The Impacts of Trade and Agricultural Policies in the Dominican Republic: A Sector Programming Approach

by

Jesus De Los Santos Pineda

Dissertation submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Agricultural Economics

APPROVED:

Dr. Darrell J. Bosch, Co-Chairman	Dr. David R. Orden, Co-Chairman
Dr. Anya M. McGuirk	Dr. George W. Norton
Dr. Djavad Salehi-Isfahani	Dr. Daniel B. Taylor

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(ABSTRACT)

A sector-wide programming model of the Dominican agriculture is developed and used to analyze the impacts of trade and agricultural policies in the Dominican Republic. The model includes ten agricultural commodities which accounted for 75 percent of the total value of agricultural production in 1988. Linear demand functions for the commodities are included and the model is solved in its quadratic form using the GAMS/MINOS package. A competitive market is assumed where consumer and producer surplus is maximized. Quantities and prices are obtained endogenously.

Nominal and Effective Rates of Protection were estimated for selected crops. Results indicated negative protection for most of the crops.

Two sets of policy changes and market condition changes

were evaluated using the sector programming model. Inward--oriented policies included a policy of self-sufficiency and a penalty on traditional export crops through an exchange rate differential. Outward-oriented policies consisted of a change in the fertilizer price to reflect the border price and the elimination of government subsidies in the agricultural sector. External market condition changes included the elimination of the US sugar quota and an increase in the US sugar quota up to the level assigned in 1990.

Agricultural production, income and employment are increased by a policy of food self-sufficiency, a reduction in fertilizer price and an increase in the US sugar quota. A policy of food self-sufficiency requires more government spending given the input subsidies available from the government.

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Chapter I: Introduction

I.1. Introduction and Justification of the Study

The Dominican Republic is a small open economy with a population of 6.7 million and per capita annual income in 1988 of US$1,163 (1980 prices). Historically, the economy has been dominated by its export sector centered on a few primary commodities, specifically sugar, coffee, cocoa, and tobacco.

Since 1968, with the enactment of an Industrial Incentive Law (IIL), the government has simultaneously undertaken programs of import substitution and export promotion. The import substitution program was undertaken to develop the domestic industrial sector and to reduce imports of industrial goods. Export promotion policies have been aimed at diversification of the country's exports. In particular, through tax-free exporting zones the government offers incentives to foreign and domestic investors to engage in export oriented manufacturing activities. The rationales given for export promotion are to reduce reliance of export earnings on a few agricultural commodities, to generate increased foreign exchange earnings, and to reduce unemployment.

In the late 1970's and early 1980's the government also initiated programs to promote development of agroindustries, under the Agroindustry Promotion Law No.409, and to encourage joint ventures for production of non-traditional crops for external markets. At the same time, considerable resources are devoted to achieving self sufficiency in domestic food crops such as rice, beans and vegetable oils.

Despite the diverse programs undertaken to improve economic performance, the Dominican Republic continues to face severe microeconomic and macroeconomic constraints. In agriculture, production of food per capita has fallen for all commodities except rice during the 1980's, and the country has had to import cereals, vegetable oils and other food products (FAO). Government budget deficits are high and unemployment is over 20% (with an additional 30% under employment). In 1988, inflation reached a record annual rate of 41.2%, and the current account deficit reached a record US$838.00 million (EIU). The value of traditional exports has stagnated and the value of imports has steadily increased. Non-traditional exports have increased, especially from the duty-free export zones, but this increase has not been sufficient to keep the trade deficit from rising.

The unsatisfactory results from the mixed implementation of the import substitution and export promotion policies have raised debate among government officials, the private sector and international lending organizations regarding the net effects of the various government policies for income and employment. At issue is how to design and implement a set of policies which can foster economic growth in the Dominican Republic.

The question of what policies to pursue to enhance economic growth centers around the basic development strategies, inward-oriented versus outward-oriented, that the country has been pursuing simultaneously. The protection of import-substitution activities in isolation will introduce a bias against exportable and non-tradeable goods, while incentives provided to export activities will negatively affect import-substitution activities and non-tradeable goods. Thus, these policies can offset each other and the net effects of their simultaneous implementation are different than their effects in isolation.

In the agricultural sector, one of the government's main objectives has been to achieve self-sufficiency in the principal staples especially rice, beans and vegetable oils. Food self-sufficiency has been supported under the arguments that food production has been taxed in the Dominican Republic in the past and that subsidized inputs have been channeled to traditional export crops in spite of their declining international prices. It is also argued that agricultural import substitution may create local linkages which increase income and employment and promote saving and capital formation in rural areas. Agricultural import substitution may also help slow rural migration to urban areas which has been difficult to absorb.

On the other hand, promotion of agricultural exports is also viewed as essential for the solution of the existing economic crisis in the Dominican Republic. The decline of foreign exchange earnings from traditional agricultural exports, due largely to unfavorable world prices, has prompted the government to look for alternative crops to diversify the country's exports. The need to generate foreign exchange to pay its external debt makes export promotion a high priority for the government.

There is the belief among international lending institutions that the poor performance of the Dominican economy is the result of distortions introduced in the economy to favor import competing firms (World Bank, 1987). These institutions favor an outward oriented economy and condition new development loans on the reduction of market distortions. Those in sectors benefited by the current set of policies argue, in contrast, that the development of the industrial sector would not have been possible without the incentives provided by the government. It is also argued that reduction of protection of the current industrial activities will cause unemployment and a setback for industrial development (Bray).

I.2. Problem Statement

In the current situation, there is a need to evaluate the impact of alternatives policies in order to implement a sensible and consistent set of trade and agricultural policies to guide resource use and bring about balanced economic development. In this study, a mathematical programming model is used to simulate the impacts of policy changes on resource use, agricultural production and prices, foreign exchange earnings, and employment in the agricultural sector of the Dominican Republic. The impacts of current policies are analyzed and compared to alternative policies.

I.3. Objectives

The main objective of this study is to evaluate the impact of alternative agricultural and trade policies as strategies to foster economic development in the agricultural sector in the Dominican Republic. Specific objectives are:

1) To develop a sectoral programming model to evaluate the impacts of alternative policies on production, agricultural income and employment and resource use.

2) To compute measures of protection for important commodities in the Dominican Republic, distinguishing for

some commodities between various production techniques.

3) To analyze the impact of inward-oriented policies such as food self-sufficiency and exchange rate penalties on traditional export crops.

4) To analyze the impact of outward-oriented policies such as a change of fertilizer price and elimination of government subsidies.

5) To analyze the impact of changes in external sugar market conditions on the Dominican agricultural sector.

I.4. Organization of the Study.

The remainder of this dissertation is organized as follows. Chapter II provides an historic description and analysis of the Dominican economy. Chapter III reviews the theories behind the different trade strategies for development which the Dominican Republic has pursued. The arguments for free trade and export promotion are compared with theories which favor government intervention in agricultural markets to achieve some policy goals and to overcome market imperfections. The effects of these strategies on income generation and distribution, resource use and prices are discussed in a theoretical framework with a focus on the rural sector. Chapter IV describes policy interventions affecting the agricultural sector. It includes measures of nominal and effective protection and evaluation of the direct effect of alternative exchange rate policies on various commodities produced in the Dominican Republic. Chapter V discusses the models used to measure empirically the impact of policy changes. Specifically, the use of programming models within a sector analysis framework is discussed. Chapter VI describes the programming model used to empirically measure the impacts on Dominican agriculture of alternative domestic policies, alternative exchange rate policies and potential changes in US sugar policy on resource use, production, prices, and foreign exchange earnings. Chapter VII presents the validation and results of the sector model, and chapter VIII is devoted to the discussion of the effects of some market and policy changes. Chapter IX presents the conclusions and recommendations of this study.

Chapter II: The Dominican Economy

II.1. Introduction

This chapter provides a historic overview of the country's development since the beginning of the century. A description of the main macroeconomic indicators and the performance of sectors of the economy follows, with an emphasis on the agricultural sector. The chapter ends with the discussion of the development policies pursued by the government during the last 25 years.

II.2. Economic History of the Dominican Republic

The Dominican Republic occupies two-thirds of the island of Hispaniola and is located approximately 500 miles southeast of U.S. mainland. With 48.7 thousands square kilometers, the Dominican Republic is the second largest country in the Caribbean in land area. At the turn of the century the Dominican economy was dominated by sugar and livestock production. Huge sugar cane plantations and mills owned mainly by foreign companies accounted for most of the agricultural and industrial activities. From 1900 to 1902, instability created by internal political struggles brought the country's exports to a halt. Foreign debts were not honored causing foreign interests to take coercive actions against the country (Wairda). In 1902, the Dominican Republic was forced to sign an agreement with the United States in which the United States took possession of Dominican customs houses. The United States obtained the right to 55% of the total duty revenues to pay Dominican debts, while the remaining 45% of the duties went to the Dominican government (Bell). This agreement lasted until 1909 but did not put an end to the domestic economic and political problems. Seven years later the United States invaded the Dominican Republic. During the following eight years the United States was in charge of the customs and controlled the rest of the economy. It was only after the country paid off its foreign loans in 1924 that the occupation by the United States ended. The period 1924-30 was then marked by severe internal fights among regional leaders.

II.2.1. The Trujillo Era

In 1930, Rafael L. Trujillo, a lieutenant in the military came into power. After being elected president, Trujillo managed to gain control of most of the country's resources. His regime changed the economy from a system of private capitalism to one strongly subordinated to the direction of the state (Murphy). Trujillo's regime, which lasted for 31 years, has subsequently been considered the most decisive period for the Dominican Republic, both politically and economically.

During his administration Trujillo acquired land for himself and his relatives through coercive methods. By 1960, over 50% of the Dominican land was in the hands of the Trujillo family and close friends. This land was devoted mainly to sugarcane production. Most of the investment in the industrial sector also was controlled by Trujillo. The businesses and enterprises owned by Trujillo accounted for 70% of the volume of business in the country (Vedovato).

Most government policies were directed to benefit the enterprises of the dictator. The industrial promotion law enacted in 1950 had this objective. High tariffs were imposed on some imported goods while the government began a program of industrial substitution for selected activities (Murphy).

The Trujillo regime did not follow any articulated development strategy, and policies and programs responded to the dictator's sense of new investment opportunities for personal profits. Nevertheless, the country achieved a fair rate of economic growth during his era. Much of this growth resulted from the development of the industrial sector, mainly manufacturing and sugar production. Exports of sugar increased threefold and the country was able to completely repay its external debts (Murphy, Bray). However, private investments other than by Trujillo and his friends were reduced to a minimum which hindered the development of a strong domestic private sector. Production of food lagged and education and health were neglected to the point that the share of national income devoted to those sectors was one of the lowest in Latin America. The military sector, created to enforce property rights and rules imposed by Trujillo, grew out of proportion (Vedovato, Wairda).

By 1961, when Trujillo was assassinated, sugar exports were the major link of the Dominican economy with the international economic system. The absence of a Dominican investment group, left the country without economic and political leadership. The period 1962-1966 was characterized by political instability and low investment. During this period there were 12 different governments, a civil war, and military intervention by the United States in 1965. In June 1966, the country held a general election with Joaquin Balaguer emerging as president.

II.2.2. Balaguer Administration (1966-1978)

The Balaguer administration is considered another turning point in the Dominican economy. Joaquin Balaguer took immediate steps to restore political stability and promote economic growth in the country. Import substitution was strongly emphasized with the enactment of the Industrial Incentive Law 299 (IIL) in 1968. At the same time, the government favored foreign investment in mining activities and undertook massive public investment in infrastructure such as highways, housing, and irrigation projects (Vedovato, Green and Roe). Along with the above measures, the government kept prices of agricultural products artificially low and froze wages for almost 12 years.

Between 1966 and 1973, the country experienced one of the most impressive economic growth rates in Latin America. Real Gross Domestic Product (GDP) grew at an annual rate of 7.5%, with inflation averaging a moderate 10% (IDB). It was also during this period that rural-urban migration accelerated, despite the land distribution program carried out by Balaguer. Foreign debts also increased noticeably in spite of favorable international prices for the Dominican Republic's main export commodities (UN).

Starting in 1973, the economy began to experience a downward trend due to internal and external factors. Externally, the recession experienced by the world economy in 1974-75 strongly affected the world demand for the country's major export commodities. Real GDP growth declined to an average of 4.2% annually during the period 1973-1982. The decline in the major agricultural exports gave rise to a decline in government revenue from trade duties. The rising price of oil almost exhausted the country's foreign exchange reserves (Bell). There was a decline in the rate of public investment in all sectors of the economy. Imports were also restricted due to both higher import prices and lack of foreign exchange.

II.2.3. 1978 to Present

In 1978, Balaguer was defeated in his attempt to win a fourth presidential term. The country was experiencing the beginning of the current economic crisis. The new administration of President Guzman tried to speed up economic activities following a Keynesian model. Heavy government spending was undertaken and nominal wages were increased (Murphy). However, natural disasters adversely affected the country and the government had to react to short-term emergency situations rather than to articulating a consistent economic strategy. In 1979, Hurricanes David and Frederick hit the country causing vast economic damage and loss of lives. The agricultural sector was adversely affected by flooding in all agricultural areas.

In the 1980's, high inflation rates combined with high external debts and large trade deficits led to a volatile economy and a decline in annual real GDP growth far below the levels achieved during the late 1960's and most of the 1970's. The inflation rate, which had been around 10% during the 1970's, began climbing and by 1988 reached a record 41%. (See also the discussion of macroeconomic indicators below.)

By 1984, the pressure imposed by a continuing lack of foreign exchange and the need to meet the demands from importers forced the government to establish a preferential exchange rate for some essential imports. Foreign exchange for non-essential imports had to be obtained in the parallel market at a rate higher than the official exchange rate (Greene and Roe; UN, 1986). A parallel market has been in existence since 1967. This topic is discussed in more detail in section II.3.4.

Since August 1986, the new administration headed by Joaquin Balaguer, who regained power after two defeats, has emphasized tourism and export-oriented activities to obtain foreign exchange and create employment. Simultaneously, domestic demand has been increased through heavy investment in the construction sector. In the agricultural sector, emphasis has been on food self-sufficiency and agricultural export diversification.

II.3. Macroeconomic Indicators

II.3.1. Population and Employment

The Dominican Republic was a predominantly rural society before 1960. The tight control imposed by the Trujillo regime and the lack of roads made it difficult to migrate to urban settings. International migration was also insignificant during the 1950's and 1960's. During those two decades the Dominican population increased at an annual rate of 3.2%.

Table II.1 contains basic statistics on the Dominican population. The population has changed from around 65% rural in 1960 to over 60% urban in 1987. The population growth rate has declined to 2.4% and rural-urban migration has accounted for 40-50% of the increase in urban population. During the 1983-1986 period, while urban population increased at a rate of 4.7%, rural population dropped in absolute terms. Most of the urban population is concentrated in the two main economic areas: Santo Domingo, the capital of the country, with 1.3 million people, and Santiago in the northern part of the country with 400,000 people (EIU).

The population of the Dominican Republic is relatively young with 48% of the total under 15 years of age and 49% of its population economically active. Agriculture absorbs 42% of the total labor force, with manufacturing employing 13%, and the construction sector 4.5% as shown in table II.1. The rest of the labor force is in the service sector and other sectors. By 1988, the unemployment rate was estimated at 25%. An additional 30% of the total labor force was engaged in part-time or low productivity jobs (EIU). The lack of employment, along with the infla-

Table II.1. Population and Employment Statistics for the Dominican Republic, 1960-1988

	Year			
	1960	1970	1980	1988
Total population (million people)	3.04	4.06	5.44	6.87
Urban (%)	35.20	39.20	51.00	60.90
Rural (%)	64.80	60.80	49.00	39.10
ANNUAL GROWTH RATES (%)	1966-73	1974-82	1983-86	
Total Population	3.20	2.60	2.40	
Urban	4.30	5.30	4.70	
Rural	.80	.08	-.40	
LABOR FORCE BY SECTOR (%)	1982			
Agriculture	41.90			
Mining	.30			
Manufacturing	12.60			
Construction	4.50			
Others	40.70			

Sources: IMF, International Financial Statistics, various years.
IDB, Economic and Social Progress in Latin America (1989).

tionary process, have brought about a severe decline in the real wage. Between 1980 and 1988, the real salary declined by almost 23% as shown in table II.2. Even when the nominal wage was raised three times during that period, the increase was not enough to offset the loss of purchasing power caused by inflation.

International migration, mainly to the United States and Puerto Rico, has skyrocketed during the 1970's and 1980's. In 1987, an estimated 900,000 Dominicans were living in the United States and Puerto Rico (Murphy).

II.3.2. Gross Domestic Product

As in many countries which have engaged in the process of industrialization, the agricultural sector has been declining as an economic activity in the Dominican Republic relative to other economic sectors. In 1988, agriculture accounted for 15.2% of total GDP compared to 22.0% in 1966, as shown in table II.3. During 1974-1982, the annual growth rate of the agricultural sector was lower than the population growth rate resulting in falling per capita food production. However, during the 1983-1986 period the agricultural sector experienced positive growth despite declining total real GDP (see table II.4). This positive growth in the agricultural sector was due in part to expansion of acreage in production in the southwest and

Table II.2. Inflation Rate and Real Wage in the Dominican Republic.

Year	Inflation Rate (%)	Minimum Wage (DR$/Mo)	Consumer Price Index (1980=100)	Index of Real Wages (1980=100)
	(1)	(2)	(3)	(4)
1980	16.70	125	100.00	100.00
1981	7.50	125	107.50	93.46
1982	7.70	125	115.80	86.40
1983	4.70	125	121.30	82.40
1984	27.00	158.3	154.00	82.23
1985	37.50	212.5	211.80	80.26
1986	9.70	250	232.50	86.02
1987	15.90	283.3	269.40	84.13
1988	41.20			77.13

Note: The minimum wage was raised to DR$175/month in May of 1984
In july 1985, it was raised again to DR$/month and to
DR$350/month in September 1987.

Sources: Column 1 from IDB, Economic and Social Progress
in Latin America, 1989.
Column 2 from Central Bank of the Dominican Republic.
Column 3 from IMF, INternational Financial Statistics.
Column 4 = ((column 2/(column3/100))/125)*100.

Table II.3. Gross Domestic Product for the Dominican Republic, 1966-1988.

YEAR	ORIGIN OF GDP: Agric. (percent)	Indust. (percent)	Serv. (percent)	REAL GDP (millions 1980 US$)	REAL GDP growth rate	POPULATION (million people)	REAL GDP/CAPITA (1980US$)	REAL GDP/CAPITA growth rate
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-
1966	21.95	25.10	53.05	2536.08		3.62	700.58	
1967	20.29	27.25	52.37	2742.70	8.15	3.72	737.28	5.24
1968	20.30	25.76	53.94	2757.60	.54	3.83	720.00	-2.34
1969	21.28	26.56	52.07	3051.00	10.64	3.95	772.41	7.28
1970	20.45	28.14	51.41	3366.90	10.35	4.06	829.29	7.36
1971	18.75	29.09	52.23	3492.60	3.73	4.20	831.57	.28
1972	17.34	29.76	52.90	3817.80	9.31	4.34	879.68	5.78
1973	18.74	30.23	51.08	4274.40	11.96	4.48	954.11	8.46
1974	18.66	30.66	50.68	4537.40	6.15	4.61	984.25	3.16
1975	18.10	34.68	47.85	4751.00	4.71	4.75	1000.21	1.62
1976	16.05	33.74	50.20	5069.10	6.70	4.89	1036.63	3.64
1977	16.91	31.77	51.33	5332.20	5.19	5.03	1060.08	2.26
1978	15.81	31.50	52.70	5469.00	2.57	5.17	1057.83	-.21
1979	15.75	31.34	52.94	5674.90	3.76	5.30	1070.74	1.22
1980	17.62	30.39	51.99	5963.90	5.09	5.44	1096.31	2.39
1981	16.18	29.59	54.22	6140.00	2.95	5.58	1100.36	.37
1982	15.40	30.66	53.94	6312.20	2.80	5.74	1099.69	-.06
1983	15.07	30.33	54.61	6580.20	4.25	5.96	1104.06	.40
1984	15.21	31.39	53.41	6484.10	-1.46	6.10	1062.97	-3.72
1985	17.91	29.30	52.80	6190.70	-4.52	6.24	992.10	-6.67
1986	17.21	29.65	53.14	6213.00	.36	6.42	967.76	-2.45
1987	18.70	29.70	51.60	7985.00	28.52	6.72	1188.24	22.78
1988	15.20	N.A.	N.A.	7995.82	.14	6.87	1163.87	-2.05

Source: Calculated using data from World Bank World Tables (1988-89).

Table II.4. Gross Domestic Product Growth by Sector, 1966-1986.

	Growth Rate (%)		
	1966-1973	1974-1982	1983-1986
Real GDP	7.55	4.21	-2.16
Agriculture	5.76	2.70	4.90
Industry	11.36	3.20	-2.17
Service	8.11	5.67	-1.74
Real per capita GDP	4.22	1.42	-4.53

Source: Calculated from table II.3.

northwest regions. Irrigation facilities built by the government brought into production a vast amount of previously idle or marginal land (Quezada et. al., 1985).

In contrast, the industrial sector showed its most impressive growth prior to the 1980's, due primarily to installation of new light manufacturing firms in the duty free zones. Manufacturing oriented to the domestic market has been stagnant during the 1980's due to the inability of the import substitution process to undertake more complex production activities and the constraints on purchases of imported inputs imposed by the scarcity of foreign exchange (Bray). Mining activities account for 4.5% of GDP but its contribution is expected to decline in the medium and long term due to exhaustion of natural reserves (EIU, 1988). The service sector which provides nearly 50% of GDP, achieved a positive growth rate between 1966-1982 but fell thereafter. Part of the positive growth was the result of sizable increases in jobs in government offices created to provide services to the public.

Real GDP per capita, considered one of the most important social indicators, increased at an annual rate of 4.2% during the period 1966-1973 but grew more slowly thereafter and by 1983 began to decline as shown in table II.3. By 1988, GDP per capita was estimated at US$1163.87 (1980 prices).

II.3.3 External Sector

II.3.3.1. Exports

The Dominican Republic can be classified as a small open economy because of the importance of its external sector and the fact that it is considered a price taker in the world market due to its inability to affect world market prices. Table II.5 provides information about the external sector. Since the mid 1970's, exports have been declining in relative terms and have averaged only 7% of real GDP. Imports averaged 36.6% of real GDP during 1966-75, and have also fallen to an average of 21% during the 1980's. A close empirical relationship between export growth and economic growth as measured by real GDP growth (columns 6 and 7 in table II.5) does not seem to hold for the Dominican Republic as shown in figure II.1.

Agricultural exports represented about 62% of the country's total exports in the 1980's with traditional agricultural exports (sugar, coffee, cocoa and tobacco) accounting for 83% of the total agricultural exports as shown in table II.6[1]. The Dominican economy has been called the "dessert economy" due to the country's reliance on a few agricultural commodities used after meals. International price fluc-

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In addition to the four agricultural commodities, mineral :ports are also considered traditional exports. They include ıre, bauxite and ferronickel.

