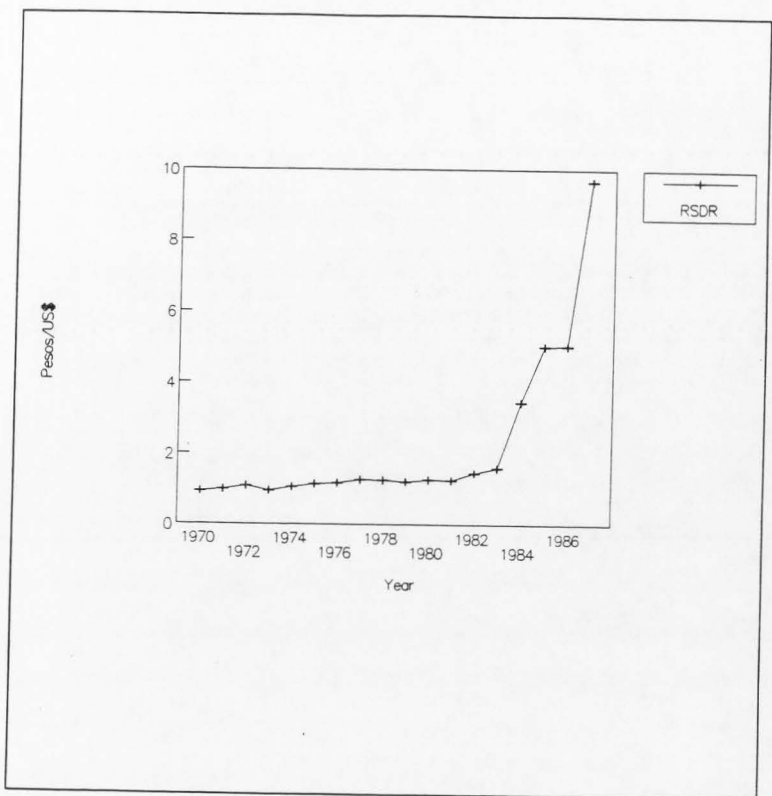


Figure 4.4 Dominican Republic: Real exchange rate, 1970-1987

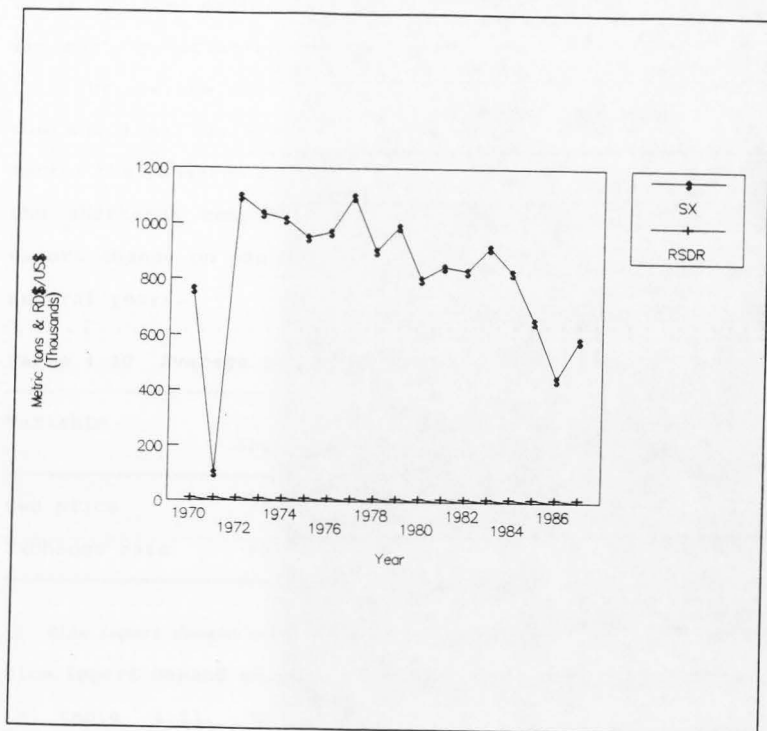


Figure 4.5 Dominican Republic: Sugar exports vs real exchange rate, 1970-1987

Table 4.10 shows the average short- and long-run elasticities of own-price and exchange rate elasticities. The average estimated elasticities are derived by using the mean value of the estimated coefficients and the mean of the explanatory variables (Appendix 2).