Table II.5. Trade Statistics for the Dominican Republic, 1966-1988

Year	Total exports	Total imports	Trade balance	Ratio exports to GDP	Ratio imports to GDP	Export growth rate (%)	Real GDP growth (%)
	...(millions of 1980 US$)..						
	-1-	-2-	-3-	-4-	-5-	-6-	-7-
1966	809.00	874.10	-65.10	31.90	34.47		
1967	981.10	918.10	63.00	35.77	33.47	21.27	8.15
1968	991.10	1001.70	-10.60	35.94	36.33	1.02	.54
1969	890.80	1152.40	-261.60	29.20	37.77	-10.12	10.64
1970	962.30	1296.00	-333.70	28.58	38.49	8.03	10.35
1971	1047.20	1442.30	-395.10	29.98	41.30	8.82	3.73
1972	1140.20	1509.90	-369.70	29.87	39.55	8.88	9.31
1973	1105.50	1526.50	-421.00	25.86	35.71	-3.04	11.96
1974	847.10	1460.00	-612.90	18.67	32.18	-23.37	6.15
1975	1401.10	1629.40	-228.30	29.49	34.30	65.40	4.71
1976	1187.40	1374.60	-187.20	23.42	27.12	-15.25	6.70
1977	1115.50	1582.50	-467.00	20.92	29.68	-6.06	5.19
1978	1035.10	1484.70	-449.60	18.93	27.15	-7.21	2.57
1979	1169.20	1498.00	-328.80	20.60	26.40	12.96	3.76
1980	961.90	1640.00	-678.10	16.13	27.50	-17.73	5.09
1981	943.41	1493.68	-550.27	15.36	24.33	-1.92	2.95
1982	481.94	1221.91	-739.97	7.64	19.36	-48.92	2.80
1983	492.32	1200.98	-708.66	7.48	18.25	2.15	4.25
1984	513.83	1164.07	-650.24	7.92	17.95	4.37	-1.46
1985	448.27	1129.37	-681.10	7.24	18.24	-12.76	-4.52
1986	491.79	1241.60	-749.81	7.92	19.98	9.71	.36
1987	415.45	1736.16	-1320.71	5.20	21.74	-15.52	28.52
1988	515.31	1673.35	-1158.04	6.44	20.93	24.04	.14

Note: Export and import values were converted to 1980 values using export and import indexes respectively from the World Bank, world tables.

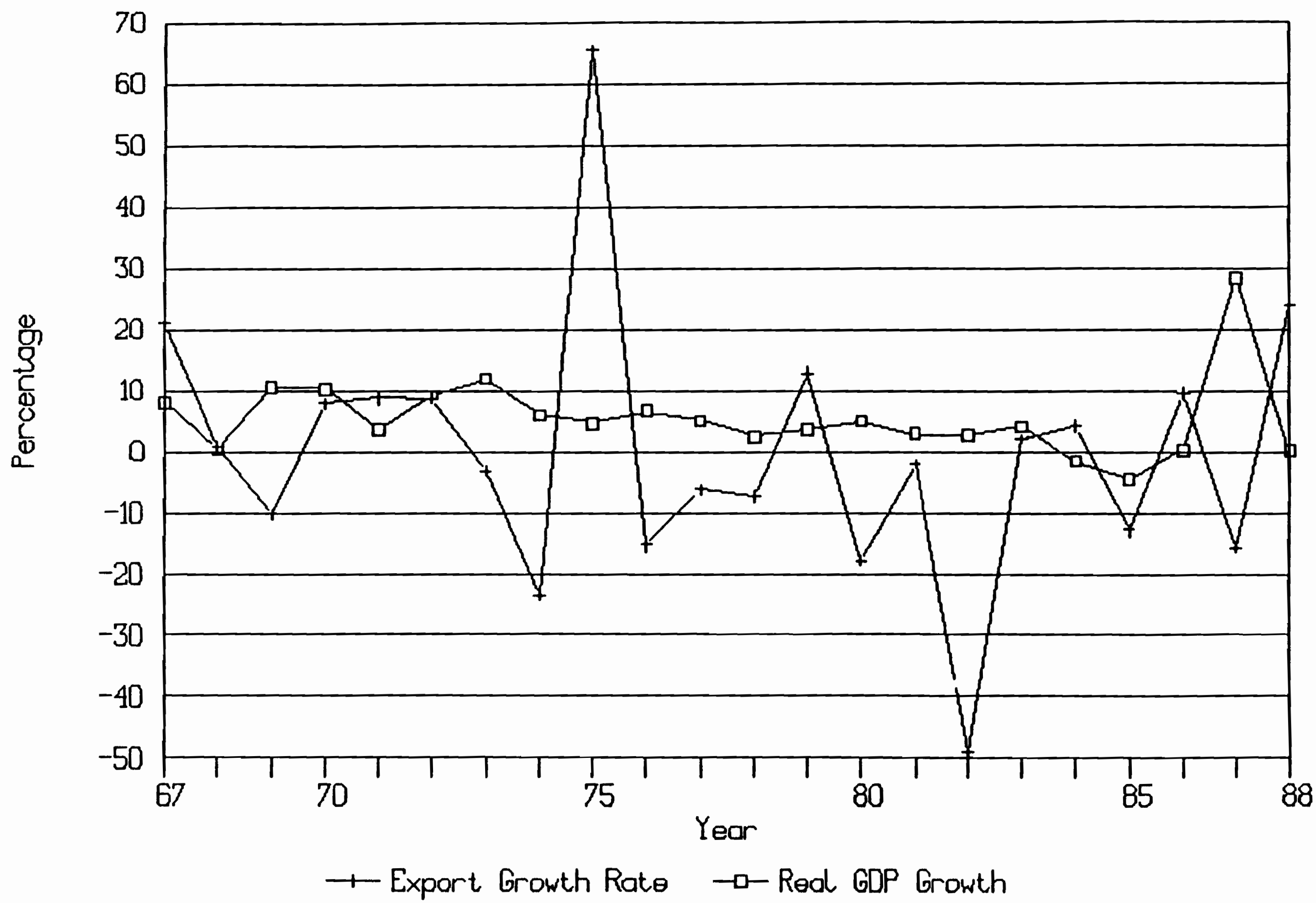
Sources: Columns 1 and 2 from World Bank, World Tables (1988-89).
Column 3 = (column 2 - column 1).
Column 4 = (column 1/real GDP).
Column 5 = (column 2/real GDP).
Column 6 calculated from column 2.
Column 7 from table II.3.

Table II.6. Values of Total Agricultural Exports and Traditional Agricultural Exports For the Dominican Republic, 1966-1988 (Million of 1980 US$).

YEAR	TOTAL EXPORTS	TOTAL AGRIC EXPORTS	PERCENT OF TOTAL EXPORTS	TRAD AGRIC. EXPORTS	PERCENT OF TOTAL AG. EXP.	RAW SUGAR EXPORTS	GREEN COFFEE EXPORTS	COCOA EXPORTS	TOBACCO EXPORTS
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-
1966	809.00	713.54	88.20	524.47	73.50	338.33	92.51	49.34	44.30
1967	981.10	855.35	87.18	593.48	69.38	397.36	74.89	53.30	67.92
1968	991.10	876.36	88.42	563.66	64.32	379.57	76.17	58.72	49.19
1969	890.80	780.56	87.62	582.24	74.59	369.41	84.31	79.22	49.29
1970	962.30	849.44	88.27	646.54	76.11	411.90	107.43	72.86	54.35
1971	1047.20	918.93	87.75	767.16	83.48	519.03	86.94	50.37	110.82
1972	1140.20	848.39	74.41	774.45	91.28	529.65	94.01	57.73	93.06
1973	1105.50	810.88	73.35	743.36	91.67	492.29	115.67	60.20	75.20
1974	847.10	734.19	86.67	720.15	98.09	517.81	69.56	73.06	59.73
1975	1401.10	917.27	65.47	882.60	96.22	743.81	55.67	37.37	45.75
1976	1187.40	706.02	59.46	646.94	91.63	383.07	143.39	63.87	56.61
1977	1115.50	724.19	64.92	680.18	93.92	292.42	233.21	117.55	36.99
1978	1035.10	569.00	54.97	519.80	91.35	229.70	122.97	108.50	58.63
1979	1169.20	614.58	52.56	568.95	92.57	232.79	182.73	90.96	62.46
1980	961.90	860.20	89.43	476.60	55.41	309.90	76.80	55.80	34.10
1981	1509.70	998.11	66.11	912.56	91.43	678.40	96.44	63.79	73.93
1982	1260.80	789.81	62.64	755.51	95.66	471.10	156.98	96.88	30.55
1983	1251.10	789.81	63.13	691.47	87.55	442.24	122.24	97.44	29.55
1984	1473.10	961.85	65.29	837.01	87.02	509.34	161.12	128.86	37.69
1985	1235.80	761.09	61.59	560.75	73.68	319.50	96.81	110.02	34.43
1986	1046.60	659.86	63.05	518.29	78.55	213.12	168.95	98.83	37.39
1987	1218.30	655.48	53.80	501.73	76.54	248.63	105.14	123.97	23.99
1988	1199.14	628.80	52.44	476.40	75.76	228.46	106.43	112.06	29.45

Note: An Export Price Index (1980=100) from World Bank, "World Tables" was used to obtain 1980 US$ values.

Sources: Column 1 from World Bank, World Tables (1988-89).
Column 2 from FAO Trade Yearbook, several volumes.
Column 3 = (column 2/column 1)*100.
Column 4 = sum(columns 6:9).
Columns 6, 7, 8 and 9 form IMF, International Financial Statistics.



Graph II.1 Export and Real GDP Growth, 1967-88 tuations for these export commodities have affected the performance of exports in the Dominican Republic. Traditional agricultural exports have declined as a proportion of total exports since 1966. In 1988, traditional agricultural exports accounted for only 36% of the total exports compared to 65% in 1966.

Sugar, which is the main export crop, has declined as the major earner of foreign exchange due to depressed world prices and the reduction of the export quota granted by the United States. The United States established import quotas for sugar in 1934 to protect domestic producers. Since 1962, the Dominican Republic has been the major exporter among Latin American countries under the quota system. However, sugar exports through the quota system have been declining since the late 1970's. During 1978-1981, the basic quota assigned to the Dominican Republic was 780,000 tons annually. During 1982-1983 it was reduced to 535,000 tons, and by 1988 it was only 123,000 tons. (It was increased later that year to 176,700 tons due to the drought in the United States) (ERS, 1988; EIU, 1989). Real income from sugar exports has consequently decreased from 743.8 million 1980 US dollars in 1975 (61% of total exports) to 228.46 million 1980 US dollars in 1986 (19% of total exports).

Coffee is the second most important agricultural export commodity in terms of foreign exchange earnings. Income from coffee exports has been erratic during the 1960's, 1970's, and 1980's due to volatile world prices. Its export share has varied accordingly from a maximum of 233.21 million 1980 US dollars in 1977 (20.90 % of total exports) to 76.8 million 1980 US dollars in 1980 (7.99% of total exports). In 1988 coffee exports totaled 106.43 million 1980 US dollars (8.87% of total exports). The major export market is the United States which buys 60% of the country's exports. Unlike sugar production, which occurs in large plantations, coffee is produced by thousands of small and medium farmers on mountainous terrain suitable mostly for coffee production.

Cocoa exports have behaved similar to coffee exports. They provide about 8.4% of the country's income generated from exports. The Dominican cocoa is classified as one of the lowest quality cocoa in the international market due to the poor handling during the fermentation process (ISA). As a consequence, the price received in the international market is also one of the lowest. In 1988, coca exports were valued at 112.7 million 1980 US dollars.

Tobacco is the fourth traditional export. Tobacco exports have been hurt by the reduction of imports from Spain, which has been a major market, after it joined the European Economic Community (EEC). Tobacco exports have also suffered from a shift in consumer preference from "black" tobacco (which is the variety exported by the country) to "blond" tobacco. The black variety is used to manufacture cigars while the blond variety is used in the manufacture of cigarettes. During 1980's, tobacco accounted for 2.9% of total exports with a real value of 29.45 million 1980 US dollars in 1988.

In addition to the traditional agricultural exports, mineral, and lately non-traditional products (fruits and vegetables and manufactures from duty free zones) and tourism, are the other sources of foreign exchange. Mineral exports as a whole (dore, ferronickel and bauxite mainly) have increased in value since 1966, but the growth of each mineral exports have been somewhat erratic. In large part, this is due to volatility in world prices. Bauxite was the main mineral exported during the 1960's and part of 1970's. However, exports of this mineral were very low during 1980's. In 1988 exports of Bauxite totaled only 2.67 million 1980 US dollars.

Dore and ferronickel have become a significant source of foreign exchange for the country. In 1980, the country exported dore (a combination of gold and silver) for a value of 259.5 million 1980 US dollars and 101.3 million 1980 US dollars of ferronickel. Dore and ferronickel exports increased to 660.9 million and 496.52 million 1980 US dollars in 1988 (see table II.7).

Table II.7. Minerals and Non-traditional Exports for the Dominican Republic, 1966-1988 (millions of 1980 US$).

Year	Total mineral exports	Dore	Ferro-Nickel	Bauxite	Fruits and Veget.	Tourism
	-1-	-2-	-3-	-4-	-5-	-7-
1966	70.44	.00	.00	68.91	8.72	26.17
1967	82.28	.00	.00	80.57	10.06	50.31
1968	77.63	.00	.00	76.23	19.39	78.79
1969	71.69	.00	.00	70.69	19.98	85.92
1970	69.48	.00	.00	68.16	28.12	73.87
1971	74.17	.00	.00	69.46	34.81	93.04
1972	200.84	.00	148.26	47.95	33.03	106.13
1973	248.54	.00	207.71	37.18	28.79	94.99
1974	165.20	.00	141.70	23.50	22.03	69.84
1975	193.01	34.66	131.70	26.65	27.95	92.16
1976	260.44	77.95	157.61	24.88	34.91	119.57
1977	216.28	69.82	115.03	31.43	32.44	131.86
1978	219.87	92.39	92.26	35.22	35.94	141.35
1979	319.34	148.09	142.99	28.26	27.94	166.76
1980	379.80	259.50	101.30	19.00	26.65	172.60
1981		227.35	120.90	20.33	38.14	261.75
1982	320.75	205.01	30.33	8.62	49.23	436.95
1983	399.30	201.35	102.20	N.A.	51.58	512.80
1984	410.62	160.93	132.48	N.A.	66.14	629.20
1985	395.04	151.67	161.15	N.A.	80.76	757.98
1986	277.36	124.50	86.64	N.A.	89.63	738.19
1987	412.76	205.55	197.34	7.03	83.71	972.77
1988	660.92	157.66	496.52	2.67	74.78	N.A.

Note: An export price Index (1980=100) from the World Bank, " World Tables" was used.

Sources:

Columns 1 to 4 and 7 from UEPA, Politicas Macroeconomicas Dominicanas en el Periodo 1966-86 y sus Repercusiones en el Sector Agropecuario.

Column 5 from FAO Trade Yearbook.

Finally, tourism has boomed in the last 10 years. New hotels have been built on the north and east coasts by both the government and the private sector. These hotels have doubled the capacity of the country to accommodate tourists. At the end of 1988, the Dominican Republic surpassed Jamaica as the leading Caribbean country for tourism, with hotel rooms for 12,000 visitors (EIU, 1989). The number of tourists visiting the country annually has increased from 500,000 in 1979 to 1.6 million in 1987. Foreign exchange earnings from tourism have also increased from 166.76 million 1980 US dollars in 1979 to 972.77 million 1980 US dollars in 1987. As a result, tourism has displaced cocoa and coffee as the second major activity in the generation of foreign exchange earnings.

II.3.3.2 Imports

The country's ability to import has been constrained by the availability of foreign exchange from exports, foreign investment, remittances from Dominican nationals (which have become increasingly important as international migration has increased), and international loans. Notwithstanding this constraint, in contrast to total exports, the value of imports achieved positive growth rates during the 1980's. Imports rose from 1640.0 million 1980 US dollars in 1980 to 1849.2 1980 US dollars in 1988, as is shown in table II.8.

Oil constitutes a major share of the Dominican import bill. Before 1973, less than 10% of the value of the imports was due to oil, but by 1981, oil imports accounted for more than 32% of the total import bill. With a poor endowment of natural energy sources, the Dominican Republic has to rely on imported fuel for its energy needs. Over 90% of the power generated by the Dominican Electricity Corporation uses hydrocarbon as a power source. The other 10% is generated by hydropower (World Bank, 1985). Manufactures account for roughly two-thirds of total imports. The country relies completely on imports to satisfy its demand for heavy manufactures (industrial machines, equipment, automobiles, etc.). In 1988, manufactured imports were valued at 1286.00 1980 US dollars.

Imported agricultural products are mainly food and edible oils (see table II.9). During the 1980's, agricultural imports accounted for an average of 12.4% of total imports with food and animal products alone accounting for an average of 8.2%. Cereals, mainly wheat and rice, accounted for about half of the food imports. The country became a net importer of forest products in 1968 when the government closed all private mills and prohibited the harvesting of live trees (Harston al). Feedstuff imports have increased due to growth of the poultry industry. Edible oils also accounted for a significant share of

Table II.8. Main Imports of the Dominican Republic, 1966-1988 (million of 1980 US$)

YEAR	TOTAL IMPORTS	MANUFACTURING VALUE	MANUFACTURING (%)	FUEL VALUE	FUEL (%)	FOOD & ANIMAL VALUE	FOOD & ANIMAL (%)	OTHERS VALUE	OTHERS (%)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-
1966	874.10	611.11	69.91	74.40	8.51	138.65	15.86	49.95	5.71
1967	918.10	660.47	71.94	68.84	7.50	112.56	12.26	76.24	8.30
1968	1001.70	682.88	68.17	66.67	6.66	134.23	13.40	117.92	11.77
1969	1152.40	827.10	71.77	93.93	8.15	115.89	10.06	115.48	10.02
1970	1295.60	948.09	73.18	89.36	6.90	106.98	8.26	151.17	11.67
1971	1442.00	1054.44	73.12	124.60	8.64	105.48	7.32	157.48	10.92
1972	1509.80	1099.61	72.83	156.42	10.36	105.60	6.99	148.17	9.81
1973	1516.40	974.22	64.25	182.30	12.02	192.33	12.68	167.55	11.05
1974	1459.70	889.87	60.96	242.31	16.60	185.41	12.70	142.11	9.74
1975	1629.00	977.29	59.99	367.95	22.59	181.39	11.14	102.37	6.28
1976	1374.60	987.17	71.81	.00	.00	187.72	13.66	199.71	14.53
1977	1582.50	919.48	58.10	329.06	20.79	144.32	9.12	189.64	11.98
1978	1484.70	844.51	56.88	335.34	22.59	127.67	8.60	177.18	11.93
1979	1498.80	784.69	52.35	397.16	26.50	114.60	7.65	202.34	13.50
1980	1640.00	886.50	54.05	417.80	25.48	148.90	9.08	186.80	11.39
1981	1611.20	752.32	46.69	531.76	33.00	168.63	10.47	158.50	9.84
1982	1484.40	700.82	47.21	508.73	34.27	107.80	7.26	167.05	11.25
1983	1566.60	720.96	46.02	570.74	36.43	129.89	8.29	145.00	9.26
1984	1561.00	792.02	50.74	463.65	29.70	108.63	6.96	196.71	12.60
1985	1643.50	884.44	53.81	452.10	27.51	112.87	6.87	194.10	11.81
1986	1653.80	1115.05	67.42	233.56	14.12	158.25	9.57	146.94	8.89
1987	1829.70	N.A.	N.A.	447.64	24.47	160.24	8.76	N.A.	N.A.
1988	1849.20	1286.00	69.54	351.80	19.02	180.27	9.75	31.13	1.68

Sources: Column 1, 2 and 4 calculated using data from World Bank, World Tables (1988-89).
Column 6 calculated using data from FAO trade yearbook (various years).
Column 8 = (column 1) - (column 2 + 4 + 6).
Column 8 includes some agric. inputs such as pesticides, fertilizer, etc.

Table II.9. Main Agricultural Imports of the Dominican Republic, 1966-1988 (million of 1980 US$).

Year	Total agric. imports	Cereals	Edible oils	Feed stuff	Dairy product	Forest product	Agric. inputs
	-1-	-2-	-3-	-4-	-5-	-6-	-7-
1966	174.88	38.60	11.59	7.73	26.57	6.76	29.95
1967	160.93	35.80	6.98	6.98	25.12	5.58	34.42
1968	180.18	61.71	26.58	6.44	32.70	.00	29.37
1969	181.07	43.93	44.86	5.37	29.35	.00	32.24
1970	153.11	26.13	31.28	9.23	29.45	53.23	36.30
1971	164.84	25.56	37.82	9.07	30.97	54.80	46.21
1972	177.12	33.58	43.89	13.62	21.63	92.96	41.36
1973	260.47	125.37	47.39	9.84	9.13	69.81	35.93
1974	262.97	148.43	53.49	10.58	5.93	41.54	14.65
1975	252.82	137.36	49.27	7.51	5.86	43.39	36.50
1976	258.06	140.23	47.79	10.80	5.40	49.42	39.83
1977	223.98	97.19	46.53	11.04	9.87	90.08	49.19
1978	186.57	72.41	45.05	12.93	11.59	118.03	49.56
1979	203.28	55.09	66.91		12.88	57.81	46.93
1980	217.02	75.15	45.52	10.70	15.37	71.39	71.50
1981	231.94	100.92	41.88	13.66	13.22	70.60	54.69
1982	188.18	54.02	64.71	13.24	8.85	63.89	38.66
1983	186.39	70.21	44.28	17.65	16.21	62.59	36.48
1984	174.38	63.43	51.61	15.94	18.07	66.16	36.43
1985	179.67	72.63	53.00	13.87	11.93	54.07	34.58
1986	234.20	90.65	42.55	16.89	18.79	61.13	N.A.
1987	231.05	81.68	42.42	19.14	25.15	52.63	N.A.
1988	269.57	92.90	54.48	28.88	25.57	56.01	N.A.

Note: An Import Price Index was used to obtain 1980 US$ values.

Source: Calculated using data from FAO Trade Yearbooks.

total agricultural imports. The Dominican Republic has been a net importing nation in cooking oil since the 1960's and by 1988 it spent 54.5 million 1980 US dollars on edible oil imports.

II.3.4. Balance of Trade and Foreign Exchange

The poor export performance combined with increased imports have resulted in an escalating trade deficit that in 1988 amounted to $866.49 million 1980 US dollars (see table II.5). The country has been forced to turn to international loans to finance development programs and cover its trade deficit. In 1988, the nominal outstanding debt was estimated at 3.84 billion US dollars (IDB).

The trade deficit has led to heavy pressure on the value of the Dominican peso. Before 1985, the peso was equated at par with the US dollar although at the parallel market a different rate was in place. As can be seen from table II.10, the Dominican peso was overvalued at the official exchange rate. Up to 1980 transactions made through the parallel market were not of significant magnitude. The main source of foreign exchange traded at the parallel market came from overinvoicing of imports, underinvoicing of exports, and remittances from Dominicans living abroad (Greene and Roe). With the enactment of the Export Promotion Law (Law 69) in 1979, the parallel market was tacitly legalized. Through this law, exporters of non-

Table II.10. Exchange Rate of the Dominican Republic, Dominican Pesos/US Dollar, 1966-1988

Year	Official Exchange Rate	Parallel Exchange Rate	Weighted Average Exchange Rate	Nominal Equilibrium Exchange Rate	Real Exchange Rate
	-1-	-2-	-3-	-4-	-5-
1966	1.00	1.08	1.01	1.37	1.14
1967	1.00	1.10	1.01	1.34	1.16
1968	1.00	1.11	1.01	1.35	1.20
1969	1.00	1.10	1.01	1.35	1.26
1970	1.00	1.15	1.01	1.35	1.28
1971	1.00	1.14	1.01	1.37	1.28
1972	1.00	1.12	1.01	1.25	1.23
1973	1.00	1.13	1.01	1.25	1.13
1974	1.00	1.14	1.01	1.21	1.11
1975	1.00	1.18	1.01	1.12	1.06
1976	1.00	1.20	1.02	1.19	1.05
1977	1.00	1.22	1.03	1.18	1.00
1978	1.00	1.25	1.04	1.29	1.02
1979	1.00	1.23	1.04	1.30	1.07
1980	1.00	1.26	1.05	1.34	1.05
1981	1.00	1.28	1.07	1.29	1.10
1982	1.00	1.46	1.19	1.50	1.20
1983	1.00	1.60	1.31	1.67	1.31
1984	1.00	2.83	2.37	3.02	1.94
1985	2.94	3.12	3.12	3.15	1.92
1986	3.08	---	---	---	1.76
1987	4.96	---	---	---	2.54
1988	6.14	---	---	---	2.63

Note: Column 3 is a weighted average based on imports using foreign exchange bought in the official and parallel markets.
The parallel market was abolished in 1985.
Column 4 was estimated by Greene and Roe.
Consumer Price Index (CPI) for US and DR are base 1980 = 100.
Column 5 = (column 3 * US CPI)/DR CPI. (see Rivera-Batiz)

Sources: Data in columns 1-4 from 1966-1985 taken from Greene and Roe, Trade, Exchange Rate, and Agricultural Pricing Policies in the Dominican Republic.
Data for 1986-88 are from International Financial Statistics.

traditional commodities could keep part of the foreign exchange earned and sell it in the parallel market at the parallel exchange rate (Greene and Roe). After 1979, importers also relied more on the parallel market to obtain foreign exchange. Imports using foreign exchange from the parallel market escalated from 17.5% of total imports in 1980 to 75% in 1984 (Greene and Roe). The parallel exchange rate rose to RD$2.83/US$1.00 in 1984 while the official rate remained unchanged (see table II.10).