The average elasticity of sugar demand in both the short run and long run are inelastic. Because of the adjustment factor the long-run elasticity of export demand is higher than the short-run response. The full impact of current sugar export change on past changes on sugar exports extends over several years.

Table 4.10 Average Elasticities of Demand for Sugar

Variable	Elasticities	
	Short-run	Long-run
Own price	-0.00013	-0.0033
Exchange rate	-0.098	-0.242

Rice import demand results. The results of the regression for rice import demand and the calculated elasticity are reported in table 4.11. The statistical significance of the coefficients of estimated model ranges from a high of 10 percent to a low of 5 percent. Except for the exchange rate variable, which is significant at a 10 percent level, all the variables are significant at a 5 percent level.

Table 4.11 Rice: Estimated Coefficients of Rice Import Demand, 1970-1987

Independent Variables	Coefficients ^a	T-Statistic ^b
Constant	-57.1435 (23.945)	-2.3865
LPGDP	8.61905 (2.9721)	2.8910
LPDRP	-0.2709 (0.0847)	-3.1979
LRS DR	-1.9234 (1.0354)	-1.8577
R Square ^c	0.354	
F Statistic ^d	1.65	
Durbin-Watson Stat	2.02	
Number of observations	17	

^a All coefficients are expressed in log terms which represent the elasticities coefficients. The standard error is in parenthesis beneath each coefficient.

^b The critical value of the t statistic at 5% and 10% level of significance are $t_{0.025,13} = 2.16$ and $t_{0.05,13} = 1.77$.

^c The R square is the unconstrained ordinary least squares (OLS) summary statistic. It shows how much of the variation in the dependent variable (real per capita rice imports) is explained by the explanatory variables.

^d The critical value of the F statistic at a 5% level of significance is 3.41 and at a 10% level is equal to 5.74.

LPRM= log of per-capita real import of rice (metric tons), which represents the dependent variable.

LPGDP= log of per-capita real gross domestic product (millions of pesos)

LPDRP= log of per-capita domestic rice production (metric tons)

LRS DR= log of real exchange rate (pesos per dollar).

The low R square (0.354) is not surprising because of some variables that were excluded in the import model, for example, the ratio of the import price index to the domestic production price index and the ratio of foreign exchange reserve to total food imports as variables reflecting relative cost and strictness of controls affecting imports.

The preliminary specification of the import model was reduced to a model in which the price variable is excluded. Ideally, price should be included in any demand model, but in this specific case, by estimating the original model the price proves to be statistically not significant at a 5 percent and 10 percent level of significance and has the wrong sign (positive instead of negative) (Appendix 1). Further consideration for dropping the price variable in the import model is that price has a high degree of correlation with the exchange rate variable at -0.66 (Appendix 1). Thus the exchange rate variable does not reflect the true effect on determining rice import. Moreover, for the purpose of policy response this study is interested in the behavior of rice import demand to changes in exchange rate.

The regression coefficient on the gross domestic product variable is of the expected sign, as are the rest of the coefficients estimated. The rice import response to GDP is highly elastic. This reflects the purchasing power effect on imports. The rapid population growth has undermined the growth of GDP, which shows a decreasing trend (figure 4.6).

The import demand for rice with respect to domestic production is inelastic. That is, if domestic rice production increases by 1 percent, the real imports of rice decrease by 0.27 percent. Domestic production is the most significant variable in the model (t statistic = -3.1979). The real gross domestic product is the second most important economic determinant of rice imports.

The trends followed by the real gross domestic product and the real rice imports are shown in figure 4.7. One can observe that the highest importation of rice occurred during the period 1979-1981, as domestic production shows a stable pattern (figure 4.8). There was a notable decrease in domestic rice production during the period 1985-1986. This decline was mainly due to the financial constraint faced by the Marketing Board Agency (INESPRE), who delayed the payment for rice bought from the farmers by more than three months. This delay discouraged rice production during the following period.

The real exchange rate shows an import demand elasticity coefficient of 1.92 in absolute value. This supports the view that the role played by the currency exchange rate in determining rice imports is crucial. Rice imports are traded in a less restricted environment than that of sugar. Therefore, it is reasonable to have a larger response in import demand relative to changes in real exchange rate than that estimated for sugar export demand.