By late 1984, the exchange rate in the parallel market was RD$4.00/US$1.00. Beginning in 1985, the government allowed the official exchange rate to fluctuate and, after a momentary decline, it jumped to RD$5.45/US$1.00 in 1986. In August 1986, the new administration tried to control the domestic financial markets by imposing tight controls on foreign exchange entering the country. Only the Central Bank and commercial banks were allowed to operate with dollars. Officially the dollar was pegged at RD$4.50/US$1.00. This control lasted just a few months and by late 1987 the government let the exchange rate float again. By mid 1988, it had climbed to RD$7.50/US$1.00. Again the government intervened in the market using force to close some non-regulated financial institutions, which were accused of introducing speculative distortions in the financial market (IDB,1989; EIU, 1989). By March 1989, the government set the official exchange rate at RD$6.37/US$1.00.

II.3.5. Agricultural Sector

Despite its decline relative to other sectors, agriculture, including production for export and domestic use, is still the most important economic sector in the Dominican Republic. It accounts for 15.0% of GDP and 52.0% of total export earnings and employs about 40.0% of the total labor force. The latest land survey (1980) shows 3.5 million hectares of land suitable for cultivation. Of these, 21.1% are used for export crops, 12.0% for food crops, and 36.5% for grazing (Harsthon et. al.). The rest of the Dominican Republic is covered by forest or is marginal land unsuitable for cultivation due to salinity or mountainous terrain.

The Dominican Republic produces about 80% of its food consumption. The main food crops produced in the country are rice, plantains, kidney beans, cassava, bananas, corn, and vegetables. Rice was introduced in the country in 1920 and by 1962 it had replaced cassava as the principal staple food. It provides 39% of the calories and 27% of the protein consumed by the population (SEA). Since 1966, agricultural officials have pursued the policy of self sufficiency in rice. This crop has been referred to as the "political crop" because the agricultural policy performance of any administration is often judged in terms of the capability of the government to provide enough rice for the population at a low price (Quezada).

As shown in table II.11, production of rice has been increasing continuously since 1966. In 1988, 100,052 hectares were devoted to rice production with a production of 422.2 thousands of metric tons of rough rice. The country achieved self sufficiency during the early 1980's due to the incorporation of new irrigated land and the introduction of new seed varieties. In addition, the government subsidized production on the acreage distributed under land reform programs through its input policies (subsidized loans, machinery, water and fertilizers) and free technical assistance (see section II.4.2.2). However, by 1985 the country had to import rice to meet domestic demand. The National Institute for Price Stabilization (INESPRE), which was the only agency allowed to market rice domestically, began to face liquidity problems and became unable to pay mill owners (World Bank, 1985). As a consequence, private producers could not obtain credit from mill owners for the 1985 harvest. In 1986, the new administration reduced the monopoly power enjoyed by INESPRE turning the marketing of rice over to the Agricultural Bank. Part
of INESPRE's debts to mill owners were paid and a differ-

Table II.11. Production of the Major Agricultural Commodities in the Dominican Republic, 1966-1988 (thousands of metric tons).

Year	Rough rice	Cassava	Red Beans	Plantains (*)	Yams	Bananas	Corn	indus. tomatoes	Peanuts in shell	Beef and veal
	-1-	-2-	-3-	-4-	-6-	-7-	-8-	-9-	-10-	-11-
1966	178.00	152.80	29.50	N.A.	N.A.	238.00	43.00	28.00	51.00	21.00
1967	147.00	152.00	30.00	N.A.	N.A.	238.00	39.00	57.00	45.00	21.00
1968	181.00	155.00	27.00	N.A.	N.A.	250.00	40.00	72.00	47.00	21.00
1969	195.00	170.00	34.00	N.A.	N.A.	250.00	43.00	76.00	50.00	21.00
1970	248.60	170.00	25.00	545.00	27.30	260.00	45.00	56.90	54.00	32.00
1971	207.00	184.00	28.00	545.00	34.00	286.00	47.00	83.00	57.00	33.00
1972	205.00	195.00	30.00	545.00	31.00	290.00	50.00	83.00	63.00	37.00
1973	205.00	200.00	20.00	550.00	29.00	310.00	52.00	84.00	65.00	39.00
1974	239.00	205.00	36.00	556.00	32.90	315.00	48.80	85.00	60.00	39.30
1975	218.60	190.70	35.70	556.00	32.00	302.00	46.10	132.80	51.20	36.60
1976	312.20	170.80	36.70	556.00	29.20	302.00	66.60	123.00	43.20	40.80
1977	308.00	184.90	35.90	531.00	29.50	302.00	35.00	139.80	48.00	36.00
1978	351.00	148.30	41.50	610.00	23.60	314.00	40.00	125.60	46.14	38.00
1979	376.70	119.30	47.70	550.00	17.20	315.00	46.00	107.90	37.54	46.00
1980	389.90	115.90	51.40	600.00	19.50	275.00	38.00	150.00	39.50	49.20
1981	400.50	125.70	52.40	625.00	17.00	301.00	41.00	155.40	24.90	52.00
1982	428.30	109.40	58.70	600.00	19.90	320.00	28.00	160.80	33.73	54.00
1983	500.50	111.50	61.10	605.00	17.30	320.00	42.00	164.80	33.09	57.00
1984	506.60	123.80	67.30	605.00	16.70	320.00	76.00	162.30	38.22	65.80
1985	493.80	135.50	48.40	600.00	17.10	314.00	91.00	164.90	41.00	60.00
1986	576.00	143.00	49.00	650.00	18.00	422.00	59.00	170.00	21.77	65.00
1987	466.00	103.00	38.00	650.00	11.00	373.00	52.00	176.00	26.45	68.00
1988	422.59	125.56	43.77	670.00	13.00	391.00	56.59	80.73	18.49	61.36

(*) In thousand of units.
Source: FAO Production Yearbook (various years).

ent grading and price structure for rice was established[1].

Kidney beans are part of the daily diet of the typical Dominican household. The beans are generally used for lunch along with rice, and meat or pasta. It is a main source of protein (17%) and provides 7% of the calorie intake. In 1988, the Dominican Republic produced 43.8 thousand metric tons of kidney beans supplying only 80% of the country's total consumption.

Plantain is another staple food in the Dominican Republic. In 1988, per capita consumption was 137.79 grams/day supplying 5% of the calorie intake and 2% of the protein (SEA). Production of plantains has been stable since 1980. In 1988, production of plantain was 670 thousand metric tons.

Cassava has been declining as a staple food for Dominican households. As the country has become more urbanized, households have changed their eating habits demanding products that can be easy stored and demand less cooking time. Not surprisingly, wheat consumption has increased and cassava consumption has declined steadily, since 1962 when the migration process accelerated. Due to climatic conditions, wheat can not be grown in the Dominican Republic. Imports of wheat have increased from 86,363.63 metric

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INESPRE's role is evaluated in section II.4.2.1 of this chapter.

tons in 1973 to 193,818.18 metric tons in 1988 (SEA).

Corn is mainly used for animal feed and self-consumption by rural households. During 1984-1985 production of corn increased significantly due to the introduction of a new hybrid variety. However the new variety proved susceptible to several diseases. Production dropped from 91 thousand metric tons in 1985 to 59 thousands metric tons the next year. Overall, production of corn declined during the period 1965-1987. Most of the corn produced comes from small plots which are usually double cropped with kidney beans.

Vegetable and fruit production have increased considerably in the last 8 years. Some of the sugarcane fields have been diverted to the production of fruit and winter vegetables to be exported to the United States. Tomatoes are grown extensively in the southwest and northwest regions. In 1988, the Dominican Republic produced 80.79 thousands metric tons of tomatoes. The country has been self-sufficient in tomato paste since the early 1970's and presently exports small amounts to some Caribbean islands. Fresh tomatoes are also exported during winter to the United States.

II.4. Government Policies to Promote Economic Development

II.4.1. Import Substitution

With a number of its policies, the Dominican Republic has pursued a strategy of economic development via the import substitution/industrialization process. The industrial policy, price controls, and the creation of government institutions to favor industrialization originated during the Trujillo era. However, it was after the enactment of the Industrial Incentive Law 299 in 1968 that the country turned most strongly toward import substitution. Under this law, three different classes of firms were created with varying degree of incentives for investment. Two of these classes of firms ("B" and "C") are firms producing import- competing goods.

Firms classified as "B" are those producing import substitutes or goods for which there is no previous domestic production. Firms in this category are 95% exempted from import duties on raw materials and intermediate goods as well as on fuel and lubricants other than gasoline. Firms "C" are firms producing goods which are being already produced, but for which the installed capacity is not sufficient to fulfill domestic demand. Firms which meet this category are 90% exempted from import duties on imported capital goods and intermediate goods. In addition, "B" and "C" firms are exonerated from income taxes on profits reinvested in the same firm or in new industries in the same or higher category (Bell).

Exemptions conceded to firms favored by law 299 together with the incentives provided by the over-valuation of the peso and the government policy of cheap food (see section II.4.2), gave rise to high levels of protection for the import substitution industries. Vedovato (1985) found that in 1970 the level of industrial protection in the Dominican Republic was the second highest in Latin America.

Due to the relative cheapness of capital inputs caused by the incentives provided by Law 299, the import substitution strategy has favored the adoption of capital intensive production techniques. This brought about an increase in the capital-output ratio in Dominican industry. This ratio rose from 2.4 in 1970 to 4.7 in 1977 (Vedovato). At the same time, there has been an under utilization of capacity (or increase in excess capacity) due to the tendency of the already established firms classified as "B" and "C" to build sufficient capacity to prevent any new firm from entering the market (Vedovato).

II.4.2. Agricultural Policy

II.4.2.1. Food Policy

Policies of cheap food to benefit urban consumers have been carried out by the National Institute for Price Stabilization (INESPRE), the General Directorate for Price Control (DGCP) and the Dominican mill (Molinos Dominicanos). Until late 1987, INESPRE was the only agency allowed to market rice. Owners of rice mills had to render their polished rice to INESPRE which in turn delivered the product to wholesale organizations and directly to consumers through its social program of "popular sales". In most of the years when INESPRE handled the marketing of rice, the price paid to millers was higher than the price INESPRE charged to wholesalers. The purpose of this policy was to subsidize consumption of rice to the population while giving attractive prices to producers. In 1986, INESPRE was responsible for transactions of 84.2% of the domestic rice production. Imports of rice are also handled by INESPRE.

INESPRE also has a monopoly on the import of edible oils. Because the country can import these commodities under concessionary terms (through PL-480), INESPRE obtains profits from the sale of edible oils in the domestic market. Quite different from its rice policy, INESPRE's markup for vegetable oils was over 60% in 1983 (World Bank, 1985). Profits from the marketing of edible oils were used to compensate for the losses from the subsidization of rice.

INESPRE also has control on corn imports which are used mainly as animal feed. It handles about 10% of the domestic production. The price policy pursued by the government has discouraged domestic production of corn. Demand for corn (especially for the broiler industry) has been met in part by imports from the United States, primarily through PL-480. Corn imports have soared from 50,000.00 metric tons in 1973 to 254,772.72 metric tons in 1988 (FAO Trade Yearbook). In the last five years, domestic corn producers have enjoyed attractive prices supported by INESPRE. However, calculations from a World Bank report in 1985 show that the country does not have a comparative advantage in corn production. Other crops handled by INESPRE include sorghum (25% of the domestic production), onions, and potatoes.

II.4.2.2. Input Policy.

The agricultural sector has benefited from government programs of subsidized inputs. Fertilizer and pesticides are provided to farmers at subsidized prices through the Agricultural Inputs Sales Centers (CVMA). However, its share of total sales of pesticides and fertilizers is less than 5%. Sugarcane and rice are the two crops which use fertilizer most intensively. Table II.12 shows that these two crops used 80% of the total fertilizer consumed in the country in 1984. Coffee, pasture and tobacco are the other crops using moderate amounts of fertilizer. The Agri-

Table II.12. Fertilizer Used by Crop, 1984.

Crop	Harvested Area (000 HA)	Percent fertilized (%)	Fertilizer rate (KG/HA)	Total fertilizer (MT)	Percent Usage (%)
Sugarcane	265	80	500	106,000	60.10
Rice	90	90	430	34,830	19.80
Coffee	150	20	360	10,800	6.10
Pasture	1,100	2	275	6,050	3.40
Tobacco	31	33	400	4,092	2.30
Plantain	40	15	350	2,100	1.20
Potatoes	2	100	700	1,530	.90
Beans	36	10	325	1,170	.70
Peanuts	40	30	180	2,160	1.20
Onion	2	95	600	912	.50
Garlic	1	100	1,400	770	.40
Ind. Tomato	5	95	300	1,340	.80
Cotton	4	100	430	1,505	.80
Cocoa	90	10	200	1,800	1.00
Corn	44	5	350	700	.40
Coconut	16	10	250	400	.20
Cassava	19	1	250	48	.10
Sweet Potato	8	1	200	16	.10

Source: SEA: Departamento de Economia Agricola, "Impact of Input Price Increases on Agricultural Production Costs", Santo Domingo, 1984.

cultural Mechanization Service Program of the Ministry of Agriculture (PROSEMA), created in 1978, provides services to small and medium farm at a subsidized rate. In 1988, 96,309.75 hectares benefited from the PROSEMA's services. Services included plowing, leveling, harrowing, planting and harvesting. Service fees are generally 40-50% lower than those charged by the private sector.

The Agricultural Bank (BAGRICOLA), is the government institution responsible for financing farming activities to small and medium farmers. It provides, at a subsidized interest rate, about 80% of the total loans directed to the agricultural sector. In 1988, about 39% of the money lent by the Agricultural Bank was channeled to finance the production of rice (see table II.13). Loans to rice producers totaled RD$306.47 million covering about 79.4% of the total land devoted to rice production during that year. Beef cattle was the livestock activity most favored by credit in 1988 with RD$64.35 million used to finance its operation. Other sources of credit include the commercial banks, mill owners and local moneylenders. The interest rates charged by those agents are higher than these charged by the Agricultural Bank.

Table II.13. Credit Provided by the Agricultural Bank, 1988.

Activity	Value (RD$000)	Percent of total loans	Area covered (HA)	Country harvest area (HA)	Percent of total harvest land
	-1-	-2-	-3-	-4-	-5-
Crops	616,910	78.59	203,082		
Rice	306,477	39.04	79,497	100,052	79.46
Coffee	40,194	5.12	11,887	99,525	11.94
Tobacco	40,225	5.12	7,925	12,513	63.33
Beans	25,664	3.27	19,623	57,630	34.05
Plantain	21,916	2.79	10,063	11,740	85.72
Ind. Tomato	16,405	2.09	3,962	6,394	61.97
Onion	14,186	1.81	1,950	2,381	81.87
Yam	12,936	1.65	7,296	9,334	78.16
Cassava	12,346	1.57	9,748	20,423	47.73
Potato	10,678	1.36	1,447	2,164	66.85
green pea	10,007	1.27	18,239	29,109	62.66
Sorghum	9,099	1.16	6,730	13,914	48.37
Garlic	6,681	.85	314	938	34.77
Coconut	5,984	.76	4,528	N.A.	N.A.
Cocoa	5,437	.69	1,887	N.A.	N.A.
Corn	5,064	.65	5,220	33,794	15.45
S. Potato	1,409	.18	1,132	7,207	15.71
Other	72,201	9.20			
Livestock	168,095	21.41			
Beef cattle	64,357	8.20			
Dairy cattle	35,116	4.47			
Hogs	3,291	.42			
Poultry	25,284	3.22			
Goats	121	.02			
Bees	1,638	.21			
Total	785,005	100.00			

Sources: Columns 1, 2 and 3 from the Agricultural Bank (BAGRICOLA).
Column 4 from Secretaria de Agricultura, Plan Operativo 1989.
Column 5 = (column 3/column 4)*100.

II.4.2.3. Land Distribution

Land is not uniformly distributed in the Dominican Republic. While 82% of the farms occupy only 12% of total land available, 2% of the farms own 55% of the total land. Farms producing export crops, mainly sugar, and livestock operations are the largest. Food crops are grown on medium and small farms.

In 1962, the government initiated a land reform program affecting only the land owned by the government. Since that time, 6.4 million tareas (402,731 ha.) of land have been distributed among 70,833 landless peasants under three different ownership systems: individual plots of land, collective farms, and cooperative farms. The Dominican Agrarian Institute (IAD), created in 1962, is the institution in charge of the administration of land reform.

In 1972, the government, under political pressures to speed up the land reform process, enacted four laws which were called "the agrarian code". Law 279 made all land not under cultivation liable for compulsory purchase by the state and placement at the disposal of the IAD. This law was passed because the government had launched a program to build dams to enhance the quality of some idle land. The government wanted some compensation in the form of land which could be distributed among landless peasants (Bell, 1981). Law 282 prohibited landlords from leasing plots of land in size smaller than the indispensable minimum sufficient to support a peasant family. Law 283 gave illegal occupiers of state lands three months to vacate it.

Law 314 is considered the most important of the four laws. It was passed to attack latifundia in the country. The purpose was to reduce the concentration of large tracks of cultivable land on the hands of few people. It established limits, depending on land quality, on the amount of land which could be owned by an individual. Agricultural land was classified in eight different categories and limits were placed on each category. Land in excess of a landowner's permitted holding would become available for agrarian reform.

Since 1972, the government has distributed land to landless peasants organized into collective farms. The beneficiaries receive only usufructuary rights and provisional titles. The beneficiary's family may inherit the use rights but they can not sell or transfer their parcels since the original land title remains with the state.

Under the collective system, beneficiaries have to work together on their plot of land and benefits or losses at the end of the season are split equally among them. Each settlement is supervised and managed by an IAD official who usually is an agronomist. He is in charge of providing technical assistance and serves as a linkage between the IAD and the land reform beneficiaries.

Since 1984, some collective farms have evolved into what is called "associative settlements." In this new type of organization, the land is kept undivided, but each farmer is assigned to a small plot of land and is responsible for all the production activities. Benefits or losses are distributed according to the yields in each individual plot.

Land distributed under the reforms is mainly used for domestic crops. In 1986, land reform settlements supplied 42% of the domestic rice production; 16% of corn; 14.3% of kidney beans; 12.9% of potatoes, and about 11% of onion and garlic (SEA, 1987).

Land reform in the Dominican Republic has been criticized because it has not achieved its original goals of increasing rural incomes and slowing rural to urban migration. During its initial years, land reform consisted only of land distribution. Ancillary services including credit, extension, and marketing were absent. Furthermore, landless peasants received land without any training which would help them to make the transition from rural workers to agricultural entrepreneurs (Quezada, et al.). The result was a reinforcement of the traditional subsistence agricultural practices with low productivity and low adoption of new technology.

In 1985, 14% of the agricultural land in the Dominican

Republic was under land reform. However, only 64% of the land distributed is being utilized (Stanfield, 1985). The main reason for the low land use is that about 50% of the land under land reform is considered marginal (low quality with little access to water or roads and/or located in isolated areas).

II.4.3. Export Promotion

Export promotion activities, especially through duty free zones, have been implemented along with import substitution measures. In the Dominican Republic there is only one law to promote industrial development which is the Industrial Incentive Law 299. It includes incentives to both import-competing and export-oriented activities.

Firms classified as "A" by the IIL are those producing only for export. Firms meeting the requirements are exempted from paying taxes on imported machinery and equipment, on raw materials and intermediate goods. In addition, the government has invested in infrastructure (buildings, roads, and electric services) to facilitate the installation and operation of duty free industries. "A" firms are located exclusively within free zones established by the government. Since 1968, 12 free zones have been created with 160 firms producing garments, shoes, tobacco and cigars, leather products, jewelry, and electronic components (Rubin). In 1982, duty free industries were responsible for about 20,000 jobs. In 1987, duty free zones provided jobs to 3% of the Dominican labor force (IDB,1988).

Non-traditional agricultural and agroindustrial exports have also been promoted through the enactment of law No. 409 which provides incentives to industries processing tropical agricultural products. Although non-traditional exports need to overcome a series of obstacles such as high cost of packaging materials, customs and transport problems, Central Bank delays, and shipping risks, there is a potential market which can be captured by the Dominican goods (World Bank, 1985). Non-traditional agricultural exports include fresh and frozen fruits (such as cantaloupe and honeydew, pineapple, bananas and mangoes) and vegetables (tomatoes, cucumbers, onions, peppers, okras, avocados, eggplants).

Some of the fruits and vegetables are being grown in land previously used for sugarcane production. The government, which owns most of the land devoted to sugarcane, has established joint-ventures with the private sector to produce alternative crops for export. Since the early 1980's, the government has closed three sugar mills. The land has been used to open a new industrial free zone and to produce fruits and vegetables (EIU).

Chapter III: Inward-Oriented Versus Outward-Oriented Development Strategies

III.1. Introduction

Evidence showing that countries which have pursued export-oriented strategies have achieved higher economic growth than countries pursuing import substitution has stimulated a discussion of the advantages and disadvantages of each strategy (Krueger, 1984; Preusse; Chen and Tang). Many have suggested that the answer to economic growth for developing countries lies in the ability of countries to adopt a more trade-oriented strategy (Krueger, 1984; World Bank, 1987). This chapter discusses the economic theories developed to support the implementation of inward-looking versus outward-oriented strategies. Each strategy and the policy instruments used to implement it are described, and the strategy is evaluated using economic theory in terms of resource allocation, income generation and distribution, technology transfer and adoption, foreign exchange earnings, and long-term economic growth.

III.2. Inward-Oriented Strategy

The inward-oriented strategy for development has consisted of a set of policies aimed at providing incentives to encourage production of industrial goods which were previously imported. It consists of a set of industrial and trade policies the objective of which is to protect domestic production. Import-substitution activities have been favored under the premises that economic linkages and long-term growth are better served by these activities (Matthews). It is also argued that an inward orientation builds up entrepreneurial experience and compensates for existing market imperfections (Kirkpatrick and Nixson). A standard argument in favor of an import-substitution strategy is known as "export pessimism". It has been argued that terms of trade for less developed countries tend to deteriorate because prices of the commodities exported by these countries tend to decline in relation to price of the industrial goods exported mainly by industrial countries (Matthews).

It is also believed by proponents of an inward-oriented strategy that by protecting domestic industry a country can overcome the problems associated with the initial stage of industrialization (Krueger, 1984). Some industries which exhibit decreasing cost over time, might experience economic losses at early stages of operation. In that case, the private sector would be reluctant to invest, unless there is some government subsidy. Furthermore, industrialization is linked to domestic capital formation and job creation which would allow the transfer of labor in the rural sector from activities where the its productivity is low, to higher productivity activities in the urban sector (Krueger; Himata).