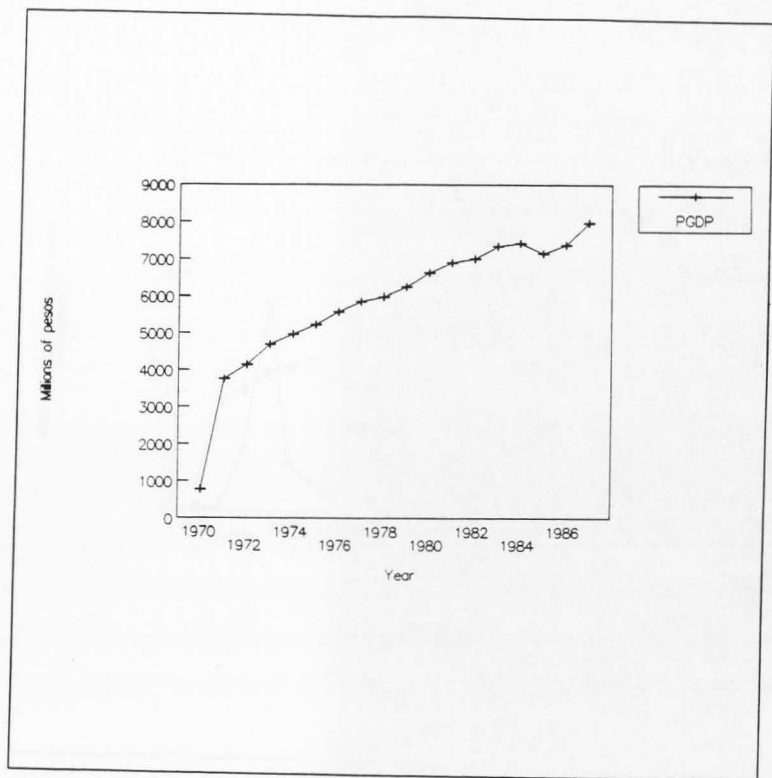


Figure 4.6 Dominican Republic: Per-capita gross domestic product, 1970-1987

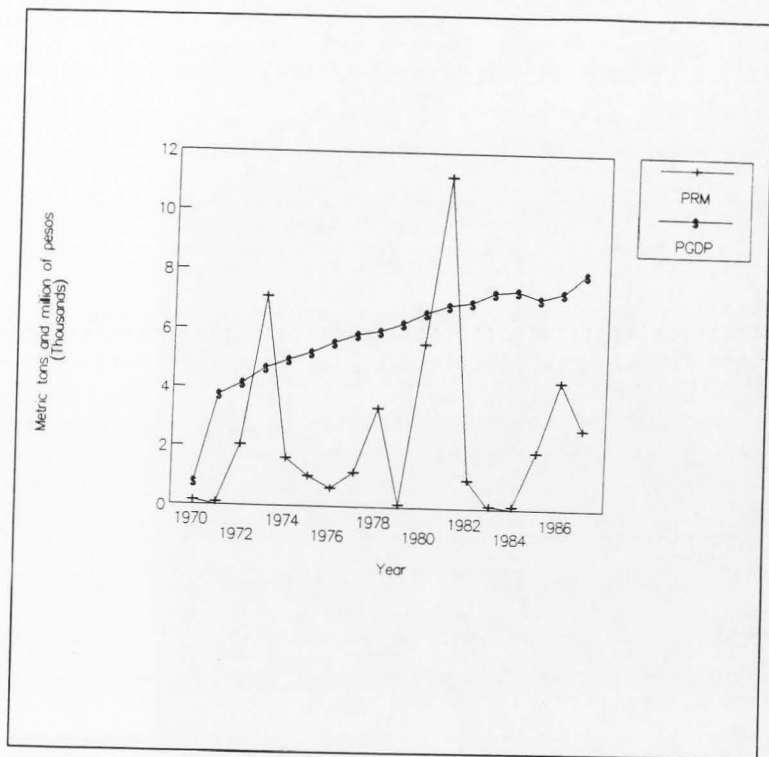


Figure 4.7 Dominican Republic: Per-capita real rice imports (metric tons) vs real per-capita gross domestic product (millions of pesos), 1970-1987