Those who favor import-substitution also claim that an export-oriented strategy which is based on the notion of comparative advantage may hinder the industrialization process and the overall growth of developing countries (Kavousi). Because developing countries often enjoy comparative advantage in the production of most primary goods, growth of factor productivity and the development of entrepreneurial skills would be inhibited by specialization in the production of such goods (Kavousi). Furthermore, due to the nature of the demand for primary commodities, any attempt by the developing countries to increase production will result in lower export prices and a transfer of income to developed countries (Kavousi). Moreover, economic performance by export-oriented countries is not only related to trade strategy, but also to external demand conditions. Thus, Singer and Gray suggest, for example, that an export-oriented strategy can not be considered a general recommendation for all countries because the factor of strong external markets for the commodities being exported is more important than the trade strategy pursued by a country.

Policy instruments used to provide incentives to import competing industries include tax holidays on imported inputs (machinery and equipment, raw materials), import tariffs, quotas and import prohibition. In addition, macroeconomic policies have also been used to favor those industries. For instance, a policy of over-valuation of the currency introduces a bias against exports and favors import-competing industries receiving tariff or other forms of protection. Production cost of the these latter industries tend to be lower because they can obtain foreign exchange at a subsidized rate (Krueger, 1984; Greenaway and Nam).

Several theoretical studies have shown that import-substitution strategies introduce distortions into the economy and do not bring about the sought after economic development. First, import substitution industries (ISI hereafter) could distort relative factor prices, favoring the use of production techniques which use capital intensively (Greenaway and Nam; World Bank, 1987). Due to the incentives provided by tax exemptions on imported capital inputs, ISI are induced to use more capital than would be the case under free market conditions. In turn, the labor/output ratio in the industrial sector decreases as the country engages in import substitution activities (Krueger,1984). The strategy of job creation in the urban sector, which is viewed as essential to reduce unemployment, is hindered by ISI. Migration to the city can be fueled by import substitution due to the implied bias against the agricultural sector. Rural residents would migrate to the city at a faster rate than the one expected by the modernization of the agricultural sector. However, because the industrial sector is not creating employment at the same rate as the rural out migration, the end result is a higher rate of unemployment.

A third argument against ISI is related to the technical efficiency of production. The fact that import-competing activities enjoy in most cases monopolistic power, due to the licensing mechanism used by the government to protect industries, provides room for inefficiency and slow growth (Krueger, 1984). The absence of domestic and external competition eliminates the need for the introduction of production techniques which will enhance productivity and reduce costs. ISI are then induced to charge higher prices and put less emphasis on product quality (Kirkpatrick and Nixson).

A standard argument used to favor ISI is the balance of payments argument. The argument is that industrial promotion through ISI will save foreign exchange and help to improve the balance of payments (Greenaway and Nam). However, import-competing production may depend on imported inputs with the result of little improvement in the trade balance. Although some final products are now produced by the ISI, intermediate goods used in the production of those final goods have to be imported. If comparative advantage had been used to make the decision about what final goods to produce, then it could be that more foreign exchange would be earned by producing export-competing goods than could have been saved by devoting the same resources to import-substitution production (Greenaway and Nam). This loss of allocative efficiency is aggravated by the inefficient use of resources devoted to rent-seeking activities by those protected by government policies. Additional resources are wasted by the government because the implementation of import-substitution strategies demands the creation of administrative procedure to channel resources to specific activities.

The agricultural sector is also often affected negatively by the implementation of an import substitution strategy. In countries where the structure of exports is based on agricultural commodities, an import substitution strategy would protect industrial activities at the expense of both exports and the agricultural sector. A policy of import substitution in the agricultural sector (mainly food self-sufficiency) tends to be self defeating due to the smallness of the domestic market. Once self-sufficiency is achieved, the surpluses have to be shipped to the international market, and additional export subsidies are often needed to compete in that market (Murphy).

III.3. Outward-Oriented Strategy.

The above discussion suggests that an outward-oriented strategy is better suited to achieving the objectives of economic growth. Empirical evidence from the newly industrialized Countries (NIC's) which have followed an outward-oriented strategy further supports this view (World Bank,1987; Hirata).

Supporters of the outward-oriented strategy use as a frame of reference the neoclassical paradigm relying on the market mechanism and a neutral government policy between domestic and export markets (Krueger, 1984; World Bank, 1987). Nevertheless, outward-oriented activities are associated with export promotion. They call for reduction or elimination of import distortions and, in some cases, for provision of specific incentives to export activities.

Supporters of an outward-oriented strategy argue that unlike ISI, firms producing for exports face external competition which forces them to be more technical and price efficient. In addition, being exposed to the external market allows them to be receptive to improved production techniques. Even in countries classified as outward-oriented, firms that produced for exports are more efficient than firms whose production goes to the domestic market (Chen and Tang).

It is argued that countries pursuing an outward-oriented strategy tend to have better macroeconomic performance than countries pursuing inward-oriented strategies. Empirical examination of macroeconomic variables such as growth rate of GDP per capita, merchandise exports, incremental capital/output ratios (ICOR), and average debt service ratios as percentage of exports, show that outward oriented economies achieved higher GDP per capita growth, better export performance, and more capital formation than inward-oriented economies (World Bank, 1987; Laux-Meiselbach).

Few countries follow a consistent strategy of import-substitution or export-promotion through time. Economic development in some countries has been carried out by an initial stage of import-substitution and then a switch to emphasize export-promotion (Greenaway and Nam). In developing countries it is difficult to find a set of policies designed exclusively to promote import-substitution or to promote exports (Siggel). It is common to find a mix of policies which may counteract each other. Governments often pursue policies which favor trade and market liberalization, but retain some policies designed to favor import-substitution activities. As a consequence, although some policies may be well designed, their impacts may be nullified by either the lack of effective mechanisms to implement them or because of the countereffects of other policies (Siggel).

III.4.Government Intervention in Agriculture

The extent and magnitude of government intervention in agriculture are difficult to assess and vary among countries. Governments design and implement policies aimed at achieving goals of sectoral and general development. Some developed countries (DCs) protect their agriculture through such methods as deficiency payments, import tariffs and quotas, and subsidized loans. These programs insulate domestic producers from external competition bringing about an increase in agricultural production compared to the level that would have been produced without government intervention (Bale and Lutz). Many less developed countries (LDCs), on the other hand, have followed a policy of cheap food to favor urban residents and keep wages low and benefit investment in industry. Along with these explicit policies, many LDCs have maintained overvalued exchange rates which have worked as an indirect tax on export-oriented agricultural products and as a subsidy for import-substitution industries. The latter industries can obtain foreign exchange to buy imported inputs at a lower cost than the rate which would prevail without any foreign exchange control. The agricultural sectors of LDCs have also been seen as the main provider of fiscal revenue especially through taxing of agricultural exports (Lutz and

Scandizzo).

Policies aimed at keeping food prices low together with an overvalued exchange rate reduce the profitability of investments in agriculture and can bring about a decline in the rate of growth in the sector (Krueger et al.). An overvalued exchange rate, imposed through exchange controls and an import licensing mechanism, can induce increased demand for capital-intensive imported goods due to the relative cheapness of these goods. This effect can be worsened if high inflation rates reinforce the overvaluation of the national currencies. Domestic inflation and overvaluation also worsen international competitiveness (Hwa). Then, pressure on foreign exchange is increased not only due to the increased import demand, but also due to a decrease in foreign exchange earnings from agricultural exports (Bale and Lutz).

For agriculture, a reduction in government intervention in markets for tradable commodities might reduce price fluctuations in international markets and bring more efficiency in the allocation of resources. Agricultural producers would benefit through greater access to export markets; consumers would benefit from lower prices and taxpayers would benefit because less government expenditure would be required (Chattin). The distribution of income between consumers and producers within a country and across countries would also be affected by a reduction in government intervention in agriculture. In countries where agriculture is subsidized through output price intervention, the reduction of government intervention would lower prices but would increase the demand for agricultural products. Where agriculture is taxed, it is expected that prices would rise, increasing supply and making investment in the sector more attractive (Reeve).

III.5. Debate Over Development Strategies in The Dominican Republic.

The Dominican Republic is still classified as a strongly inward-oriented country (Greenaway and Nam[1]). Even when steps have been taken by the government to overcome the current economic crisis, some of its policy measures conflict with others. For instance, although export-oriented activities are now being promoted, there is no new legislation favoring exports and policies of protection for import-competing industries are still in place. There are still some doubts regarding the effectiveness of duty-free export processing zones in addressing the Domini-

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Greenaway and Nam classified countries as outward-oriented, derately outward-oriented, moderately inward-oriented, and rongly inward-oriented according to their trade orientation. iteria used for their classification include the level of trade ntrols, the use of direct control and licensing arrangements, d exchange rate control.

can Republic's main economic problems. Although industries located in the free zones provide employment, they use few domestic inputs and their contribution to the domestic economy is only through wage payments. There is also the issue of job security in the long run. It is argued that free-zone industries do not invest in infrastructure and can leave the country any time, leaving behind a pool of unemployed workers (Murphy). Because manufactured exports are a small fraction of total exports, the impact of development of the export industries on employment, income distribution and economic growth may be relatively small. In countries like the Dominican Republic, where the agricultural sector is still of great importance, the impact of an outward-oriented strategy on the agricultural sector is believed to be of greater magnitude. Specifically, the diversification of the agricultural sector through agroindustry development and non-traditional crops for exports can foster economic growth and establish domestic economic linkages (JAAC).

In the agricultural sector, the substitution of production of fruits and vegetables for sugar production does not enjoy consensus support among economists and policy makers. Those who still favor sugar production argue that even when potential markets for fruits and vegetables exist, there are also more risks involved and the market may end up being more volatile than the one for sugar. In addition, there is more domestic value added for each unit of foreign exchange earned via sugar production than from non-traditional exports (USGAO).

The above arguments favoring outward-oriented activities has implicitly assumed that market imperfections are not relevant and that resources can move across activities reacting to relative prices. It also assumes that transition from import-substitution to an export-orientation can be achieved without high adjustment costs. However, due to the commitment of resources in import-competing industries and the political and economic leverage of the ISI group, the transition to an outward-orientation may be accompanied by economic disruption and political upheaval (Kirkpatrick and Nixson, Hirata).

Although this study is concerned with the effect of alternative trade strategies on the performance of the Dominican economy, the major emphasis will be placed on the agricultural sector. Trade policies as a means of achieving development objectives will be evaluated mainly as they affect the performance of the agricultural sector. Due to the linkages of the agricultural sector with other economic sectors, some conclusions can be drawn regarding the overall effect of alternative policies on the whole economy.

Chapter IV. Nominal and Effective Protection in the Dominican Agriculture

IV.I. Introduction

This chapter discusses government interventions including price and trade policies and their impact on the agricultural sector. The first section describes the measures of nominal and effective rates of protection used to evaluate the degree of market distortions introduced by trade interventions. The next section presents estimates of these interventions for selected crops for the Dominican Republic for 1984-1988. These estimates help identify the different policy scenarios to be analyzed with the mathematical programming model of the agricultural sector of the Dominican Republic in subsequent chapters.

IV.2. Measures of Government Intervention

Most empirical studies estimating the effects of price and trade policies on the agricultural sector have made use of Nominal Rates of Protection (NRP) and Effective Rates of Protection (ERP). Domestic Resource Costs (DRC's) have also been calculated to assess the comparative advantages of different production activities. Along with these measures, a partial equilibrium model in the Marshallian economic surplus framework is often used to measure welfare impacts of these policies.

IV.2.1 Nominal Rate of Protection (NRP).

NRP estimates the difference between the domestic output price and the world (border) price caused by market interventions such as taxes, subsidies and other policy instruments (Appleyard, Hsu). The formula can be expressed as:

$$1)\ NRP = ((P_{Do}-P_{Bo})/P_{Bo})*100$$

where:

P_{Do} = domestic price of a specific commodity

P_{Bo} = international (border) price of the commodity

Both the domestic and the border price are usually converted to farmgate prices to assess the incentives (or disincentives) being provided to producers of a commodity by the market interventions. When distortions are absent, border prices represent the price that producers would receive once marketing costs are subtracted.

To compute NRPs, border prices are converted into the country's currency using some measure of the exchange rate. If the official exchange rate is utilized, the level of protection may be distorted. For example, in the Dominican Republic a parallel market for foreign exchange exists which differs from the official exchange rate. If it is assumed that the parallel exchange rate reflects more closely the real opportunity cost of foreign currency, then NRPs based on the parallel rate might provide a more useful measure than those based on the official rate.

A deviation of NRP from zero indicates some sort of distortion which would affect resource allocation. A negative NRP indicates that producers are being penalized because the border price evaluated at the farmgate level is greater than the price received by producers. When NRP is positive, producers are receiving nominal incentives, reflected in a higher price for their product than the border price equivalent.

NRP's have been used extensively to measure protection because of their ease of calculation. However, they are subject to a number of criticisms. The first obvious limitation of NRPs is that they do not consider input costs. Adjustments have to be made to include the effects of subsidized or taxed inputs. This leads to the measures of Effective Rates of Protection (ERPs) discussed below.

Another criticism of NRP's is that they do not take into consideration some government programs, such as soil erosion programs and research and extension programs, which provide incentives to farmers (McClatchy). One way to overcome this problem is by estimating the tariff-equivalent impacts of all government programs and then assessing their impacts on the wedge between the domestic price and the border price. However, even this more extensive approach may not show the real effects of government intervention on production, consumption, trade, resource allocation, and income distribution. For instance, although an import quota may have the same impact on domestic price as a tariff, the rent from the quota will accrue to the importer with the quota permits (unless the government allocates the quota with some kind of auction). The income from a tariff will be collected by the government (Parikh et. al.). In addition, the size of the tariff equivalent will depend on the world market price. For instance, if a country pursues a policy of domestic price stability through quotas and stock operations with a fluctuating world price, it may appear that government policy is changing because the size of the tariff equivalent will fluctuate as the world price changes (Harling).

Even with the above criticism, NRP's still provide a good indicator of the types of government intervention and the direction of the impacts of distortions. They are useful measures because the primary distortions are often due to output price interventions.

IV.2.2. Effective Rate of Protection (ERP)

The Effective Rate of Protection (ERP) is used to analyze the structure of incentives in a specific production activity by measuring the degree to which market interventions cause domestic value added to diverge from the value added without any market intervention (Appleyard, Henneberry and Henneberry). ERP's take into account input policies by comparing value added at domestic prices and world prices. The domestic value added is computed as the output price received by domestic producers minus the cost of tradable inputs used evaluated at domestic prices. The value added at the international (border) prices is calculated as the border price of a specific production activity minus the cost of tradable inputs valued at world (border) prices. Border prices can be converted to domestic currency using the official exchange rate, a parallel exchange rate, or a calculated equilibrium exchange rate.

ERP can be expressed as (Henneberry and Henneberry):

2) $ERP = ((V-V')/V)*100$

where:

$V' = P_{wi} - \Sigma (A_{ij}*P_{wj})$ = value added without market intervention (free trade).

$V = P_{di} - \Sigma (A_{ij}*P_{dj})$ = value added at domestic price.

P_{wi} = border price of output i.

P_{di} = domestic price of output i.

A_{ij} = quantity of tradable input j used per unit of good i.

P_{dj} = domestic price of input j

P_{wj} = border price of input j.

ERP's can be positive or negative depending on the policies affecting inputs used in the protected industry and the level of output price protection. A positive ERP means that production of a particular commodity is receiving net positive incentives. A negative ERP implies that the net incentive for a particular commodity is negative. The case of negative effective protection rates for agricultural commodities is not unusual in LDC's. Agricultural output prices are sometimes kept below world levels by government interventions as discussed above. Governments also impose tariffs on inputs which are used in the production of agricultural commodities in order to raise revenue or to reduce consumption of these inputs. That has been the case with tariffs on fuel oil, for example, which affects the price of agricultural machine services and the costs of fertilizers. Governments may also want to build a national industry to produce some inputs. To help such an industry develop, they may provide protection by prohibiting import of those inputs or by providing other tax exemptions to the industry. Fertilizer production in the Dominican Republic, for example, has been protected by the government in order to build a domestic industry that can supply the amount of fertilizer demanded by the country's agricultural activities.

ERP is a better measure than NRP for estimating the effects of policy intervention on the direction of resource shifts among activities producing traded goods. Domestic production will shift from activities with negative or low effective protection rates to activities with high effective protection rates. Estimation of ERP's may explain why some agricultural and non-agricultural activities have not grown at the rate expected when protection was placed on output prices.

Although ERP is a more comprehensive measure than NRP, it is more difficult to compute and to interpret. It is usually difficult to obtain reliable data on the real prices of all the tradable inputs used in a production activity. Another limitation of ERP's is that non-tradeable inputs such as water for irrigation, which may be affected by government policies, are not included in the calculation. This limitation is also shared by NRP's.

IV. 3. Nominal and Effective Rates of Protection for Agriculture in The Dominican Republic

Nominal and effective rates of protection were calculated for eight agricultural commodities in the Dominican Republic for the years 1984-1988. The commodities include traditional exports (sugar, coffee, tobacco), imported food crops (rice, beans, corn), and non-traditional export crops (salad tomatoes and beef).

To compute the rates of protection, producer prices and marketing costs were obtained from the statistical appendices of the Ministry of Agriculture annual operating plans, the National Council for Policy Analysis Reports (CAPA), and the FAO Production and Trade Yearbooks. Conversion ratios for rice and sugars were obtained from the Study Unit of Agricultural Policy (UEPA). Foreign exchange rates were obtained from the Central Bank Statistical Bulletins. Border prices came from different sources including International Financial Statistics from the International Monetary Fund, World Sugar Production and Situation Outlook, and the FAO Trade Yearbooks.

Table IV.1. illustrates how NRP's and ERP's were calculated, using rice as an example. In order to calculate protection at the farmgate level, producer prices and border prices were converted to rough rice equivalents. The rough/polished rice ratio of 64.5% indicates that a ton of rough rice renders 0.645 tons of polished rice.

In 1984 the country produced 506,600 metric tons of rough rice (see row A), which, after processing, became 326,760 tons of polished rice (row C)[1]. In 1984, rice growers received an average price of RD$481.32 per metric ton of rough rice (row E). The marketing margin includes

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' The farmgate price of rough rice was obtained directly from ıe statistical appendices of the Dominican Ministry of Agriculıre's operating plan for 1989.

Table IV.1. Nominal and Effective Rates of Protection for Rice(*).

		Unit (**)	1984	1985	1986	1987	1988
A.-	Production, rough rice	1000 MT	506.60	493.80	461.24	512.97	425.44
B.-	Conversion rough/polished rice	Percent	64.50	64.50	64.50	64.50	64.50
C.-	Production, polished rice	1000 MT	326.76	318.50	297.50	330.86	274.41
D.-	Producer price, polished rice	DR$/MT	746.24	1134.98	1004.08	1326.38	1050.06
E.-	Producer price, rough rice	DR$/MT	481.32	732.06	647.63	855.52	677.29
F.-	Mktg. margin farmgate/wholesale	DR$/MT	127.81	177.52	217.28	249.59	357.35
G.-	Border price, import (CIF)	US$/MT	418.00	426.00	255.50	453.50	356.70
H.-	Official Exchange Rate (OER)	DR$/US$	1.00	3.11	2.90	3.84	6.14
I.-	Border price at OER for polished rice	DR$/MT	418.00	1324.86	740.95	1741.44	2190.14
J.-	Border price at OER for rough rice	DR$/MT	269.61	854.53	477.91	1123.23	1412.64
K.-	Border price of rough rice at farmgate and OER adjusted for mktg. cost	DR$/MT	141.80	677.02	260.63	873.64	1055.29
L.-	Direct Nominal Rate of Protection	Percent	239.45	8.13	148.49	-2.07	-35.82
M.-	Parallel Exchange Rate (PER)	DR$/US$	2.83	3.12	2.91	3.84	6.15
N.-	Border price polished rice at PER	DR$/MT	1182.94	1329.12	743.51	1743.62	2194.17
O.-	Border price rough rice at PER	DR$/MT	763.00	857.28	479.56	1124.63	1415.24
P.-	Border price rough rice at farmgate and PER adjusted for mktg cost	DR$/MT	635.18	679.77	262.28	875.04	1057.89
Q.-	Total Nominal Rate of Protection	Percent	-24.22	7.69	146.93	-2.23	-35.98
R.-	Fertilizer/rice coefficient	Ratio	.08	.08	.08	.08	.08
S.-	Actual price, fertilizer	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
T.-	Fertilizer Border Price	US$/MT	171.30	203.15	190.00	194.00	222.00
U.-	Fertilizer border price (OER)	DR$/MT	171.30	631.80	551.00	744.96	1363.08
V.-	Fertilizer border price (PER)	DR$/MT	484.78	633.83	552.90	745.89	1365.59
W.-	Fert. price(actual)*fert./rice coeff.	DR$/MT	36.85	46.35	73.46	100.58	127.70
Y.-	BP. fert. (OER)*fert/rice coeff.	DR$/MT	13.77	50.79	44.30	59.89	109.58
Z.-	BP fert.(PER)*fert/rice coeff.	1000 MT	38.97	50.96	44.45	59.97	109.78
AA.-	Value Added (distorted)	DR$/MT	444.47	685.72	574.17	754.93	549.59
AB.-	Value Added (OER)	DR$/MT	128.02	626.23	216.33	813.75	945.71
AC.-	Value Added (PER)	DR$/MT	596.21	628.81	217.83	815.07	948.11
AD.-	Effective Rate of Protection (OER)	Percent	247.18	7.50	145.41	-7.23	-41.89
AE	Effective Rate of Protection (PER)	Percent	-25.45	7.05	143.59	-7.38	-42.03

Note: OER = Official exchange rate; PER = Parallel exchange rate; BP = border price.
(*) Irrigated land, high level of inputs, mechanized, good quality land (type A).
(**) MT= Metric ton; DR$ = Dominican pesos; US$ = US Dollars

processing cost plus wholesale profit.[1] In some cases the marketing margin was only available for 1985. In these cases, the nominal marketing costs for other years were estimated using changes in the Producer Price Index for Inputs (PPII) with 1985 as a base year (1985=100).

Two different Nominal Rates of Protection were calculated for each of the eight agricultural commodities. The first one is called Direct Nominal Rate of Protection (DNRP) because it takes into consideration only the effects of agricultural policy intervention affecting output prices. Border prices are evaluated at the official exchange rate. In terms of table IV.1, the expression for DNRP is:

3) DNRP = ((row E - row K)/row K)*100

For 1984, the DNRP for rice was 239.45 percent.

The second nominal protection rate calculated is a Total Nominal Rate of Protection (TNRP). It adds the effect of exchange rate distortions to the output price effect by evaluating border prices at the parallel exchange rate (PER). The equation for TNRP is:

4) TNRP = ((row E - row P)/row P)*100.

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[1] Data were converted from Dominican pesos per hundreweight of ›lished (RD$/QQ) rice to Dominican pesos per metric ton of rough .ce. The wholesale marketing cost for polished rice was ex:essed also in RD$/QQ and was converted to RD$/MT by multiply›g the cost by 22. Then it was converted into rough rice equiva›nt by multiplying the latter figure by 0.645.

For 1984, the TNRP for rice was -24.22 percent.

It can be seen from the above calculation that the use of different exchange rates can change the magnitude and direction of the nominal rate of protection. When the official exchange rate was used, a positive protection was recorded. However, when the parallel exchange rate was used, the level of protection was negative. What is first seen as a positive price protection is transformed into negative protection when the distortion introduced by the exchange rate control is taken into account.

To account for these exchange rate effects, ERP's were also calculated for each commodity based, respectively, on the official exchange rate and the parallel exchange rate. Fertilizer was the only tradable input incorporated into the calculations because it was the only input for which border prices and the amount of input per unit of output could be adequately assessed.

In the case of tractor services, there were no data to calculate what percentage of the cost could be accounted for by tradable components. For pesticides, the diversity of pesticides used and the level of aggregation of the price data made it impossible to calculate a border price. For non-tradable inputs such as irrigation water, border prices bear no meaning. As mentioned earlier, distortions affecting the non-traded inputs are not measured in ERPs.

A fertilizer/rice coefficient was calculated based on the amount of fertilizer used per unit of land and the rough rice yielded per unit of land. The rice technique on which table IV.1 is based uses 0.7 ton of fertilizer per tarea and yields 8.01 ton of rough rice per tarea (national average)[1]. That gives a fertilizer/rough rice coefficient of 0.08 ton of fertilizer per ton of rice.

Domestic prices for fertilizer were obtained from the annual budgets of the Economic Unit of the Department of Agriculture. Border prices for 1984-1985 were obtained from a report from the Economic Unit for Policy Analysis (UEPA, 1988). For 1986-1988, prices were obtained from the FAO Trade Yearbook and the ERS/USDA publication on Fertilizer Outlook and Situation. Border prices for fertilizer were converted to Dominican peso equivalents using either the official or the parallel exchange rates. The cost associated with the use of fertilizer was calculated by multiplying the fertilizer/rice coefficient by the fertilizer price evaluated at the domestic price and the official and parallel exchange rates, respectively.

To compute ERP, the value added was first evaluated at domestic prices as the difference between the producer price and the cost of fertilizer. This can be interpreted as the value added under distortions. For 1984, the value

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One tarea is equal to 1/16 of a hectare.

added with distortions was RD$444.47 (row AA) per metric ton which resulted from subtracting RD$36.85 (row W) from RD$481.32 (row E).

Next, value added was computed using the farmgate value of rice at the border price based on the official exchange rate and the cost of fertilizer at the border price based also on the official exchange rate. These estimates reflect the value added in the absence of price distortions and assuming that the exchange rate is an appropriate rate of conversion. For instance, the value added in 1984 was RD$128.02 = (RD$141.8 - RD$13.77) = (row K - row Y).

Estimates of the value added at domestic prices and value added at the official exchange rate were used to calculate ERP's at the official exchange rate (OER). For 1984 the ERP(OER) for rice was 247.18% ((row AA - row AB)/row AB)*100.

The second measure of ERP is based on a comparison of value added at domestic prices and value added at border price based on the parallel exchange rate. The measure, ERP(PER), for rice producers for 1984 was -25.45% ((row AA - row AC)/row AC)*100. Thus the effect of the exchange rate on ERP's is very similar to its effect on NRP's, again illustrating the importance of the exchange rate to measurement of domestic price distortions.

IV.3.1. Direct and Total Nominal Rate of Protection for Traditional Export Crops

Based on calculations similar to those discussed above, table IV.2. shows the direct and total NRP for the eight selected commodities for the period 1984-1988. These results indicate that sugar and coffee (traditional export crops) were penalized during that period through both price and exchange rate distortions. Total nominal protection was negative for both crops during the entire period. Special exchange rates for traditional export crops were taken into account in making these calculations (see appendices A.1 through A.4 and table IV.1). In 1984, traditional exports received an incentive of 48% above the official exchange rate. However, when the government officially devaluated the Dominican peso in 1985, traditional exports were taxed 36% of the market exchange rate. The conversion rates of Dominican pesos per US dollar for sugar, coffee and tobacco were RD$1.48 in 1984, RD$1.99 in 1985, and RD$1.86 in 1986 instead of RD$1.00, RD$3.11, and RD$2.90, respectively. In late 1986 this tax was lowered to 18% and later eliminated.

Rates of protection for sugar were also evaluated using both the world market price and a weighted average border price consisting of the world market price and the price under the US sugar quota. When the average border price was used (sugar (1)), negative NRP's were found for the

Table IV.2. Direct Nominal and Total Nominal Rates of Protection For Selected Crops in the Dominican Republic, 1984-1988

Crops		1984	1985	1986	1987	1988
Sugar (1)	Direct	-51.03	-56.30	-50.34	-64.89	-78.69
	Total	-74.86	-72.60	-68.79	-64.93	-78.73
Sugar (2)	Direct	52.69	44.02	18.55	-43.20	-77.13
	Total	-24.65	-13.10	-27.18	-43.28	-77.18
Coffee	Direct	-46.37	-49.80	-36.18	-28.54	-42.24
	Total	-72.81	-68.10	-60.13	-28.54	-42.36
Tobacco	Direct	-38.77	61.07	99.83	29.35	N.A.
	Total	-70.56	-5.20	13.33	29.17	N.A.
Rice	Direct	239.45	8.10	148.49	-2.07	-35.82
	Total	-24.22	7.70	146.93	-2.23	-35.98
Beans	Direct	408.63	85.40	66.53	99.13	71.82
	Total	47.83	85.01	66.43	98.85	71.43
Corn	Direct	320.14	60.90	167.17	-18.10	-18.14
	Total	6.87	60.50	166.96	-18.22	-18.32
Tomatoes	Direct	314.94	36.90	N.A.	-13.27	-26.89
	Total	-29.75	36.20	N.A.	-13.27	-27.06
Beef	Direct	-18.08	-69.98	-34.65	-60.65	N.A.
	Total	-72.58	-70.04	-34.68	-60.70	N.A.

Note:
(1) Using a weighted average of export prices received for sugar exports (world market price and price under USA quota).
(2) Using the world market price as a border price.

Sources: Table IV.1 and appendices IV.1.-IV.4.

five years being considered. For the years 1984-86, TNRP's were lower than DNRP's. That is, during the 1984-86 years, price distortions and overvalued domestic currency adversely affected domestic producers of sugarcane. After 1986, there was no significant difference between the official and parallel exchange rates for traditional export crops and the negative protection for producers was due to price distortions. Negative DNRP's ranged from -0.34% in 1986 to -78.69% in 1988.

At the world market price (sugar (2)), sugar producers enjoyed positive protection between 1984 and 1986 showing the highest direct NRP of 52.69% in 1984. The higher price obtained in the US market served as a cushion to pay relatively attractive prices to producers. However, when the world market price was evaluated at the parallel exchange rate, negative NRP's were obtained for the whole period. Nevertheless, the negative rates of protection are lower than the ones obtained with an average border price. It can be argued that the price to be used to calculate rate of protection should be the world market price because it is the price that the country faces for its marginal sugar exports above the US quota.

The NRPs reported for sugar in table IV.2. are consistent with Greene and Roe's results. They found negative nominal protection for sugar producers between 1970 and 1984, with the only positive NRP in 1980. Even when the government eliminated foreign exchange controls in 1985, agricultural export crops were still penalized. Due to the decline in the world market price of sugar, the government initiated a program to reduce the country's reliance on sugar exports. Some of the sugar mills owned by the government have been closed down and the land used to grow food crops and/or non-traditional export crops.

Coffee production was also penalized during the period 1984-1988. Negative direct NRP's ranged from -28.54% in 1987 to -49.8% in 1985. World prices of coffee have fluctuated during the 1984-1988 period, while domestic prices have increased. However, the increase in domestic prices has not been sufficient to match the effect of the devaluation of the Dominican currency which would have raised domestic prices even more. Similar to the case for sugar, NRP's evaluated at the official exchange rate diverge from the ones calculated using the parallel exchange rate during the years 1984-1986. Taxes on coffee exports have been passed on by the coffee exporters to the coffee growers in the form of lower prices for their products.

Different from sugar and coffee, tobacco producers appeared to have enjoyed positive protection after 1984. In an attempt to support producers, the government's Tobacco Institute has been buying part of the tobacco production at prices higher than that price offered by local tobacco dealers (UN). However, tobacco exports have decreased due to external factors such as the reduction of demand from Spain after it joined the European Economic Community (EEC) and the world reduction of tobacco consumption caused by health concerns.

IV.3.2. Direct and Total Nominal Rates of Protection for Import-Substituting Crops

Nominal rates of protection for three import-substitution crops (rice, beans, and corn) are also shown in table IV.2. Import-substituting crops such as rice also enjoyed some price protection during 1984-1986. Up to 1986, the government pursued a policy of self-sufficiency for rice and producer prices were kept above import cost. INESPRE, the government agency responsible for carrying out that program, had a monopoly on the domestic sales and imports of rice. The mechanism which INESPRE used to establish prices at each level of the marketing chain has been explained in section II.4.2 of chapter II. Both direct and total nominal protection were positive for the years 1985-1986 (see table IV.2). After 1986, the new administration modified the rice policy by turning the distribution of rice over to the Agricultural Bank instead of INESPRE. Production of rice subsequently experienced negative NRP's. Even though producer prices for 1987 and 1988 were higher than the 1986 prices in Dominican pesos, the gap between border prices and domestic prices was wider. This is ex plained by the devaluation of the Dominican currency.

Red beans is another important import-substituting crop. For the entire period of analysis, producers enjoyed positive level of protection for their product. INESPRE has been offering a procurement price to red beans producer higher than offered by local buyers. However, domestic production has not been sufficient to satisfy domestic demand of red beans. In 1988 beans imports totalled 12,000 tons. In 1986, a World Bank study calculated NRP's for a selected group of food crops including red beans. It was found that during 1980 to 1983 production of red beans was being penalized. However, after the unification of the parallel and official exchange rates in 1985 for all commodities except traditional export crops, domestic production of red beans has enjoyed a more attractive price relative to the import price.

Corn is an import-substituting crop which has been used basically as a feedstuff for poultry. It has been the policy of INESPRE, since the early 1980's, to keep producer prices above the border price to provide incentives to domestic production. Positive NRP's for corn have been as high as 320% in 1984. A report by the World Bank (1985) also found positive protection for corn between 1980-1984.

In short, government intervention in rice, beans, and corn has been channeled through INESPRE with the purpose of obtaining self-sufficiency. However, negative protection of rice and corn was found for 1987 and 1988. There are not sufficient data on border prices to evaluate the other two staple crops in the country (plantains and cassava) for the whole period. It is argued that plantain and cassava are produced for domestic consumption and that the export market is only marginal to the producers of those crops. In that sense, border prices may be of no use when evaluating the level of distortion in both crops.

IV.3.3. Direct and Total Nominal Rates of Protection for Non-traditional Export Commodities

The final two commodities shown in table IV.2 are tomatoes and beef which are non-traditional exports. Producers of salad tomatoes enjoyed some relative protection in 1984 and 1985 but were penalized during 1987 and 1988. Beef production (another non-traditional export commodity) was also penalized during the entire period (see table IV.2.).

IV.3.4. Effective Rates of Protection.

Table IV.3. depicts the Effective Rates of Protection (ERP's) for the sugar, rice and tomatoes. As explained above, fertilizer was the only tradable input used in the calculation of the value added in the production of the selected crops. ERP values are shown for sugar, rice and tomatoes because more than 80% of producers of those crops use fertilizer (see table II.10). For other crops, the low level of fertilizer use means that the ERP estimates will be almost the same as the NRP estimates. Only 20% of coffee production, 33% of tobacco production, 10% of beans production, 5% of corn production, and 2% of pasture is fertilized (see table II.10).

ERP estimates at both official and parallel exchange rates were more negative, showing more negative protection, than their counterpart NRP's between 1985-1988. This greater disprotection results from the higher domestic than world price of fertilizer during that period. As can be seen in table IV.1, the domestic price paid for fertilizer was higher than the international (border) price evaluated at either exchange rate, except in 1984. It has been suggested that the two domestic firms which process fertilizer in the country may be subsidizing exports through the price being charged to domestic consumers (World Bank, 1986). As a consequence, ERP estimates for sugar and rice

Table IV.3. Effective Rates of Protection at the Official and the Parallel Exchange Rates for Selected Crops in the Dominican Republic, 1984-1988

Crops		1984	1985	1986	1987	1988
Sugar (1)	Official	-41.02	-64.73	-68.47	-80.05	-90.91
	Parallel	-69.57	-79.23	-80.22	-80.08	-90.93
Sugar (2)	Official	-54.56	-35.66	-14.17	-65.29	-90.16
	Parallel	-19.17	-14.92	-47.94	-65.33	-90.18
Rice (3)	Official	247.18	7.50	145.41	-7.23	-41.89
	Parallel	-25.45	7.05	143.59	-7.38	-42.03
Rice (4)	Official	248.84	9.79	169.45	-8.30	-43.20
	Parallel	-25.70	9.33	167.57	-8.45	-43.35
Rice (5)	Official	257.26	11.19	192.53	-13.49	-49.94
	Parallel	-26.92	10.72	190.25	-13.64	-50.07
Tomatoes	Official	325.98	39.58	N.A.	-16.00	-28.54
	Parallel	-30.60	38.85	N.A.	-16.00	-28.71

Note:
(1) Using a weighted average of the export price received for sugar export (world market price and price under USA quota).
(2) Using the work market price as a border price.

(3) Using fertilizer/rough rice ratio of 0.08.
(4) Using fertilizer/rough rice ratio of 0.10.
(5) Using fertilizer/rough rice ratio of 0.16.

Sources: Table IV.1. and appendixes IV.1.-IV.4.

show greater disprotection compared to NRP estimates for 1985-1988.

In the case of rice, ERPs were calculated for three different techniques which use different amounts of fertilizer. The criteria used to differentiate techniques included access to irrigation, level of mechanization and land quality. Technique 1 is rice grown on irrigated land, using a high level of inputs and a high level of mechanization on land of good quality. Technique 2 consists of rice grown on irrigated land of good quality, using high levels of inputs and semi-mechanized production techniques. With technique 3, rice is grown on dryland of low quality, using moderate levels of inputs and mechanical services. There was not much difference in terms of ERP estimates between techniques 1 and 2 because they used a similar amount of fertilizer. That is not the case for technique 3 which had a lower rice yield per unit of land than the other two techniques but also had a much lower fertilizer use per unit of land. As a consequence, the fertilizer/rice ratio for technique 3 was the highest of the three techniques. During those years when rice production was protected, technique 3 shows the highest positive effective rate of protection among the three techniques. However, when rice production experienced negative protection, technique 3 showed the highest negative values for effective rate of protection.

Even when only fertilizer is used as production input, it can be seen from the results for rice production that effective rates of protection can be better measures of protection than nominal rates of protection. In addition, it can be seen that even for a single crop not all producers enjoy the same rate of protection.

IV.4. Summary and Discussion

Between 1985-1988, the difference between the official and the parallel exchange rate was negligible (see chapter 2). That has not been the case since 1989 when the government again pegged the Dominican peso to the US dollar at RD$6.35/US$ and the parallel market again flourished. As of April 1990 the parallel market rate was RD$10.00/US$ (Business International). It is expected that measures of protection after 1988 will again show large differences between direct and total nominal rates of protection with low or negative total nominal protection due to the control on the exchange rate. In general the direct NRP's were different from total NRP's for all crops during 1984 and during 1985-1986 for traditional export crops when the official exchange rate was lower than the parallel exchange rate. The foreign exchange distortions resulted in a tax on producers.

If subsidies provided through machine services and irrigation had been accounted for, the results might have been different. If the different technique is used as a proxy for the access to resources (land, water, mechanical services and chemical inputs), those farmers who use purchased inputs more intensively will benefit most from a policy of input subsidy. More specifically, rice growers using subsidized machine services and chemical inputs will be better off than those who do not have access to them. In chapter VII a sector model of the agricultural sector is used to include the effects of all input prices on the production of a set of agricultural commodities.

Chapter V. Modeling Methodology

V.1. Introduction

This chapter presents a justification for the sector-wide modeling approach used in this study to analyze agricultural and trade policies in the Dominican Republic. A brief survey of the approaches generally used for sectoral policy analysis is presented in the first section. The second part is devoted to reviewing the role of mathematical programming within a sector analysis framework. Then, the elements and the structure of a sector model are presented. Then, a mathematical representation of the model to be used in this study follows. The chapter ends with the explanation of how policy variables are incorporated into a sector model.

V.2. Models for sectoral policy analysis

Quantitative models used to analyze the direct and indirect impacts of policies on the agricultural sector include single or multi-commodity econometric analysis in a partial equilibrium framework, and general equilibrium models of the input-output type. In addition, mathematical programming models depicting either the supply side (farm programing model) or supply and demand for the entire agricultural sector (agricultural sector models) are widely used (De Janvry, McCarl and Spreen).

.2.1. Econometric models

Econometric models have been used to answer questions related to the structure of the sector. The most common approach is based on a single commodity using demand and supply schedules to analyze the impact of price policies on income, foreign exchange earnings, production, and consumer and producer surplus changes (Lutz and Scandizzo). Estimates of nominal and effective rates of protection for the commodity of interest often complement econometric studies.

Econometric models used to measure the impact of policies tend to perform better than programming models when the relationships among variables and past policies remain stable (Shumway and Chang). Specifically, for short-term forecasting, econometric models of the agricultural sector may provide a better assessment of policies in place than a programming model (Chen).

Single commodity analyses do not take into account the cross price effects on closely related production activities. Substitution or complementary relationships are lost when using these models because they do not contain information regarding the behavior of other commodities which are related to the commodity affected by the policy. This is a major drawback for single-commodity econometric analyses because it is difficult to find a crop which does not share any complementary or substitution relationships with other crops.

Econometric analysis of a single commodity may provide biased estimates of the effect of policies because the effects of policies in the sector are not the sum of effects on individual commodities. The fact that agricultural commodities compete for the same set of resources means that substitution occurs when policies affect relative prices. So policy changes are best analyzed in a broad context such as the agricultural sector level (Braverman). Models of the agricultural sector have been constructed and linked to an economy-wide model to measure the effects of agricultural and macroeconomic policies in the short run (Chen).

Another type of econometric model used to measure the impacts of agricultural policies on output supply and input demand are cost or profit function models. These models have the advantage of requiring less algebraic manipulation than production functions and allowing for more complex functional forms (Lopez). In addition, the profit or cost function approach allows the study of farmers' behavior in the absence of explicit prices for some agricultural commodities and inputs used in the production of those commodities (Lopez). This fact is deemed to be important in developing countries where markets for output and inputs are not well developed. Cost and profit function analyses facilitate the evaluation of efficiency (allocative and technical) in agricultural production (Lopez).

Econometric models for either single or multiple commodities may be criticized because their estimates may not be suitable for predicting effects of the explanatory variables outside the range of the historical data. This is more noticeable when the proposed policy changes depart greatly from historical trends (Norton). Econometric models are based on historical data which are shaped by the policy structure in place during that period. It is expected that once policies are changed, the structure of the econometric model would also change (Peterson). In the case of the Dominican Republic, which has experienced a change in economic policies, historical data may not be of great help in predicting future events. For accuracy of prediction, there is the need to capture the future behavior of the explanatory variables meaning that older historical data may be of little use. In addition, to avoid degrees of freedom problems some explanatory variables may have to be excluded from some equations, constraining the scope of the model (Colman). Thus, estimates from econometric models may not be suitable to analyze the impacts of policy changes and outside judgments may be necessary to complement those estimates (Colman). Econometric models are also less capable of handling a high level of disaggregation in outputs and inputs as compared to programming models (Braverman). Furthermore, econometric models are not easily suited to handle inequality constraints which predominate in the agricultural sector such as seasonal land and labor constraints (Norton).

V.2.2.General equilibrium models

With the general equilibrium approach, the whole economy is modeled including the linkages among sectors. Agriculture is incorporated as one or more sectors of the economy. A general equilibrium model of the input-output type includes an accounting of the sources of factor supply and demand as well as the income spent and generated in the economy. Technology is assumed constant and prices are exogenous. Input-output models include inputs, outputs, and international markets. In each period the economy is driven to a static general equilibrium (Sarris). These models can be used to analyze the impacts of sectoral and macroeconomic policies on specific sectors and on the whole economy. Policy impacts are multipliers of the Keynesian type and include output, income, and employment multipliers (Syed). Such models are suitable as an analytical tool to evaluate various policy variables on a sectoral basis and are very useful when the data set is reliable and rich (Braverman). However, due to the way factors and income are specified in the model, it is impossible to establish the disaggregated effect of policies within a sector. Because income is assumed to accrue to either labor or capital and because the unit of analysis is the labor or capital and because the unit of analysis is the sector rather than production and consumption activities, the model cannot deal with changes in relative prices among activities within a sector as, for example, prices of export crops versus subsistence crops (Sarris).

Computable General Equilibrium (CGE) models are more flexible than input-output models. They allow the introduction of equations describing the behavior of several sectors as well as modeling the degree of factor mobility in the economy (Sarris). The structure of the model is determined by the nature of the behavioral equations and the closure rule adopted. The closure rule refers to the way the system reaches a short-run equilibrium after a shock. Two opposite closure rules are usually adopted. With the first one, outputs adjust to meet demand. It assumes a Keynesian approach in which there are some unemployed resources that can be used to increase production in order to meet demand. With the second closure rule, supply is relatively fixed in the short run and demand adjusts through price changes. In the latter case there is full employment of resources (Sarris).

CGE models have been used more often since the development of computer packages which can solve large models. Most of the empirical studies carried out using CGE models have been used to assess short-run impacts of macroeconomic policies in developing countries.

Input-output models have the limitation that they assume no resource limitations. CGE models recognize resource constraints but are non-linear and require a large amount of data and computer time to be solved, which may limit their usefulness for timely policy evaluation. Because of their complexity, the effects of changes in the model's parameters, due to policy changes, are difficult to trace (Braverman). Often, results from general equilibrium models are not easily understood by policymakers.

V.2.3. Mathematical Programming Models

Programming models of the agricultural sector provide somewhat of a middle ground between the econometric and input-output models. Sector models can incorporate supply and demand schedules with the high level of detail deemed important for policy analysis. They also can include some relationships for which no time series data exist (House). This last characteristic is important for this study which incorporates new production activities resulting from an emphasis in the Dominican Republic on non-traditional export crops.

Mathematical programming models have been used widely by economists as tools to analyze direct and indirect effects of policy changes in a specific sector, particularly agriculture. Programming models are suitable for agricultural sector analysis because they can capture many of the characteristics of agricultural production. For instance, production is determined by the allocation of resources (fixed and variable) to various production activities. Some of those resources, such as land, can be used only for agricultural production and there is a specific input mix for a given technique which determines the level of output obtained (Braverman).

Two levels of optimization can be identified in a sector model. The first deals with a government's objective function trying to maximize the effect of policy goals subject to budget constraints. However, the government can not influence directly the way farmers will react to policy changes (Ballenger). Farmers try to maximize their objective function based on external conditions. For example, their key objective may be profit maximization, achieving some level of subsistence income, or minimizing risk.

In order to maximize the first objective function subject to the second being maximized, multi-level programming is required. There is no specific procedure to solve the problem satisfying both objectives jointly. An iterative process is required which uses a vast amount of data from farmers (Norton and Scheifer; Chandler). Difficulties in obtaining reliable results from multi-level studies have limited the extensive use of this approach. Instead, sector models which focus on describing how farmers optimize their objective function subject to market and policy constraints have been used more frequently (McCarl; Hazell and Norton).

The early sectoral programming models used in agriculture tried to model the supply side (Thorbecke). They assumed constant output prices and did not consider the effects of farmers' decisions on demand. These were farm models in which the objective was to estimate how farmers would optimize their objective function subject to resource limitations and external constraints (Hazell and Norton; McCarl). Profit maximization or cost minimization was often the assumed objective function of farmers. Prices were given as parameters and the response of quantity produced to given prices was modeled.

A sector programming model, in contrast, recognizes the interrelationships among prices and quantities. Supply and demand relationships are introduced into the model and equilibrium price and quantity are obtained endogenously. The assumed objective is no longer profit maximization or other farm level objective, but the maximization of producer and consumer surplus (Hazell and Norton; McCarl). Consumer and producer surplus are measured as the area below the demand curve and above the supply curve. In these models, prices of the agricultural commodities are determined jointly by the actions of consumers and producers.

The maximization of consumer and producer surplus will lead to equilibrium prices and quantities being obtained under a competitive market. This notion was first developed by Samuelson (1952) who viewed it as a static spatial equilibrium problem which could be solved using mathematical programming. Takayama and Judge (1964) developed an algorithm to solve the spatial equilibrium model using quadratic programming.[1]

V.3. Elements of a Sector Model

A sector model is characterized by five elements: economic conditions, producer preferences, resource limitations, the technology set and the policy environment (Hazell and Norton).

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[1] A good summary regarding the development and use of programing models is given by Norton and Schiefer and by Hazell and orton.