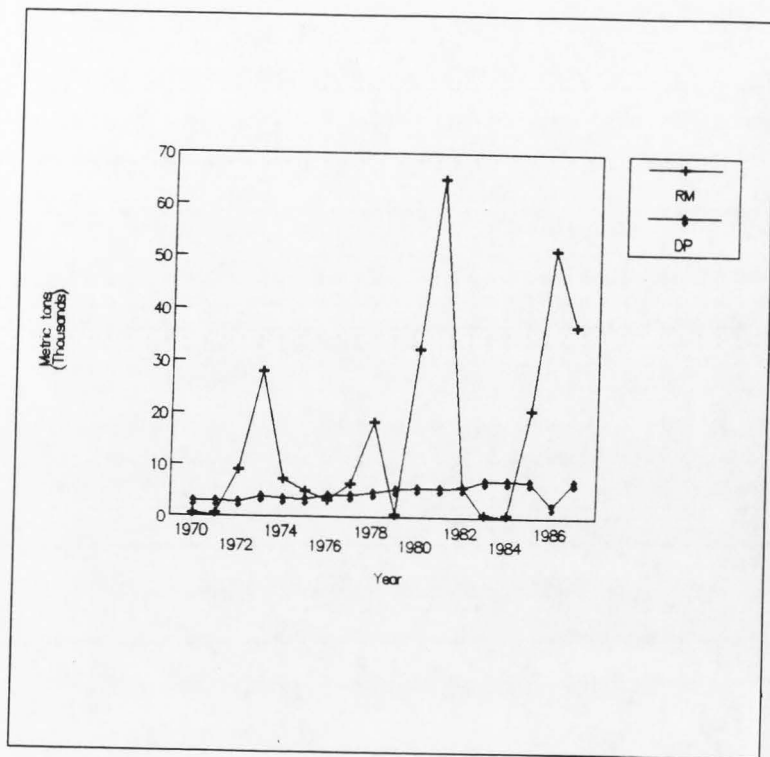


Figure 4.8 Dominican Republic: Rice imports vs domestic rice production in metric tons, 1970-1987

Simulated Trade Effects

Table 4.12 reports the estimated effects of a 10 percent change in the value of the dollar on sugar exports and rice imports. The minus sign indicates a negative relationship between a change in the value of the peso and a change in exports and imports of sugar and rice, respectively. For example a 10 percent depreciation (appreciation) of the currency value results in a 19.23 percent decline (rise) in the imports of rice. Likewise, from the U.S point of view, a 10 percent decline in the value of the Dominican peso could be expected to increase U.S imports of sugar by 0.98 percent.

Table 4.12 Simulated Impacts of a 10 Percent Depreciation on the Value of the Dominican Peso in the Short Run

Variable	Sugar Exports percent change	Rice imports
Real exchange rate	-0.98	-19.23

Source: tables 4.10 and 4.11

CHAPTER V

SUMMARY AND CONCLUSIONS

This study tested for the impact of exchange rate changes on sugar exports and rice imports. Moreover, post-1970 monetary, fiscal, and exchange rate policies of the Dominican Republic were reviewed.

It is extremely difficult to assess the net effects of all of the fiscal, monetary, and exchange rate policies on agricultural trade. Many policies that favor producers may decrease trade, and, on the other hand, consumer-biased policies may increase trade. A full assessment of policy responses would be difficult to measure. However, it is possible to draw some general conclusions from studying two traded commodities: sugar and rice.

The results of subsidy policy as a fiscal policy in rice production shows that the Dominican government has alternated between subsidizing rice consumption and rice production, although the intent of the policy was to obtain self-sufficiency by providing strong producer incentives. Importing rice at a world price and selling it at a lower domestic price may offset the value of subsidies. Also, the increased rice consumption resulting from this policy would increase Dominican imports, thereby increasing the per-unit subsidy to producers cost borne by the Dominican government. To be

effective in stimulating increases in rice production and assure efficient resource allocation, prices must reflect market prices.

An opposite picture is reflected in sugar. The government subsidized sugar by keeping the domestic price above world market price. Thus, consumers bear the costs of this policy because they must pay prices that exceed world market prices. Although this policy exists, the sugar export value has declined over the years due mainly to protectionist U.S trade policies and low world market price. Trade of sugar is carried out at an officially fixed exchange rate. Exporters earn less for their products in domestic currency than they would under market or parallel exchange rates. This policy could be expected to discourage sugar production and export growth.

This study suggests that Dominican monetary authorities should take appropriate measures to restrain the inflation by restricting monetary growth. They should restrain the banking system from expanding lending through changes in reserve requirements. A step in the right direction would be to reduce the Central Bank's expanding domestic credit available to finance public sector deficits. Restrictions would limit expansion of credit to the public as well.

The empirical results of this research indicate that the real exchange rate has a significant negative effect on rice imports. The real exchange rate is less significant in explaining the export performance of sugar.

Expanding monetary and fiscal policies borne of serious foreign exchange problems have undermined the Dominican Republic's capacity to import rice. Furthermore, as the exchange rate increases, the gap between domestic rice production and imports will be greater unless production incentives come to reflect market prices. This leads to an increase in domestic subsidy for rice consumption and higher domestic rice prices as the population grows. Without sufficient producer incentives it is likely that a shortage of rice will occur with government-mandated prices. Other findings of the study suggest that neither U.S price nor exchange rate play important roles in determining U.S demand for Dominican sugar. The average elasticity coefficient of sugar export demand with relation to exchange rate and own price in the short run are 0.0013 and 0.098, respectively. The inference to be drawn from these results is that bilateral agreements between the U.S and the Dominican Republic, which favor U.S sugar producers, have a stronger influence in determining the general performance of sugar exports than do domestic monetary and fiscal policies.

With the exception noted for price of rice and the very limited responsiveness of sugar exports price and exchange rate, the results of this study are in general agreement with those of early works on the sugar and rice trade. Dutton and Grennes (1988) emphasized that the long-run elasticity response of an increase in exports is considerably greater

than the short-run response. The results also support the view of Roe and Senauer (1985) that the exchange rate is an important variable in determining the free trade outcome.

Over the time period studied rice import response was elastic to changes in real gross domestic product and exchange rate. The import elasticity of demand for rice shows a coefficient of 8.62 with respect to GDP and 1.92 for the exchange rate.

The short-run exchange rate elasticity implied by the regression estimates on the sugar equation range from 0.032 to 0.588, while price elasticities range from 0.00034 to 0.00281. The elasticity of rice import demand with respect to exchange rate is 1.92. This estimate indicates that sugar export is not appreciably responsive to either price or exchange rate in the short run. Rice imports are more responsive to change in exchange rates.

In conclusion, the full impact of recent changes in price and exchange rate variables may not be fully reflected in the present study results. This study should be repeated in the next three to five years. The fact that the currency has become increasingly overvalued in recent years suggests that it is risky to make generalizations on policy action with respect to import and export performance based on the relationships observed between 1970 and 1987. The outcome of rapid depreciation of the currency value is likely to be more dramatic on trade performance in the future. Finally, a more

comprehensive study on monetary and fiscal policy, which allows quantitative linkage to the exchange rate, may reveal a better explanation of the behavior of Dominican trade.

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APPENDICES

Appendix 1. Covariance Analysis, Regression
Printout of Original Rice Equation, Estimated
Equation, and Data Used

Covariance analysis printout

SMPL 1971 - 1987
17 Observations

Series	Mean	S.D.	Maximum	Minimum
PRM	2578.1150	3021.8885	11194.150	0.0000000
PGDP	6135.5886	1250.9162	7985.0000	3761.0000
PDRP	38.513734	9.3266244	51.241350	15.557910
RWP	439.59801	224.05146	1021.2500	120.09280
RSDR	2.2782353	2.3321054	9.6700000	0.9300000

	Covariance	Correlation
PRM, PRM	8594645.0	1.0000000
PRM, PGDP	363934.03	0.1022928
PRM, PDRP	-1475.0178	-0.0556062
PRM, RWP	107913.24	0.1693470
PRM, RSDR	-81.684191	-0.0123152
PGDP, PGDP	1472744.7	1.0000000
PGDP, PDRP	5589.5292	0.5090395
PGDP, RWP	-172251.44	-0.6530040
PGDP, RSDR	1737.2359	0.6327197
PDRP, PDRP	81.869103	1.0000000
PDRP, RWP	-466.60552	-0.2372502
PDRP, RSDR	2.8288419	0.1381863
RWP, RWP	47246.169	1.0000000
RWP, RSDR	-324.50092	-0.6598556
RSDR, RSDR	5.1187911	1.0000000