V.3.1. Economic Conditions

Consumer behavior is modeled by individual demand functions. Demand schedules refer to all demands for the goods of the sector and not only the demand by the agents of the sector. Incorporation of demand schedules provides more flexibility to the model because it allows substitution between outputs as a consequence of policy changes (McCarl).

In order to simplify the model, either zero cross-price elasticities or symmetric cross-price effects over all pairs of goods usually are assumed. That is, the matrix of first derivatives of the output demand functions must be symmetric (McCarl; Hazell and Norton). According to Zusman (1969), symmetry will be met only if the goods are closely related in demand, have low income elasticities and contribute a minor share of the consumer expenditure. In some cases, only cross-price effects for specific commodities are modeled and zero cross-price effects are assumed for the remaining commodities.

V.3.2. Resource Limitation

Optimization of a specific objective function is subject to the availability of resources. In an agricultural sector model, resources typically consist of land, irrigation water, family and hired labor, machines, capital and livestock availability (Hazell and Norton). Land quality determines not only the yield by crops but also the type of crops to be grown. Although land may be limited in physical quantity, it may not be the limiting factor in a sector model. Limitations on other resources such as family labor, can constrain the farmer's ability to make full use of the land available.

V.3.3. Producer Preferences

The optimization formulations generally assume that farmers are trying to maximize profit. Other objectives may include some level of risk minimization or achievement of some level of family consumption with some degree of assurance (Hazell and Norton).

Assuming that producers try to maximize profits, they will determine output levels by equating the product price to the marginal cost of producing another unit of that product. Likewise, they will purchase inputs up to the point where input prices equal their marginal value products.

Sector models assume competitive markets for both producers and consumers, a finite set of production alternatives representing different input-output combinations, and technical efficiency under each production alternative

(McCarl and Spreen)[1].

Equilibrium in the input market is often obtained by assuming that there is no restriction on the availability of purchased inputs and that the supply of inputs is perfectly elastic (Hazell and Norton). However, some purchased inputs such as hired labor, can be modeled with an upward sloping supply curve. As more hired labor is used, a higher wage is required to hire workers engaged in activities outside the sector.

V.3.4. Technology Set

Technology set refers to the production alternatives available to the producers. To obtain reliable supply responses in an agricultural sector model, a set of techniques available for various production activities are often included in the model (Hazell and Norton). Each technique may include a unique combination of chemical inputs, type of land, farm size, degree of mechanization, and access to irrigation water. The availability of alternative techniques and limited input availability allows the model to assess supply responses to changes caused by price policies (Norton and Scheifer). Even when the model includes fixed input/output coefficients, input substitu-

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' Other type of market structure such as oligopoly and monoploy ın be used in sector model. However, a competitive market proıdes a more appropriate portrayal of the market structure in the ;ricultural sector.

tion is possible due to the existence of different techniques with different input combinations. The model may also evaluate potential techniques, identified by research centers, which can be introduced and adopted by producers. Figure V.1. shows an isoquant depicting discrete substitution possibilities that can take place in a sector model. The isoquant shows a range of input combinations to produce a specific amount of output. Each technique reflects a unique combination of labor and capital. As the labor-capital price ratio changes, the cost minimizing technique becomes to produce the given amount of output may change. For instance, technique four represents a combination of input use where labor is used more intensively. On the other hand, technique one represents a technique where capital is used more intensively than labor. The same amount of output can be obtained by a linear combination of technique four and three or any two adjacent techniques (Hazell and Norton).

V.3.5. Policy Environment

The agricultural sector is affected not only by sectoral policies but also by economy-wide policies. Sectoral policies include output price supports or ceilings, input subsidies or taxes, and import and export tariffs or quotas for specific commodities. Other policies which are aimed

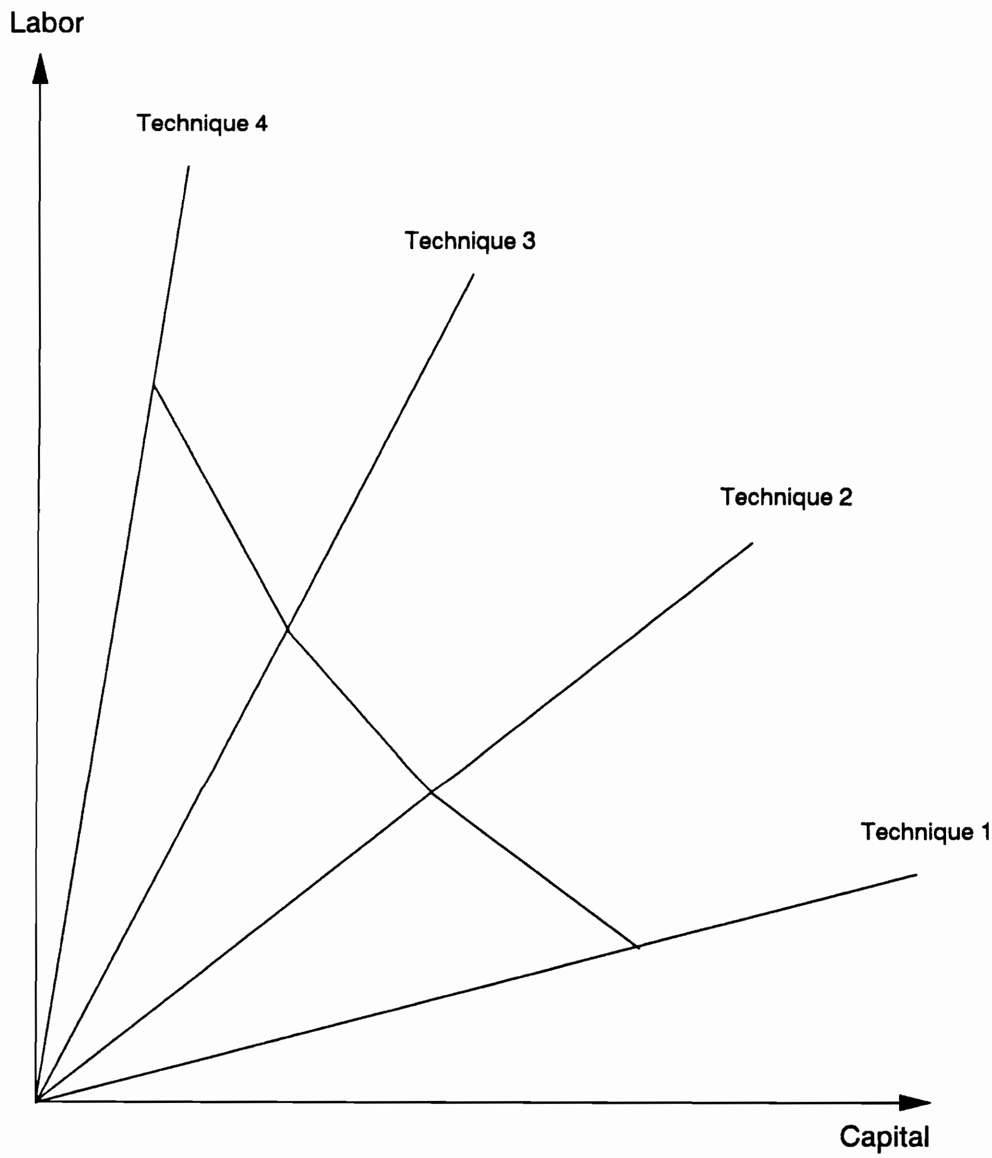

Figure V.1 Production function isoquant in a sector programming model at the whole economy such as minimum wage policies and foreign exchange controls also affect the agricultural sector (McCarl). Incorporation of these policies into the agricultural sector model gives more realism and breadth to the model.

V.4. Incorporation of Policies in a Sector Model

Sectoral and economy-wide policies that affect the agricultural sector are introduced into a sector model in several ways. Input policies (subsidies or taxes) directly affect the cost of production for any activity. They are incorporated in the model through modification of appropriate cost terms in the objective function. For instance, a subsidy provided to water users is assumed to reduce the unitary cost of production by the amount of the subsidy. The effect of the subsidy on the production activity mix can be traced via the change in relative input prices and amount used of the now cheaper input. A change in the minimum wage for hired labor is incorporated in the same fashion.

Incorporation of a new set of activities such as a new production technique for a specific commodity is introduced by adding a new set of technical coefficients which describe the input-output relationship.

Output price policy is not integrated directly into the model because prices are obtained endogenously. To analyze the impact of some price policy, the model is first solved without any price intervention and the solution is compared to the results obtained when the model is solved with the policy in place.

Trade policies such as import/export tariffs or subsidies are incorporated through the border price of the commodities (Hazell and Norton). If the assumption of a small country is adopted, the country cannot affect the international price. For the sector model, border prices are expressed in the form;

1) $P_{ed} = P_{ew} * (1 - t_e) * FE$ for exports and,

2) $P_{md} = P_{mw} * (1 + t_m) * FE$ for imports

where:

P_{ew} = export border price (foreign currency)

P_{ed} = domestic price of exports (domestic currency)

P_{mw} = import border price (foreign currency)

P_{md} = domestic price of imports (domestic currency)

t_e = export tariff or subsidy

t_m = import tariff or subsidy

FE = foreign exchange rate

From the above equations it can be seen that trade policies such as tariffs and quotas are directly incorporated into the sector model through changes in either import or export prices in the objective function. Foreign exchange controls can be accounted for in the model in the same way as trade policies.

Export and import quotas are incorporated similarly in the model. When a country faces an export quota, the model includes an additional equation where the right hand side shows the maximum amount of that specific commodity which can be exported. Similar treatment occurs when there is an import quota for a commodity. In the extreme case of total prohibition of imports for a commodity (which may occur when the government wants to be self-sufficient in that commodity), the supply-demand balance equation is modeled without imports (Stocker and Li).

Other policy and market changes can be incorporated into the model by modifying the right hand side of appropriate equations. For example, changes in the government budget constraint, the availability of different sources of credit, or the change in the availability of fixed resources can be modeled by changing the right hand side values (Stocker and Li). The latter case might occur when more land is now available due to government investment in land and infrastructure such as roads and irrigation facilities.

V.5. Conceptual Model to be Used in this Study

The model to be used in this study is a price-endogenous agricultural sector model as developed by Duloy and Norton. In mathematical terms, the model is specified as follows:

Maximize $Z = (\delta - \frac{1}{2}\beta Q)Q - CX + P_eX_e - P_mX_m$

(objective function)

subject to:

3) $Q + X_e - (X + X_m) \leq 0$, supply-demand balances

4) $RX \leq B$, resource constraints

5) $X_e \leq E$

6) $X_m \leq M$

$Q, X, X_m, X_e \geq 0$

where:

Z = objective function (consumer plus producer surplus)

Q = a vector of quantities demanded,

X = a vector of quantities produced,

X_e = a vector of export volumes,

P_e = a vector of export prices,

X_m = a vector of import volumes,

P_m = a vector of import prices,

C = a vector of unitary cost coefficients,

δ = a vector of demand intercepts,

β = a symmetric matrix of own and cross price-effects in demand,

R = a matrix of technical coefficients depicting the amount of input required to produce a unit of output,

B = a vector of resource availability.

E = a vector of export upper bounds

M = a vector of import upper bounds

Equations of a sector model can be grouped into three types: the objective function, resource restrictions, and supply-demand balances.

V.5.1. The Objective Function

The objective function consists of the maximization of producer and consumer surplus. The two sources of demand included in this model are domestic demand and export demand. Domestic demand is assumed as a linear demand function for each commodity of the form,

7) $P = \delta - \beta Q$

Assuming no cross price effects, the integral part of the demand function is then:

8) $W = (\delta - 0.5\beta Q)Q$, which is the area below the demand functions.

The above term introduces a quadratic element into the objective function. In this study, the model is solved directly in its quadratic formulation using a computer package called MINOS.

Export demand is portrayed in this model as a demand function which is perfectly elastic up to a bound representing a quota for the exporting country (Hazell and Norton). The upper bound is shown in equation five.

The two sources of supply include in this model consist of domestic supply and import supply. Domestic supply is not explicitly modeled in the model, but it is obtained through the introduction of different production techniques for each commodity in the model. These different techniques have different costs and different input combinations. The output supply function obtained in the model is a step function similar to the one depicted in figure V.2. The number of steps is determined not only by the number of techniques but also by the availability of different sources of inputs having different per unit costs. For example, machinery services are available from the government at a subsidized rate as well as from the commercial sector at a higher rate. Import supply functions are portrayed in this model as supply function that are perfectly elastic up to a bound imposed by the importing country. The upper bound is shown in equation six.

Although the objective function may bear no meaning for farmers individually, it can be viewed as the market result under competition caused by each economic agent acting in his best interest (Norton and Scheifer; McCarl). The objective function can be interpreted as a measure of social welfare although criticisms have been raised concerning its use in this way due to the partial equilibrium nature of this measure, among other reasons (Norton and Schaefer). The advantage of this objective function is

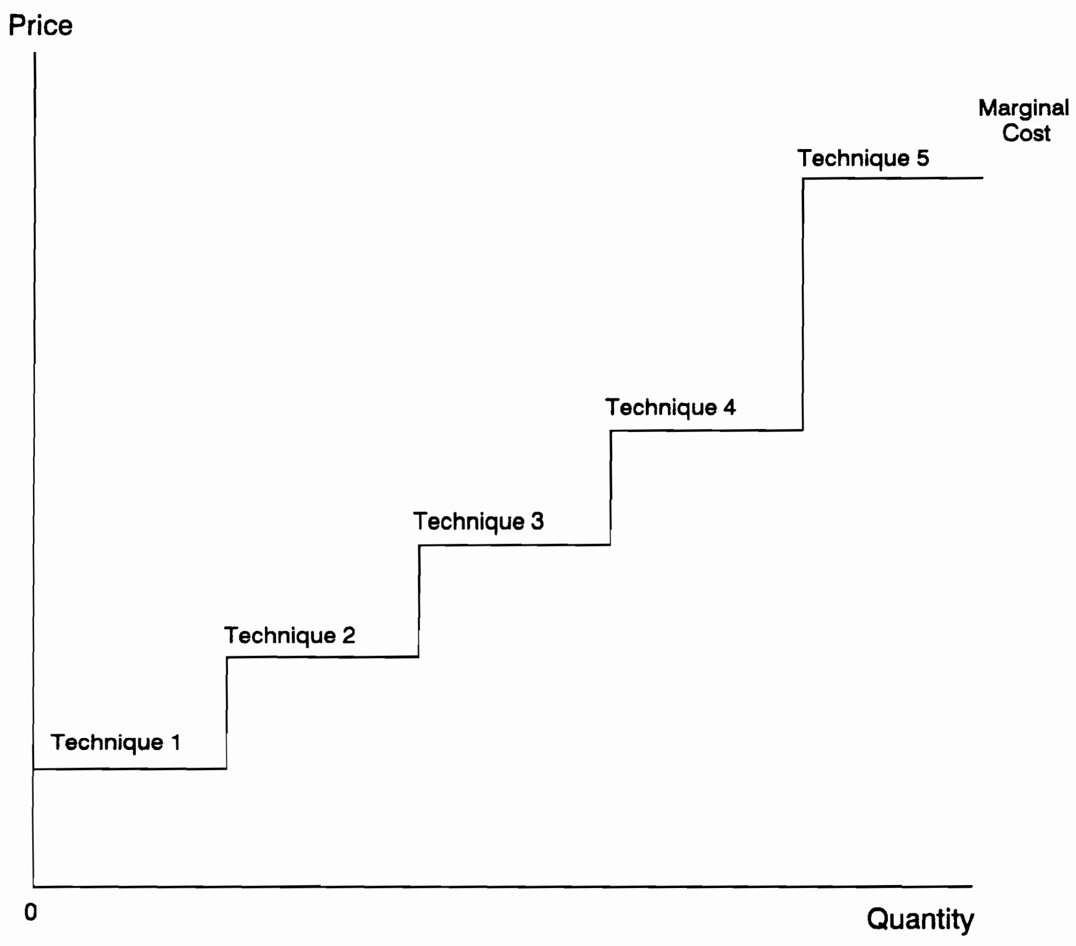

Figure V.2. A sector programming supply function that it renders results which are consistent with the economic marginal conditions and profit maximization assumptions regarding market behavior of participants (Onal, 1988). It also allows prices to be determined endogenously based on supply and demand equilibrium condition, rather than being taken exogenously.

V.5.2 Resource Restrictions

Resources used in the model in this study are classified as purchased and fixed inputs. This is specified by equation four in the model. Purchased inputs can be bought by farmers in any amount at the going market price. They include fertilizer, chemicals, and commercial machine services. Although there is no quantity constraint on those purchased inputs a balance row is introduced to assure that the quantities used will not exceed quantities purchased.

Resources such as land and labor are assumed to be available in fixed quantities. Their total availability is reflected in the right hand side of the equation and the constraints are expressed as inequalities. The use of resources is given by the technical coefficients for each production technique available for the commodities included in the model. Labor is broken down by month when possible. Land is classified by quality and farm size. The shadow price of the associated land quality is interpreted as its opportunity cost. In that sense, land and other fixed resources are priced endogenously in a sector model.

V.5.3. Supply-Demand Balances

In order to achieve equilibrium in the model, supply-demand balance equations are introduced for outputs and inputs. They are represented by equation three. These constraints are important for the sector model because they force the model to achieve an equilibrium and they allow endogenous prices to be obtained via their shadow prices. In the case of outputs, export or import may be allowed to achieve market equilibrium if the specific commodity is traded. Prices for exports and imports are determined by world prices instead of by domestic market clearing prices.

Some commodities undergo transformation before they reach the final consumers. That is the case for sugarcane, peanuts, and paddy rice which are converted into sugar, cooking oil, and polished rice, respectively. The coefficients of transformation for those commodities are included in this model.

From equation three, the supply-demand balance equation for output is expressed as, 3') $Q + X_e <= X_j + X_m$

The quantity demanded should not exceed the supply of the output and amount imported. The equation is expressed as an inequality to allow the possibility for stocks. For purchased inputs, supply-demand balance equations follow the same procedure as the output supply-demand equations. Other equations in this model include export and import quotas.

V.6. Summary

In this chapter different approaches to model the agricultural sector were presented. A mathematical programming model of the Dominican agriculture was considered as the most appropriate to analyze the impacts of policy and market changes. In the next chapter the empirical model used in this study is presented.

Chapter VI. Empirical Agricultural Sector Model For The Dominican Republic

VI.1. Introduction

This chapter provides details about the agricultural sector model for the Dominican Republic used in this study. It begins with a description of the commodity coverage of the model and data sources. It then provides an overview of the demand specification and production activities included in the model, as well as the resource constraints. The structure of the model is then laid out in tableau form using rice as a typical activity included in the model.

VI.2. Commodity Coverage

The model includes ten of the most important crops in the Dominican Republic. The year 1988 was selected as the base year because of the availability of reliable data on technical coefficients as well as market prices and quantities. Table VI.1 shows the activities to be included in the model and the level of production and farmgate prices for the commodities for 1988. These ten activities account for more than 75% of the total value of agricultural production in the Dominican Republic. For a better appraisal of the impacts of policy changes, these activities are grouped into three categories: food crops, traditional export crops, and non-traditional export crops.

Table VI.1. Quantity Produced and acreage for the Activities Included in the Sector Model, 1988.

Activity	Quantity Produced (000 MT)	Area Harvested (HA)
Traditional Export Crops		
Sugar	730.40	176,670
Coffee	50.32	99,525
Tobacco	26.14	23,000
Food Crops		
Rice (*)	274.41	100,052
Red beans	45.78	57,631
Corn	57.23	33,794
Peanuts (**)	8.32	10,221
Cassava	126.68	20,423
Plantain (***)	22.73	11,740
Non-traditional Export Crops		
Salad Tomato	16.74	1,920
Total	1358.75	534,976

(*) Expressed in polished rice equivalent.
(**) Expressed in peanut oil equivalent.
(***) Thousands of units of plantain were converted into metric tons assuming that an unit of plantain weighs approximately 0.5 pound.

Traditional export crops include: sugar cane, tobacco, coffee and cocoa. In this study, cocoa is not included because it is very similar to coffee in its production and marketing. They are affected similarly by government policies and their markets tend to behave in the same way. Although coffee is grown in high elevation terrain that has limited production possibilities, it is still considered in the model because it competes for other resources apart from land. Sugarcane is included because of its importance and because it competes with food crops for land and other resources. Tobacco is also grown on land which can be used to produce food crops.

Food crops consist of crops which are exclusively grown to satisfy domestic demand. Those crops include rice, beans, plantain, cassava, corn, peanuts, potatoes, sweet potatoes and yams produced mainly by small and medium farms. The first six crops were chosen for inclusion in the model because they provide most of the food consumed in the country. Rice, beans, plantain and cassava are the staple foods of the Dominican Republic. Corn is included as a crop used for human consumption and animal feed. Peanut production was chosen to represent activities related to vegetable oil production and because its by-product is used for animal feed.

Non-traditional export crops is a broad category which includes fruits and vegetables such as lettuce, eggplants, squash, salad tomatoes, melon and okra. Although some of these crops are grown for export only, others are grown to satisfy domestic demand and the surplus is exported. Due to their similar input requirements, salad tomatoes are used as a representative crop for the non-traditional export crops instead of including all crops individually. This simplification reduces the number of activities to be included in the model. Salad tomato was the second non-traditional agricultural export crop in terms of value in 1987 (with yams number one) (CEDOPEX).

Resources used by the activities not included in the model are subtracted from the total resource endowment (Hazell and Norton). Specifically, land and labor devoted to the production of those activities are subtracted from the amount of resource available in the model.

VI.3.Output Demand and Production Activities

To allow for input and output substitution at the sector level, aggregate output demands and alternative production techniques are considered. Own-price demand elasticities were obtained from Yen and Roe. Table VI.2 shows own-price elasticities, intercepts and slopes for the set of commodities included in the model[1]. The vectors of intercepts and slopes were calculated, assuming linear demand, using the data on own-price elasticities and the base year (1988) equilibrium quantities and prices for the respective commodities.

In order to capture differences in production techniques, agricultural production activities were classified using four criteria: access to irrigation water, level of purchased input use, degree of mechanization, and land quality. The classification of farms by the availability of water allows the introduction of yield variability for the same crop. Table VI.3 shows the total irrigated acreage by water district and crops. In 1988, 262,155 hectares of land were irrigated which is about 21% of the total land suitable for agriculture. Rice production benefits most from irrigation with about 70,780 hectares of rice land being irrigated. This acreage constitutes almost 94% of the total land devoted to rice production and 27% of the total irrigated land (UEPA). A sizable portion of land was brought into production after construction of irrigation infrastructure by the government. New crops (especially for export) and increases in the productivity of previously grown crops have occurred as a consequence of the water

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· Data for tobacco were not included because most of the domesic production is sold in the external market.

Table VI.2. Own-price Demand Elasticities, Equilibrium Quantity, Equilibrium Price, Intercept and Slope of Linear Demand Functions for the Commodities included in the Sector Model.

Commodity	Own price elasticity	Equilibrium quantity (MT)	Equilibrium price (DR$/MT)	Slope (*)	intercept
	-1-	-2-	-3-	-4-	-5-
Sugar	-.95	259,177	1,477	-.006	3,127
Coffee	-1.02	24,217	5,830	-.236	11,454
Rice	-.70	274,954	2,750	-.014	6,680
Red beans	-.78	68,409	7,722	-.145	17,647
Corn	-.89	456,727	1,628	-.004	3,463
Peanuts	-.95	27,135	2,875	-.111	5,889
Cassava	-.89	120,999	1,430	-.013	3,042
Plantain	-.89	22,725	1,480	-.073	3,148
Salad Tomato	-.98	21,558	2,948	-.139	5,947

(*) To obtain slopes and intercepts the following formulas were used:

a = -Po/n*Qo ;   k = Po + a*Qo .

where: a = slope;   k = intercept;

Po = Initial price (1988); Qo = Initial quantity (1988);

n = own price elasticity

Sources: Column 1 from Yen and Roe.

column 2 = (domestic production - exports + imports).

column 3 = average consumer price obtained from Secretaria de Estado de Agricultura, plan Operativo 1989.

availability.