Printout of the original rice import equation

SMPL 1971 - 1987

17 Observations

LS // Dependent Variable is LPRM

Convergence achieved after 5 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-72.009173	29.523042	-2.4390837	0.033
LPGDP	8.0531140	3.1917148	2.5231308	0.028
LPDRP	-0.2447889	0.0882039	-2.7752622	0.018
LRWP	2.9473113	2.7996670	1.0527364	0.315
LRSDR	0.4409896	2.4742826	0.1782293	0.862
AR(1)	-0.3415363	0.2119214	-1.6116180	0.135

R-squared	0.413329	Mean of dependent var	6.260603
Adjusted R-squared	0.146660	S.D. of dependent var	3.099085
S.E. of regression	2.862823	Sum of squared resid	90.15329
Durbin-Watson stat	1.937029	F-statistic	1.549971
Log likelihood	-38.30249		

Covariance Matrix

C,C	871.610038	C,LPGDP	-73.7755343
C,LPDRP	0.66166707	C,LRWP	-41.5515718
C,LRSDR	-17.1082833	C,AR(1)	-2.87928924
LPGDP,LPGDP	10.1870435	LPGDP,LPDRP	-0.15340099
LPGDP,LRWP	-1.21154033	LPGDP,LRSDR	-2.99075599
LPGDP,AR(1)	0.24229243	LPDRP,LPDRP	0.00777992
LPDRP,LRWP	0.05611646	LPDRP,LRSDR	0.07000848
LPDRP,AR(1)	0.00098144	LRWP,LRWP	7.83813524
LRWP,LRSDR	6.24979261	LRWP,AR(1)	0.11506397
LRSDR,LRSDR	6.12207432	LRSDR,AR(1)	0.08471985
AR(1),AR(1)	0.04491066		

Residual Plot

	obs	RESIDUAL	ACTUAL	FITTED
:	1971	-0.37933	0.00000	0.37933
:	1972	-0.09879	7.63046	7.72924
:	1973	3.10475	8.87188	5.76713
:	1974	-0.90642	7.38773	8.29415
*	1975	-2.49461	6.93530	9.42990
:	1976	-0.84418	6.44543	7.28961
:	1977	-0.17974	7.06098	7.24072
:	1978	1.05202	8.12358	7.07156
:	1979	-0.56260	4.52056	5.08316
:	1980	1.95514	8.62382	6.66869
:	1981	2.96219	9.32315	6.36096
:	1982	1.61279	6.87590	5.26311
*	1983	-2.23594	1.74297	3.97891
:	1984	-6.07995	-0.96587	5.11408
:	1985	2.13986	7.56850	5.42864
:	1986	-1.62749	8.37699	10.0045
:	1987	2.59926	7.90888	5.30962

Printout of the estimated import demand equation of rice

SMPL 1971 - 1987

17 Observations

LS // Dependent Variable is LPRM

Convergence achieved after 4 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-57.143469	23.944817	-2.3864650	0.034
LPGDP	8.6190477	2.9721140	2.8999721	0.013
LPDRP	-0.2709134	0.0847153	-3.1979271	0.008
LRSDR	-1.9234243	1.0354030	-1.8576576	0.088

AR(1)	-0.3847274	0.2015526	-1.9088194	0.080
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R-squared	0.354935	Mean of dependent var	6.260603
Adjusted R-squared	0.139914	S.D. of dependent var	3.099085
S.E. of regression	2.874117	Sum of squared resid	99.12659
Durbin-Watson stat	2.024247	F-statistic	1.650696
Log likelihood	-39.10902		

Covariance Matrix

C,C	573.354277	C,LPGDP	-70.6655162
C,LPDRP	0.85249469	C,LRSDR	14.2943434
C,AR(1)	-2.04387568	LPGDP,LPGDP	8.83346136
LPGDP,LPGDP	-0.13148706	LPGDP,LRSDR	-1.81545724
LPGDP,AR(1)	0.23173287	LPDRP,LPDRP	0.00717669
LPDRP,LRSDR	0.02382668	LPDRP,AR(1)	0.00071134
LRSDR,LRSDR	1.07205935	LRSDR,AR(1)	-0.00342815
AR(1),AR(1)	0.04062344		