The level of input use refers to the use of purchased inputs such as fertilizers, insecticides, fungicides and improved seed. The model adopted the criteria used by the Agricultural Economics Department of the Ministry of Agriculture which considers three levels of input usage. High level refers to the use of more than 80% of the recommended amount of modern inputs. Medium level occurs when about 60-80% of the recommended input amount is used. Low level of input use occurs when less than 60% of the recommended inputs are used in the production of the agricultural commodity. Fertilizer is the purchased input used most frequently by farmers on all crops. Table VI.4 shows prices for chemical inputs charged by the government and private companies. Except for fertilizer, chemical inputs are represented in the tableau for the sectoral model based on monetary value instead of physical quantities. The diversity of formulations for different insecticides and fungicides, as well as the diversity of measurements used, made it difficult to use physical coefficients for these inputs. Prices charged by the private companies were used in this study.

Different levels of purchased inputs are combined with land, water, labor, and machinery services to produce a specific crop. Different production techniques for the same crop vary by technical coefficients, costs, and

Table VI.3. Irrigated Land by Water Districts and Crops, 1988

Districts	Crops under irrigation	Irrigated Area (Hectares)
Yuma-Camu	Rice, Potato, Vegetables Red beans	41,641
Yaque de Sur	Rice, Cassava, Red beans Sugar cane, Sweet Potato Coconut, corn, Plantain, Pasture, Banana	32,652
Valle San Juan	Rice, Peanuts, Cassava Red Beans, Sweet Potato, Tobacco, Corn, Plantain Pasture, Vegetables	32,518
Valle Azua	Tomato, Vegetables, Red beans Peanuts, Sorghum, Corn Plantain, Cassava, Banana, Melon	17,235
Ozama-Nizao	Rice, Onion, Vegetables, Red Beans, Penauts, Pasture, Sugar cane, Plantain	36,094
Bajo Yaque Norte	Rice, Banana, Sorghum, Plantain, Vegetables, Red beans, Cassava, Pasture	31,623
Alto Yaque Norte	Rice, Sugar Cane, Plantain, Tobacco, Vegetables, Red beans, Sorghum, Corn, Cassava, Pasture	38,031
Bajo Yuna	Rice	32,362
Total		262,156
Total Agricultural land		1,257,862

Source: Instituto Nacional de Recursos Hidraulicos (INDRHI)
The Dominican Republic, 1988.

Table VI.4. Government and Private Prices for Chemical Inputs, 1988

Product	Unit	Government Price (DR$)	Private Price (DR$)	Government Subsidy (3-2)
	-1-	-2-	-3-	-4-
Fertilizer				
15-15-15	MT	1413.50	1588.40	174.90
Urea 46%	MT	2002.00	1942.60	-59.40
Insecticides				
Azodrin 60%	Gallon	248.44	225.00	-23.44
Decis	Gallon			
Tamaron 600	Gallon	273.75	281.25	7.50
Mocap 20EC	Gallon	264.37	300.80	36.43
Sistemin 40EC	Gallon	227.81	227.81	.00
Fungicides				
Dithane M-45	Kilogram	27.00	31.00	4.00
Kocide 101	Kilogram	29.00	35.00	6.00
Benlate	Kilogram	190.00	250.00	60.00
Manzate 200	Kilogram	34.75	35.00	.25
Antracol	Kilogram	34.10	42.90	8.80
Herbicides				
Gramoxome super	Gallon	147.19	153.75	6.56
Goal 2E	Gallon	660.00	435.99	-224.01
Gessapax 500	Gallon	345.94	189.11	-156.83
Herbadox 330E	Gallon	1646.50	1772.50	126.00

Source: Garcia P. and W Mendez, "Evaluacion del Programa Centros de Venta de Materiales Agropecuarios (CVMA) de la Secretaria de Estado de Agricultura". Tesis de Grado, ISA, 1989.

yields.

Agricultural machines are used mainly for land preparation and harvesting. Land preparation includes plowing, disking, leveling and harrowing. In the model, machinery requirements are expressed in service value instead of physical requirements. Similar to purchased inputs, three levels of machine use are included: highly mechanized, semi-mechanized and no mechanization. Two different sources of machinery services considered are government subsidized and private services. Table VI.5 presents the service fees for the private sector and the government and the area covered by government machinery services in 1988. The government provides subsidized services which in most cases are 50% cheaper than private services.

When animals are used instead of machines, the cost of the animal services is not explicitly modeled. The requirement is expressed in terms of the labor requirement for the operator who drives the animal. Animal costs are not included in the provision of the service because there was not a way to assess these costs.

Labor is expressed in man-days for different activities. All labor requirements for each activity are included by month. Family labor is implicitly modeled by assuming that family labor accounts for 30% of the total labor availability (Stocker and Li). Due to differences in wages by region and by crop, it was not possible to specify a

Table VI. 5. Fees Charged for Machine Services by the Government and the Private Sector, 1988.

Type of Service	Government fee (DR$/HA)	Private fee (DR$/HA)	Government subsidy (DR$)	Land area covered by govt. serv. (Hectares)
Deep plowing	95.40	190.80	95.40	6,598
Plowing with harrow	71.55	127.20	55.65	27,557
Disking	63.60	127.20	63.60	25,519
Soil aeration	318.00	556.50	238.50	3,338
Furrowing	39.75	63.60	23.85	2,973
Rampart Building	39.75	55.65	15.90	1,141
Planting	47.70	120.55	72.85	3,896
Harvesting	39.75	63.60	23.85	1,895

Source: Programa de Servicios de Mecanizacion Agricola (PROSEMA). Taken from E. Gutierrez and R.Moran, "Evaluacion de PROSEMA como Organismo de Servicios Publicos, 1990 daily wage for hired labor. Instead, family and hired labor are treated as a fixed resource. Total labor availability was obtained from the FAO Production Yearbook which estimated the economically active population in agriculture to be 815,000 people in 1988. In the model it is assumed that there are 25 working days per month.

Three types of land quality are considered in the model for crop production. Land type A includes soil types I and II which are excellent and very good for cultivation, respectively (Harsthon et. al). Table VI.6 shows that 6.06% of the total land in the country belongs in that category. Land type B consists of classes III and IV with good to limited capability for cultivation, accounting for 14.2% of the total land available in the Dominican Republic. Land classes V and VI are pasture land and are only usable for livestock. These categories constitute about 24.5% of total land. The rest of the land is non-agricultural land and is not included in the model.

To summarize, resources in the model are classified as fixed or purchased inputs. Fixed resources consist of land, water, and labor as described above. In addition, operating capital is considered as a semi-fixed input because some sources of credit such as official lending have upper limits. When those sources are used up, credit from other sources such as commercial banks and moneylenders are available, but at a higher interest rate. The

Table VI.6. Land Capability Classification

Class	Hectares	Percent	Production Capacity
I	69,810	1.13	Excellent for cultivation
II	305,500	4.93	Very good for cultivation
III	405,860	6.55	Good for cultivation
IV	473,070	7.63	Limited or marginal cultivation
V	789,230	12.73	Pasture; no erosion hazard
VI	729,430	11.76	Pasture; erosion hazard
VII	3,270,930	52.76	Forest
VIII	156,260	2.52	Wildlands
TOTAL	6,200,090	100	

Source: Harsthon, et. al " The Dominican Republic. Country Environmental Profile".

model does not have an upper bound for the latter source of credit.

Purchased inputs include chemicals and machinery services. There are limits to the quantities of these inputs available at the government subsidized price but there is no quantity constraint for the supply of these inputs in total. Chemical inputs are not subsidized in this model. Any amount of these purchased inputs can be used at the going private market price (see below for further discussion in the tableau format).

VI.4. Trade Specification

External conditions which have some impact on domestic markets are also considered in the model. For instance, export quotas for traditional export crops are included as constraints. In the case of sugar, exports to the United States are constrained by quota. Coffee exports are constrained by the quota assigned to the country by the International Coffee Organization (ICO). Likewise, imports are sometimes constrained by the government based on foreign exchange availability and to protect domestic producers. Actual exports and imports in the base year are selected as the upper bounds on exports or imports. Table VI.7 shows quantities exported or imported and unit export and import prices in the base year for the commodities

Table VI.7. Quantity Exported and/or Imported for the set of Commodities Included in the Sector Model, 1988

Commodity	Export volume (000 MT)	Unit export value (US$/MT)	Unit export value (DR$/MT)	Import volume (000 MT)	Unit import value (US$/MT)	Unit import value (DR$/MT)
	-1-	-2-	-3-	-4-	-5-	-6-
Sugar	518.51	256.67	1077.06	.00	.00	.00
Coffee	29.29	2768.41	11363.09	.00	.00	.00
Tobacco	15.30	1301.50	5512.26	.00	.00	.00
Rice	.00	.00	.00	46.32	218.28	917.33
Red beans	.00	.00	.00	10.50	671.11	2858.94
Corn	.00	.00	.00	320.17	105.26	457.1
Peanuts(*)	.00	.00	.00	.06	1354.46	5778.77
Cassava	5.67	315.01	1564.28	.00	.00	.00
Plantain	1.17	193.78	985.86	.00	.00	.00
Salad Tomato	3.21	289.58	1214.52	.00	.00	.00

(*) imported for oil processing

Sources: Columns 1 and 2 from CEDOPEX, Statistical bulletin.
Column 3 was calculated using a weighted average exchange rate.
Columns 4, and 5 from FAO Trade Yearbooks.
Column 6 was calculated using a weighted average exchange rate.

included in the model.

Export and import prices are taken as parameters in the model because the Dominican Republic is assumed to be a small open economy. A three year average (1986-1988) of border prices is calculated to smooth out annual variations. Export prices are expressed as FOB prices while the import are CIF prices.

VI.5. Tableau Presentation of the Model

Table VI.8 depicts an abbreviated version of the model in tableau form. Rice is used to provide an explanation of the production, marketing, trade, consumption, and resource supply activities considered in the model. The whole model in the GAMS format is presented in appendix B. The first block of columns in table VI.8 depicts different production techniques for rice production. Each one represents different combinations of inputs and yields. These techniques were selected from the budgets elaborated by the Ministry of Agriculture based on surveys carried out in 1988 among Dominican farmers. Table VI.9 describes the types of production techniques considered for each of the activities included in the model, including the seven rice techniques.

The first technique (RICE1) represents the production of rice making intensive use of inputs, on irrigated land

Table VI.8. Tableau Depicting a Sector Programming Model Using Rice as a Representative Commodity.

	Production activities			Mktg. Activity	Trade		Demand activities	Resource supply activities										Constraints constants	
	Rice1	Rice3	Rice6	Ricepol	Imprice	exprice	Derice	Coindus	Couhol	Coretail	Cochem	Cofert	Coplo0	CoploC	Ricefin0	RicefinC	Coirr		RHS
Z	.00	.00	.00	.00	-761.21			-1.00	-1.00		-1.00	-1588.40	-95.40	-190.80	-.17	-.36	-1.00		MAX
Chemical	788.70	326.50	131.87								-1.00							≤	.00
Fertilizer	.70	.64	.09									-1.00						≤	.00
Plowing	1.00	1.09	1.06										-1.00	-1.00				≤	.00
Plowingmax													1.00					≤	5,146
Ricecap	203.27	431.04	81.09												-1.00			≤	0
Ricecapmax															1.00			≤	306,477,000
Irrig	15.42	11.45															-1.00	≤	.00
A-Land	1.00	1.00																≤	3,753,310
B-Land			1.00															≤	878,930
Irr-Aland	1.00	1.00																≤	68,681
Irr-Bland																		≤	160,840
Labor-January																		≤	18,730,000
Labor-April	3.41	27.50																≤	18,438,000
Labor-July	5.10	8.55																≤	18,277,000
Labor-dec			15.34															≤	18,344,000
Riceprod	-8.01	-8.08	-3.25	1.00														≤	.00
Polprod				-.65	-1.00	1.00	1.00											≤	.00
Industri				124.52				-1.00										≤	.00
Wholesal				35.00					-1.00									≤	.00
Retail				90.20						-1.00								≤	.00
Imricmax					1.00													≤	545.40
Expricmax						1.00												≤	.00

Table VI.9. Techniques Included in the Model by Activity

Activity	Land Quality	Water Access	Input Usage	Production Practices	Other Features
Sugar					
Technique 1	A	irrigated	high	mechanized	private
Technique 2	A	irrigated	high	mechanized	government
Coffee					
Technique 1	A		high		50 yrs. (*)
Technique 2	A		medium		25 yrs. (*)
Technique 3	A		low		15 yrs. (*)
Tobacco					
Technique 1	A	irrigated	high	mechanized	
Technique 2	A	dryland	medium	mechanized	
Technique 3	A	dryland	low	mechanized	
Technique 4	B	dryland	medium	semi-mec.	
Technique 5	B	dryland	medium	animal	
Rice					
Technique 1	A	irrigated	high	mechanized	
Technique 2	A	irrigated	high	semi-mec.	
Technique 3	A	irrigated	medium	semi-mec.	
Technique 4	A	irrigated	medium	animal	
Technique 5	A	irrigated	low	semi-mec.	
Technique 6	B	dryland	medium	mechanized	
Technique 7	B				
Red Beans					
Technique 1	A	irrigated	high	mechanized	
Technique 2	A	irrigated	medium	mechanized	
Technique 3	A	irrigated	medium	semi-mec.	
Technique 4	A	irrigated	low	semi-mec.	
Technique 5	B	dryland	medium	animal	
Technique 6	A	dryland	low	mechanized	
Technique 7	B	dryland	none	mechanized	
Technique 8	A	dryland	low	semi-mec.	
Technique 9	B	dryland	none	animal	

Table VI.9 (cont).

Corn					
Technique 1	A	irrigated	medium	mechanized	
Technique 2	A	irrigated	low	mechanized	
Technique 3	A	irrigated	none	mechanized	
Technique 4	A	irrigated	none	semi-mec.	
Technique 5	A	dryland	medium	mechanized	
Technique 6	A	dryland	low	mechanized	
Technique 7	B	dryland	low	semi-mec.	
Technique 8	A	dryland	none	none	
Technique 9	B	dryland	none	none	
Peanuts					
Technique 1	A	dryland	low	mechanized	
Technique 2	B	dryland	low	mechanized	
Technique 3	B	dryland	low	semi-mec.	
Technique 4	A	dryland	low	animal	
Technique 5	B	dryland	none	animal	
Cassava					
Technique 1	A	irrigated	medium	mechanized	
Technique 2	A	irrigated	low	mechanized	
Technique 3	A	irrigated	none	mechanized	
Technique 4	A	irrigated	none	animal	
Technique 5	A	dryland	low	mechanized	
Technique 6	B	dryland	low	semi-mec.	
Technique 7	B	dryland	none	animal	
Plantain					
Technique 1	A	irrigated	high	mechanized	
Technique 2	A	irrigated			maintenance
Technique 3	A	irrigated	medium	semi-mec.	
Salad Tomato					
Technique 1	A	irrigated	high	semi-mec.	winter
Technique 2	A	irrigated	high	semi-mec.	spring
Technique 3	A	irrigated	high	animal	

(*) The years refer to the length of life the plantain stand.

Source: Annual crop budgets, Ministry of Agriculture.

and using machines for land preparation on good quality soil. Technology 6 (RICE6) depicts non-irrigated production of rice on lower quality land, using less inputs and machine services. The difference in land quality and input use is reflected in both production costs and yields. At the bottom of column one representing technology 1, in the row labeled RICEPROD, it can be seen that the yield for that production technique is 8.01 metric tons per hectare, while the yield for technique 6 is only 3.25 metric tons per hectare.

The second block represents marketing activities. In the case of rice, the transformation of paddy rice to polished rice is represented by the activity labeled RICE-POL. A metric ton of paddy rice renders 0.65 ton of polished rice after milling. That coefficient is shown at the bottom at the intersection with the commodity balance row (POLPROD). The rest of the coefficients shown in this column will be explained below.

The next column depicts trade activities (exports or imports). In the case of rice, an import activity (IMRICE) is included because the country's production has not been sufficient to satisfy domestic demand. Import prices, expressed in Dominican pesos per metric ton are included in the objective function with a negative sign while export prices (also expressed in Dominican pesos per metric ton) are included with a positive sign. In table

VI.8, the import price for rice is DR$761.21/MT.

Next, domestic final use activities are represented by a set of demand functions of the type explained in chapter V. For rice the activity is labeled DERICE. The demand function are not linearized but are integrated with the quadratic terms to be solved using the GAMS software package.

The next block of columns consists of the resource supply activities. Only purchased inputs are included as columns. The supply of fixed inputs, such as land and labor, is incorporated in the right hand side of the row accounting for the use of the fixed input and is discussed below when rows of the tableau are described.

For the purchased inputs, their unit cost is subtracted from the objective function. For some purchased inputs two different unit costs are included reflecting the cost of buying from the government or the private sector. For instance plowing service from the government (COPLOG) costs DR$95.40/HA while the private sector (COPLOC) charges DR$190.80/HA. There are upper bounds for the amount of inputs supplied by the government. In the case of plowing, it can be seen in the right hand side of the row called PLOWGOMX that the maximum amount of land to be plowed by government machines can not exceed 5,146.44 hectares.

Similar to machines services, the model includes two different sources of credit. The Agricultural Bank is the government financial institution which provides credit to farmers at a subsidized interest rate. Farmers also have the option to borrow from commercial banks but at a higher interest rate. The official interest rate charged is 17% while commercial banks charge 36% annually. There is an upper bound on the amount of money used by the agricultural bank to finance a specific agricultural activity. In the case of rice, the credit constraint is introduced in the right hand side of the row RICECAPMX (DR$306.477 million). For the rest of the activities, subsidized credit constraints will be determined by the amount of money lent by the Agricultural Bank to each activity in 1988 as shown in table II.13.

Equations in the model are depicted as rows in the tableau. The first row represents the objective function which is to maximize producer and consumer surplus. The next block of equations represents the use of inputs. Two different kinds of inputs are specified in the model: purchased inputs and fixed inputs. Purchased inputs are divided into chemical inputs (insecticides, fungicides, herbicides and seed), fertilizer and mechanical services. As explained above, chemical inputs are expressed in monetary value by unit of land (DR$/HA), while fertilizer use is expressed in physical quantities (MT/HA). From table

VI.8, it can be seen that all techniques use chemical inputs and fertilizer, with technique 1 using them most intensively. Mechanical services are disaggregated because there are different fee charges by type of activity performed. For instance, plowing services provided by the government cost DR$95.40 per hectare, while harrowing costs DR$39.75 per hectare. Machine services are measured in units of land (HA). For some activities which require a seedbed apart from the crop production area, the coefficient is greater than one. That is the case for plowing land for techniques 3 and 6.

In the case of purchased inputs, where any quantity can be supplied at the going price, the input balance rows assure a balance of demand and supply. If input purchases are not constrained and a positive input amount is used, their shadow prices should equal the inputs' prices. However, machinery services provided by the government are constrained by the availability of machinery owned by the government[1]. The upper bounds on the amount of services provided by the government can be seen in the right hand sides of the equations regarding government mechanical services (PLOWGMX). Those upper bounds are the amount of

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· It has been estimated that the government provides about 20% f the total machine service in the country (Gutierrez and oran).

land covered by government machinery services during 1988.

The operating capital required in the production of each activity is represented by the row RICECAP. The row RICECAPMAX, represents an upper bound of government subsidized credit available for rice production.

In the case of irrigation water, there is a flat annual user's fee for irrigation which varies by water district. The difference in water charge by technique in some sense reflects the difference in water service fee by districts. Water use is quantified in monetary value and not in physical quantity.

Crop land is classified as land A and B. The endowment for each type of land is included in the right hand side of their respective equations (A-land and B-land). For the fixed resources such as land and labor, their shadow prices are interpreted as the marginal value of those fixed factors.

Labor requirements are expressed by month to provide a realistic portrayal of labor requirements and availability throughout the year. Labor availability is depicted in the right hand side of the monthly labor requirement. It can be seen from table VI.8 that monthly labor requirements vary by technique.

The next block of equations represents transfer, commodity balances and transformation activities. Production has to be transported from the farm to the final consumption site. In addition, processing, wholesaling and retailing activities are required. The value added by marketing activities is accounted for in these rows. The first equation in this block is called a transfer row (RICEPROD). In the case of rice, the production of paddy rice from each production technique is transferred to a rice polishing activity. The values that appear in each production activity reflect the yield by each production technique. The paddy to polished rice rate is accounted for by the next equation called the commodity balance row (POLPROD). One ton of paddy rice will render 0.65 ton of polished rice. Other activities which undergo transformation are peanuts to be converted into peanut oil and sugarcane to be transformed into sugar. The coefficients of transformation are 0.65 for peanut oil and 0.11 for sugar. The balance rows represent the heart of the model because they force the model to produce all that is consumed. The shadow prices of the commodity balances are interpreted as the commodity prices. Some of the by-products that can be obtained after product transformation of some commodities (such as bran from paddy rice and molasses) are also included in this study. Along with these equations are the INDUSTRI, WHOLESAL and RETAIL equations which represent the value added and the respective cost of the processing, wholesale and retail activity. In the case of rice the processing of paddy rice into polished rice in the Dominican Republic cost DR$124.52 per ton of polished rice in 1988.

The last block of equations consists of other market constraints such as export and import quotas and credit constraints. In the case of rice, there is an import upper bound of 545 metric tons for the base year. No exports are allowed for rice in the model. Other activities which experience some import during the base year include red beans, corn and peanuts (see table VI.7). Shadow prices for the import quotas are a measure of the unit rent accruing to those allowed to import. In the case of export quota rows, their shadow prices are a measure of the unit rent that accrues to those who have export rights. For the model there is an upper bound for the exports of sugar consisting of 176,710 metric tons to be exported through the US sugar quota system. Coffee exports are limited to 26,102 metric tons, while tobacco exports are constrained to be less than 26,136 metric tons.

VI.6. Summary

In this chapter, the mathematical programming model for the Dominican Agriculture was presented. It included ten of the most important agricultural commodities in the Dominican Republic. Commodities are classified as traditional export crops, food crops and non-traditional export crops.

In the model linear demand functions are included for each commodity except for tobacco. Several production techniques were specified for each commodity. Those technique were identified using as criteria the level of input use, access to irrigation water, the level of mechanization and land quality.

Inputs were classified as fixed and purchased inputs. Fixed inputs included land (land Type A and B and tree crop land) and labor. Labor requirement and availability were specified on a monthly basis. Purchased inputs included fertilizer, chemicals and machine services.

Two sources (private and government) for machine services and credit were modeled with different prices. In addition, processing and marketing activities (wholesale and retail) were included in the model. Upper bounds for exports and imports for the commodities selected were imposed based on values from the base year, 1988. The next chapter presents results obtained from the mathematical programming model for the base year.

Chapter VII. Model Validation and Results

VII.1. Introduction

This chapter presents the validation tests performed on the sector model of the Dominican agriculture and results obtained from the base model. First, verification and validation procedures for sector programming models are discussed and the model is evaluated in terms of its ability to replicate actual data for the base year 1988. Then results from the model are discussed in terms of sector income, production, and employment. The chapter ends with a discussion regarding the usefulness and weakness of the model for policy analysis.

VII.2. Verification and Validation of the Model

There is no standard statistical procedure to validate a sector model (Ballenger; Hazell and Norton). The most common procedures used for validation consist of comparing actual aggregate and microeconomic variables with the model's results. Aggregate variables include agricultural production, income, and employment. Microeconomic variables consist of production by crop, prices, and acreage devoted to each commodity and inputs used by each activity.

VII.2.1. Model Verification

Model verification is done to assure that model coefficients reflect values observed in the base year. The different types of data used to build the model are reconciled with the values observed in the base year. Among those types of data are technical coefficients, production and consumption quantities, consumer prices, quantities and border prices for traded commodities, input prices, demand elasticities, and marketing margins.