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
:	1971	-0.54499	0.00000	0.54499
:	1972	-1.45637	7.63046	9.08682
:	1973	3.33732	8.87188	5.53456
:	1974	1.05557	7.38773	6.33216
:	1975	-1.40039	6.93530	8.33569
:	1976	-1.09213	6.44543	7.53756
:	1977	-0.69567	7.06098	7.75665
:	1978	1.00192	8.12358	7.12166
:	1979	-0.73558	4.52056	5.25614
:	1980	1.97305	8.62382	6.65078
:	1981	3.35824	9.32315	5.96490
:	1982	0.88278	6.87590	5.99312
:	1983	-3.07842	1.74297	4.82139
:	1984	-5.82889	-0.96587	4.86303
:	1985	2.64640	7.56850	4.92210
:	1986	-2.21371	8.37699	10.5907
:	1987	2.82264	7.90888	5.08624

Data used in estimating the rice import demand equation

obs	PRM	PGDP	PDRP	RWP	RSDR
1970	156.4175	776.2014	31.23593	503.9084	0.910000
1971	0.000000	3761.000	30.55392	443.5646	0.970000
1972	2059.989	4152.000	28.11912	430.8316	1.060000
1973	7128.672	4687.000	37.08511	707.2142	0.930000
1974	1616.031	4969.000	31.83460	1021.250	1.040000
1975	1027.925	5226.998	30.06087	672.3435	1.120000
1976	629.8140	5577.999	36.56757	459.9702	1.160000
1977	1165.591	5856.002	35.61117	439.1689	1.260000
1978	3373.078	5982.002	38.60917	508.3185	1.240000
1979	91.88705	6252.002	44.83379	445.0409	1.190000
1980	5562.607	6631.000	44.52720	496.0400	1.260000
1981	11194.15	6900.000	43.29273	526.0279	1.240000
1982	968.6442	7008.001	42.58419	316.6667	1.450000
1983	5.714285	7350.998	51.24135	312.0033	1.600000
1984	0.380653	7424.000	50.22147	246.5844	3.450000
1985	1936.239	7158.002	48.41292	180.5949	5.040000
1986	4345.894	7384.003	15.55791	147.4538	5.050000
1987	2721.338	7985.000	45.62039	120.0928	9.670000

PRM = Per-Capita Rice Imports (metric tons)

PGDP = Per-Capita Gross Domestic Product (million of Pesos)

PDRP = Per-Capita Rice Domestic Production (metric tons)

RWP = Real World Rice Price (US\$)

RSDR = Real Exchange Rate (pesos per US\$)

**Appendix 2. Calculation of the Sugar
Export Demand and Elasticities Using
the Partial Adjustment Model**

Partial adjustment model

$$(1) \quad SX_t^* = \beta_0 + \beta_1 SX_{t-1} + \beta_2 DWSP_t + \beta_3 RSDR_t + \mu_t$$

(long-run demand equation for sugar exports)

$$\text{Adjustment Process: } SX_t - SX_{t-1} = \delta (SX_t^* - SX_{t-1})$$

$$SX_t = \delta SX_t^* + (1-\delta) PSX_{t-1}$$

$$SX_t = \delta (\beta_0 + \beta_1 SX_{t-1} + \beta_2 DWSP_t + \beta_3 RSDR_t + \mu_t) + (1-\delta) SX_{t-1}$$

$$(2) \quad SX_t = \delta \beta_0 + \delta \beta_1 SX_{t-1} + \delta \beta_2 DWDP_t + \delta \beta_3 RSDR_t + (1-\delta) SX_{t-1} + \lambda \mu_t$$

(short-run demand equation for sugar exports)

where:

δ = Adjustment coefficient

SX_t^* = Expected sugar export

The equation 2 is estimated by an ordinary least square method with an iterative procedure. From the estimated coefficients of equation 2 the long-run demand function is estimated (equation 1).

Estimated short run demand equation for sugar export

$$SX_t = 411611.02 + 0.5948 SX_{t-1} - 3.0739 DWSP_t - 35726.36 RSDR_t$$

$$\delta = (1 - 0.5712) = 0.4052$$

Then dividing each coefficient of the short-run demand equation by 0.4052 (coefficient of adjustment) and dropping

the lagged variable the long-run demand function is obtained.

Estimated long run export demand equation for sugar

$$SX_t = 1015821.8 - 7.5861DWSP - 88169.69RSDR$$

The average elasticity coefficient for the exchange rate are estimated by multiplying β_3 by the ratio of the mean value of the real exchange rate to the quantity of sugar exported. In the same way the price elasticity is computed.

Computer printout of the estimated export demand function for sugar

SMPL 1971 - 1987

17 Observations

LS // Dependent Variable is SX

Convergence achieved after 6 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	411611.02	195845.00	2.1017184	0.057
SX(-1)	0.5948304	0.2206037	2.6963756	0.019
DWSP	-3.0738867	214.59797	-0.0143239	0.989
RSDR	-35726.357	20438.925	-1.7479568	0.106
AR(1)	-0.6340667	0.2431813	-2.6073821	0.023
R-squared	0.349347	Mean of dependent var	828882.9	
Adjusted R-squared	0.132463	S.D. of dependent var	257422.4	
S.E. of regression	239767.6	Sum of squared resid	6.90D+11	
Durbin-Watson stat	1.554817	F-statistic	1.610753	
Log likelihood	-231.7476			

Covariance Matrix

C,C	3.8355D+10	C,SX(-1)	-37939.4962
C,DWSP	-3446033.27	C,RSDR	-2026573158
C,AR(1)	11946.3638	SX(-1),SX(-1)	0.04866599
SX(-1),DWSP	-15.5502968	SX(-1),RSDR	1301.17115
SX(-1),AR(1)	-0.01834186	DWSP,DWSP	46052.2890
DWSP,RSDR	207937.406	DWSP,AR(1)	8.03721210
RSDR,RSDR	417749643.	RSDR,AR(1)	290.777374
AR(1),AR(1)	0.05913717		

Residual Plot		obs	RESIDUAL	ACTUAL	FITTED
*	:	1971	-580079.	102524.	682603.
:	:	1972	202951.	1098583	895632.
:	*	1973	427893.	1037344	609451.
:	:	1974	31107.6	1015744	984636.
:	*	1975	-6450.85	950532.	956983.
:	*	1976	20226.0	969798.	949572.
:	:	1977	178178.	1098697	920519.
:	*	1978	-16617.5	904693.	921311.
:	*	1979	12809.6	992370.	979560.
:	*	1980	-97895.0	801974.	899869.
:	*	1981	-92134.0	847501.	939635.
:	*	1982	-27136.2	833289.	860425.
:	*	1983	49180.0	917719.	868539.
:	*	1984	37728.1	828442.	790714.
:	*	1985	-72056.0	655229.	727285.
*	:	1986	-214318.	449212.	663530.
:	*	1987	147337.	587358.	440021.

Covariance analysis printout

SAMPL 1971 - 1987
17 Observations

Series	Mean	S.D.	Maximum	Minimum
SX	828882.88	257422.45	1098697.0	102524.00
DWSP	354.51755	222.96958	888.99330	92.012140
RSDR	2.2782353	2.3321054	9.6700000	0.9300000
		Covariance	Correlation	
SX, SX		6.237D+10	1.0000000	
SX, DWSP		5192498.2	0.0961199	
SX, RSDR		-240833.26	-0.4262367	
DWSP, DWSP		46790.996	1.0000000	
DWSP, RSDR		-6.9658644	-0.0142334	
RSDR, RSDR		5.1187911	1.0000000	

Data used to estimate the sugar export demand equation

obs	SX	DWSP	RSDR
1970	763806.0	226.4228	0.910000
1971	102524.0	242.4682	0.970000
1972	1098583.	230.2919	1.060000
1973	1037344.	333.8200	0.930000
1974	1015744.	888.9933	1.040000
1975	950532.0	554.5638	1.120000
1976	969798.0	305.1731	1.160000
1977	1098697.	210.3541	1.260000
1978	904693.0	227.1839	1.240000
1979	992370.0	287.1968	1.190000
1980	801974.0	806.1293	1.260000
1981	847501.0	445.1195	1.240000
1982	833289.0	206.8219	1.450000
1983	917719.0	194.8615	1.600000
1984	828442.0	92.01214	3.450000
1985	655229.0	177.6679	5.040000
1986	449212.0	287.3523	5.050000
1987	587358.0	536.7887	9.670000

SX= Per-Capita Sugar Exports (metric tons)

DWSP= Deflated World Sugar Price (US\$)

RSDR= Real Exchange Rate (pesos per US\$)