In this study, the model was verified in the four areas described by Hazell and Norton. First, the product-product verification consisted of reconciliation of quantities supplied and demanded for all activities included in the model with actual quantities for the base year. This included domestic production and imports on the supply side as well as domestic demand and exports from the demand side.

Domestic production data for the activities included in the model were checked to assure that they corresponded with the actual values reported by the Ministry of Agriculture. Production data were used along with export and import quantities to estimate the equilibrium quantity. However, quantities produced and consumed included in the model may be underestimated with respect to the actual production of some activities due to some self-consumption of food crops by farmers and their families. There are no data regarding the amount of production that is kept by farmers for self-consumption or as seed material for the next season. In the case of red beans some production is kept as seed for the next period. Cassava and plantains are produced by some small farmers and part of the production may not reach the traditional markets so their production is not recorded. Import quantities and prices were checked from different sources such as the FAO Trade Yearbook, the Statistical bulletin from CEDOPEX and the Ministry of Agriculture, to assure consistency and converted into Dominican currency using the appropriate exchange rate.

Second, the model was verified from a product-input dimension which consisted of reconciliation of technical coefficients. Special attention was paid to assure a realistic assessment of the average yield as published in the budgets elaborated by the Ministry of Agriculture and the yield obtained in the field.

Product-price dimension is the third area of verification. It consists of verifying output prices for all commodities included in the model. Although prices are obtained endogenously, the average price for each commodity in 1988 was used as the equilibrium price to estimate the respective respective demand intercept and slope.

The fourth area of verification is related to the technical coefficients. Domestic conversion ratios for sugarcane/sugar, rough rice/polished rice and peanuts/peanut oil were checked and compared to their respective ratios in the United States. Technical coefficients obtained from the set of budgets were verified to assure internal consistency. For instance, the use of more purchased inputs per unit of land should render a higher yield. Likewise, the data were analyzed to detect any inconsistency in the amount of labor used during the calendar year by each activity. As an example, coffee production demands more labor during the harvest season which runs from late November to early March.

VII.2.2. Model Validation

Validation of a sector model is constrained by the availability and quality of data (Ballenger). Some previous sector models were not validated against aggregate variables due to lack of reliable data that could be used to test those variables against the base model results (Norton and Solis; Ballenger). This was the case for agricultural employment and income where data for the Dominican Republic were not available.

In this study, the focus of validation is on the six standard tests outlined by Hazell and Norton. These tests are: 1) production test, 2) capacity test, 3) price test,

4) marginal cost test, 5) land rental test and, 6) level of input use test. Out of these six validation tests only the first four were carried out in this study due lack of reliable data as explained below.

VII.2.2.1. Production and Capacity tests

The production test consists of comparing the model results on production quantities against the observed values for the base year. Table VII.1. presents production and yields, exports, imports and consumption for the model and the base year.

The model overestimates production of all commodities except sugar. Sugar production is about half of the actual production in the base year. The shortfall occurs because two different export markets were specified for sugar, the world market and the United States market operating through the sugar quota system. Results from the model do not show any sugar exports to the world market suggesting that at the going world market price it is not profitable for the country to export sugar. That notion is reinforced when results from the capacity test are discussed later on. However, the model does show exports to the United States market where prices were more attractive. The level of domestic sugar consumption achieved in the model is very close to the actual consumption for the base year.

Table VII.1. Production, Exports, Imports and Domestic Consumption: Model and Actual Data.

	Production (MT)		Yield (MT/HA)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual
Sugar	408,140	730,400	43.73	46.76	176,700	577,727	N.I.	N.I.	231,430	251,177
Coffee	54,836	50,318	.36	.45	26,102	26,102	N.I.	N.I.	28,733	24,217
Tobacco	26,136	26,136	.997	1.22	26,136	26,136	N.I.	N.I.	---	---
Rice (*)	413,335	274,409	4.71	2.89	N.E.	N.E.	545	545	413,880	274,954
Beans	106,000	45,773	.88	.8	N.E.	N.E.	0	22,636	106,000	68,409
Corn	426,730	57,227	1.58	1.52	N.E.	N.E.	0	399,500	426,730	456,727
Cassava	162,681	126,682	8.37	6.11	5,681	5,681	N.I.	N.I.	157,000	120,999
Plantain	35,135	22,725	9.38	5.67	1,167	1,167	N.I.	N.I.	33,968	22,725
Peanuts (**)	8,638	3,743	1.13	.969	N.E.	N.E.	23,392	23,392	32,029	27,135
Tomato	39,685	17,090	26.54	9.86	7,606	7,606	N.I.	N.I.	32,080	21,558

Note: N.E. = no export ; N.I. = no import.
(*) Rice is listed as polished rice.
(**) Peanut oil equivalent.

The model results for coffee production, the second traditional export crop, are only 8.9% greater than actually observed in the base year. The export bound is met by the model and the excess quantity is absorbed by the domestic market.

The domestic demand for tobacco, the other traditional export, was not modeled. Rather it was assumed that tobacco was produced for export and faced a perfectly elastic demand determined by the export market. Tobacco production in the model was equal to actual production and equal to quantity exported for the base year. In fact about 95% of the black tobacco produced in the country is being exported. Black tobacco is used to produce cigars and cigarettes. The domestic consumption of cigarettes made of black tobacco represents only 8% of the total cigarette consumption and has had a marked tendency to decrease (Tobacco Institute). The "blond" tobacco (Virginia and Burley) used to produce cigarettes has a different market structure and it was not included in the model. That tobacco accounted for 8% of the total production of tobacco and is directed totally to the production of cigarettes (Tobacco Institute).

Rice, beans, corn and peanuts are the food crops which the Dominican Republic imported to satisfy domestic demand. The levels of production and consumption for rice are overestimated. This occurred because the model selected a technique with a higher yield than the national average achieved during the base year. The model selects an activity with a yield of 4.71 metric tons/hectare which is almost twice as high as the average yield (2.89 tons/hectare); the model is also providing almost twice as much production.

The model does not show imports for beans and corn despite the sizable amount imported of both commodities during the base year 1988. Both production and consumption of beans are overestimated by the model. The model's yield was close to the base year's yield, however overestimation of production occurred as more area was devoted to bean production in the model than was actually harvested. Corn production is overestimated, while consumption is underestimated but only by a negligible amount (1.2%). In both crops substantial actual imports are being replaced by domestic production in the model.

Peanut oil production, which is used in the model to represent cooking oil, is also overestimated by the model[1]. However, unlike corn and beans, the level of imports in the base year is replicated. Consumption of peanut oil is also overestimated but only by 18%. One of the reasons

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· Peanut meal is not included in the model due to the lack of rice data and because livestock activities are not included in 1e model. Its inclusion may have induced a greater production of eanuts.

for the overestimation is that the model is not capturing the structure of production of peanuts. Peanut production is being carried out by small farmers in land of low fertility with few possibilities to engage in other agricultural activities.

Cassava and plantain are produced mainly for domestic consumption, although some exports occurred during the base year. Although export prices may be attractive, there exist some limitations on the country's ability to export these two commodities. Specifically, it is the government's goal to assure that the domestic demand for these two commodities is met by the domestic production and export is subject to the achievement of that goal. In 1989 the government prohibited exports of plantain in order to achieve the above goal (Ministry of Agriculture, 1989). Production and consumption for both crops are overestimated by the model. Model yields for both commodities are higher than the average yield for the base year.

Salad tomato production and consumption are also overestimated by the model. Overproduction may have occurred not only due to the high yield of the technique selected, but also because the model does not account for the riskiness of high value crops such as salad tomatoes and other vegetables.

In general, overestimation of production of the food crops and non-traditional export crops is due to selection of production techniques with a higher average than the national average for the base year. Although several techniques with different yield levels actually occur and are included in the model, only the most profitable is being picked by the model. Possibly other restraints, not included in the model, may prevent some farmers from achieving the higher yields selected by the model. Among those restraints are inability to acquire modern production inputs (improved seed varieties, fertilizer and chemicals in general) and inadequate extension services. In addition, the risk averse behavior of some farmers may reduce output. Also family consumption was not subtracted, which may cause output to be overstated.

The model was not adjusted in order to choose yields close to average observed yields. Instead, the yield selection of the model is analyzed as the one that could have occurred if the selected techniques were available to all producers. In that sense, results from the model should be evaluated in light of that outcome.

To complement the production test, a capacity test was conducted to see if the model could reproduce the production levels for all commodities in the base year 1988. With the capacity test, a new set of constraints is introduced into the model to force it to produce the quantities produced during the base year (Kutcher, Hazell and Norton).

The objective function and all other constraints remain unchanged. If the model can not achieve that level of production, it indicates unrealistic constraint levels and/or unrealistic input coefficient requirements.

Results from the capacity test only showed changes with respect to the level of production and consumption for sugar. When the minimum quantity constraint was imposed on sugar production, the model increased production to the level achieved in the base year. Exports to the world market occurred, but at a lower level than the base year (247,270 tons compared to 401,027 tons in the base year). Domestic consumption increased to 306,410 from 231,430 tons in the base model.

In general, an overestimation of production by the model is expected because it does not include some of the deviations of the real world from the assumption of perfect competition. These deviations include bureaucratic controls and legal and geographic constraints (Hazell and Norton). In addition, as pointed out in chapter five, optimization of some other objective functions can occur in the real world different from the objective function chosen in this study (Hazell and Norton).

VII.2.2.2. Price and Marginal Cost Tests

The price test consists of comparing model prices with the base year prices. Prices in the model are the shadow prices in the commodity balance rows. Because the model tends to overestimate production, prices are underestimated for eight of the ten commodities as shown in table VII.2. Furthermore, because most of the crops face demand with elasticities lower than one in absolute value, prices diverge more than quantities (Hazell and Norton). The model's price for sugar is higher than the base year as would be expected because quantities produced and consumed in the model were lower than base year quantities. The largest relative differences occur between model prices and base year prices for rice, beans and plantain where the over prediction of production leads to underprediction of prices.

Along with the price comparison, a marginal cost test was performed to test the assumption of perfect competition. The test consists of forcing the model to produce at least the amount produced in the base year and modifying the objective function to minimize total cost (Kutcher, Hazell and Norton). If perfect competition is present, then the marginal cost of production should be equal to the price. Marginal costs are the shadow prices of the equations constraining the minimum amount to be produced.

Table VII.2. Model and Base Year Prices and Marginal Cost (*)

Activity	Base year price (DR$/MT)	Base model price (DR$/MT)	Marginal cost (test) (DR$/MT)
Sugar	1,477.08	1,738.85	1,769.75
Coffee	5,830.00	4,764.64	4,579.60
Tobacco	8,979.00	7,205.42	7,826.94
Rice(**)	2,750.00	895.53	777.61
Beans	7,722.00	2,277.14	1,733.24
Corn	1,628.00	1756.48	1,658.72
Cassava	1,430.00	1,001.19	1,001.19
Plantain	1,480.00	668.89	616.39
Peanuts (**)	2,875.15	2,333.64	2,224.20
Tomato	2,948.00	1,487.89	1,469.34

(*) Marginal costs are the shadow prices obtained from the minimum quantity constraint rows in the model version designed to evaluate marginal cost.

(**) Polished rice

(***) Peanut oil equivalent

These marginal costs are compared to the base year prices. Marginal costs lower than base year prices can be caused by the existence of some market behavior different from the perfect market assumption, failure to include some cost elements such as management skills and/or failure to include production risks in the model (Hazell and Norton).

Marginal costs for all commodities included in the model are lower than the actual base year prices except for sugar and coffee. However, in most crops the difference between marginal cost and the base model prices were relatively small or zero. The major discrepancies between actual prices and model marginal costs occur for rice, beans, plantain, peanuts and salad tomatoes. In the case of these crops, overestimation of yield may account for part of the difference; underestimation of costs may explain some of the differences for all crops. Failure of the model to account for production risks especially for tomatoes may account for part of the differences as well.

VII.2.2.3. Land Rental Test

The land rental test which consists of comparing the shadow price from the land constraint equation with the existing land rental charge during the base year, was not performed. There are different rental charges throughout the country depending on the region and the crop being planted. In the model, the country is treated as only one region. In addition, there is not a well-defined land market in the country and some laws affect the use of some land. The main laws defining the use of land are described in chapter II.

VII.2.2.4 Level of Input Use Test

The last test suggested by Norton and Hazell is the test on the level of input use. It consists of comparing the level of inputs estimated by the model against the base year values. Due to the lack of reliable data for the base year, it was impossible to conduct those tests for all inputs. Data on the amount of chemicals and fertilizer used as well as mechanical services provided by the private sector were not available. In addition, chemicals used were introduced in the model in monetary values instead of physical quantities.

The model exhausts the availability of both irrigated and non-irrigated type A land as well as the available land devoted to permanent crops. However, only 36% of the type B land is used in the model. Overall about 63% of the total land available is being used by the model. Model results resemble the land use pattern observed in the country. According to the latest agricultural census, only 69% of the potential land for agriculture was being used (World Bank, 1986).

Table VII.3 shows the labor use and the total wage by crops estimated by the model. Coffee and rice represent the two crops which employ the most total labor. Salad tomato is a labor intensive crop with the highest labor use per unit of land but the area harvested is very low compared to either rice or coffee. Tobacco production also employs a high level of labor per hectare and provides employment in all production stages. Sugar production employs more labor during the harvest season but most of the laborers employed are Haitian nationals. There exists an agreement between the Haitian and Dominican government by which some Haitians are hired temporarily to work in the sugar fields during the harvest season. The wage paid to those workers is usually much lower than the minimum salary. For that reason few Dominican laborers work in the sugar fields.

Labor use shows some seasonality. From Table VII.4. it can be seen that most labor is demanded during the November-April period. In only two months, December and March, is more than 40% of the labor available is used. In July and September only 1% of the available labor is used. This pattern occurs because most of the labor-intensive activities such as planting, weeding and harvesting are performed during November-April.

Although the model may underestimate the level of labor use, it reflects the fact that unemployment is quite high

Table VII.3. Area Harvested and Labor Use: Model Results.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	84,848	27.00	2,291	30	68,727
Coffee	171,178	147.70	25,283	30	758,489
Tobacco	36,409	105.77	3,851	30	115,530
Rice	102,642	118.24	12,136	30	364,091
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,576	30	47,265
Plantain	3,784	91.29	345	30	10,362
Peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,477
Total	831,469		65,842		1,975,261

Table VII.4. Seasonal Labor Use.

Month	Labor Use (000 MAN/DAY)	Percent of total labor available
January	6,188.70	33.04
February	4,438.90	23.98
March	9,125.00	48.55
April	6,958.60	37.74
May	2,578.50	14.03
June	1,777.60	9.81
July	64.45	.35
August	6,161.10	33.11
September	401.42	2.17
October	2,256.90	12.27
November	6,267.30	34.93
December	8,821.40	48.09

in rural areas. In 1988 it was estimated that unemployment in the rural sector was running at 29% in addition to 40% of the labor force being underemployed (UEA).

Other factors which constrain the model are the availability of government machinery services, subsidized credit and the upper bounds imposed on exports. But most important, the introduction of the supply-demand balance condition, forces the model to achieve a market equilibrium which does not depart greatly from the base year.

The above discussion regarding the validation of the model suggests that the model can not be used to make policy recommendations based on the absolute values of production, consumption, prices and income. Instead, effects of policy changes, as measured by the model should be evaluated in relative terms at best. The ability of the model to replicate the relative importance of the activities makes it appropriate for policy evaluation in terms of relative changes. Similarly, the tendency of the model to specialize in production by specific technique with higher than observed yields, suggests that the model should not be used to make recommendations on specific commodities. Instead, recommendation at the sector level would be more appropriate.

To improve model accuracy, more dissagregation by farm size and production areas is needed. In addition, including other factors such as production risks and input and output market imperfections would likely cause production levels and prices to be closer to actual levels.

VII.3. Consumer and Producer Surplus

Table VII.5. depicts the calculation of consumer surplus for the model. Rice renders by far the highest consumer surplus. Beans, corn and cassava also provide sizable amounts of consumer surplus. Tobacco production is not included because consumer surplus could not be computed due to the assumption of perfectly elastic export demand. In that sense, only producer surplus is present. The measure of consumer surplus for the base model will be useful when evaluating the effects of policy changes. Producer surplus is not obtained directly from the model results but can be estimated as the difference between the objective function value (which is the sum of producer and consumer surplus) and the estimated consumer surplus. The objective function value for the base model was DR$3,663.06 millions and the estimated consumer surplus was DR$2,966.79 millions. The producer surplus was then DR$696.27 millions.

VII.4. Sector Income.

Sector income is measured as the sum of domestic sales, export earnings, wages and government payments to subsi-

Table VII.5. Consumer Surplus Estimation: By Crops and Total

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127.45	1,738.85	231,430	160,681.85
Coffee	11,545.68	4,764.64	28,733	97,421
Rice	6,689.83	895.53	413,880	119,072
Beans	17,647.45	2,277.14	106,000	914,627
Corn	3,463.40	1,756.48	426,730	364,197
Cassava	3,042.18	1,001.19	157,000	160,217
Plantain	3,148.55	668.89	33,967	42,114
Peanuts	5,888.93	2,333.64	32,029	56,937
Tomato	5,946.98	1,487.89	32,079	71,523
Total				2,966,791

Note: to calculate consumer surplus the following formula was used:

$CS= ½*(\delta -Pe)*Qe$

where:

δ = demand intercept for crop i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

dized crops minus the sum of production and import costs for agricultural commodities (Ballenger). For the model, sector income was calculated as:

value of domestic sales (DR$000).......		2,214,342.00
+	export earnings(DR$000)...........	1,181,339.00
+	subsidy(DR$000)..................	228,360.00
-	cost of production...............	2,886,408.00
-	import cost(DR$000)...............	44,953.53
Total sector income		769,483.00

Cost of production does not include land and labor charges. Thus, total sector income is a return to the fixed factors in the agricultural sector. Table VII.6 details domestic sales values, export earnings, import costs and gross income by crop. Traditional export crops provide about 50% of the total gross income estimated from the model results. Sugar was the first, and corn second most important commodities in terms of gross income. The latter result does not correspond with actual data, since large quantities of imported corn were needed to satisfy the domestic demand during the base year. The same comment applies for beans production.

Costs of production are depicted in table VII.7. Chemicals, fertilizer, and financial charges account for 92% of the direct costs of production. However, the implicit labor cost is not included. When the calculated total wage

Table VII.6. Domestic Sales, Export and Import Values and Gross Income: Model Results.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	231430.00	1738.85	402422.06	176710.00	2977.00	526065.67	.00	.00	.00	928487.73
Molass	24600000.00	.45	11070.00	.00	.00	.00	.00	.00	.00	11070.00
Honey	.00	.00	.00	1113100.00	4.81	5354.011	.00	.00	.00	12791610.00
Coffee	28733.26	4764.64	136903.64	26102.00	15140.00	395184.28	.00	.00	.00	532087.92
Tobacco				26136.00	8979.00	234675.14	.00	.00	.00	234675.14
Rice	413880.00	895.53	370641.96				545.4	761.21	415.16	370226.79
Beans	106000.00	2277.14	241376.84	.00	.00	.00	.00	3090.00	.00	241376.84
Corn	426730.00	1756.48	749542.71	.00	.00	.00	.00	520.00	.00	749542.71
Cassava	157000.00	1001.19	157186.83	5681	1884.00	10703.00	.00	.00	.00	167703.32
Plantain	33968.00	668.89	22720.86	1167	1284.00	1498.43	.00	.00	.00	24219.91
Peanuts	32030.00	2333.64	74746.49				23392	1904	44538.37	30208.12
Tomato	32080.00	1487.89	47731.51	7606.00	1690.00	12854.14				60585.65
Total	26061851.26		2214342.89			1186334.68			44953.53	16141794.14

Table VII.7. Costs of Production: Model Results.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	% of total direct cost	% of total direct cost when labor included (*)	% of total cost	% of total cost when labor included (*)
Chemicals	123530.00	1.00	123530.00	26.10	4.10		
Fertilizer	112.8	1588.00	179126.40	37.85	5.98		
Plowing (govt.)	5.15	95.40	490.97	.10	.16		
Plowing (private)	34.57	190.80	6596.28	1.39	.22		
Crossing (govt.)	19.90	71.55	1424.19	.30	.04		
Crossing (private)	2.84	127.20	361.72	.08	.01		
Leveling(govt.)	5.44	127.20	691.45	.15	.02		
Harrowing (govt.)	5.44	39.75	216.24	.05	.01		
Planting (govt.)	3.04	47.70	144.91	.03	.01		
Planting (private)	13.93	120.55	1679.44	.35	.06		
Irrigation	1706.10	1.00	1706.10	.36	.06		
Other	22441.00	1.00	22441.00	4.74	.75		
Financing	134859.40	1.00	134859.40	28.50	28.50		
Total direct cost (**)			473268.12	100.00		16.40	50.33
Processing	468720.00	1.00	468720			16.24	9.65
Wholesale	737320.00	1.00	737320			25.54	15.18
Retail	1207100.00	1.00	1207100			41.82	24.85
Total(***)			2886408.1			100.00	

(*) The calculated labor cost is obtained from table VII.3. When the labor cost is included, the direct cost of production increases to DR$2,996,995 and total cost to DR$5,410,135.

(**) Direct cost of production is the cost incurred to produce the crop.

(***) Total cost includes direct cost of production plus marketing cost (processing, wholesale and retail).

is added to total direct cost, then labor costs account for almost 60% of the cost. Chemical cost represents only 4 percent and fertilizer's share of total cost is only 6%. When marketing activities are added to the direct cost of production, the latter account for 16% of the total cost. Retail cost represents 42% of the total cost while processing and wholesale costs account for 16% and 25% of the total cost. With labor costs included, total direct cost of production represents about 50% of the final price with processing, wholesale and retail representing 9.6%, 15% and 24.8% respectively.

VII.5. Summary

In this chapter, six different validation tests for a sector model were presented. Out of these six validation tests, four were performed for this study.

From the production test, it was found that the model overestimated production of all food crops and underestimated production of sugar (a traditional export crop). Imports for beans and corn were not reported either. The main reason for overestimation is the selection of production techniques with higher yields than the average yields observed during the base year, 1988. On the other hand, prices were underestimated for eight of the ten commodities included in the model.

Policy recommendations taken from the model are more meaningful if results are evaluated in relative terms and at the agricultural sector level. In the next chapter the effects of selected market and policy changes on sector income, and employment, foreign exchange earnings, production level and prices are evaluated. Effects will be evaluated against the base model results.

Chapter VIII Policy Scenarios

VIII.1. Introduction

This chapter discusses results obtained from the evaluation of alternative policy changes in terms of their effects on target variables such as agricultural production, income and employment, export revenue, and producer and consumer surplus. Policy instruments are classified as inward-looking and outward-looking as they are used to pursue one of these two alternative development strategies. In addition, changes in selected external market conditions are also evaluated.

Policy instruments analyzed here that could be classified as inward-oriented include a policy aimed at achieving food self-sufficiency by prohibiting imports of selected crops and a policy aimed at keeping domestic food costs low by penalizing traditional export crops. The latter penalty is imposed through an exchange rate differential. Policy instruments classified as outward-oriented include reduction in the fertilizer price to the level of the border price and the elimination of all direct government subsidies for crops.

The selection of policy instruments is based on measures that are found to be important in chapter IV. There, product price intervention, exchange rate intervention and input price (fertilizer) intervention were found to be important sources of deviations between domestic and border prices. The instruments included here reflected two of those distortions namely input price subsidies (penalties) and exchange rate distortions. Results from the base model are used as the standard against which the isolated effects of the different policies are compared.

Some external market conditions can influence the composition and structure of the output mix and affect employment, income and welfare distribution. In this study external market changes analyzed include changes in the quota assigned to the Dominican Republic for exporting sugar to the United States at a preferential price.

As it was pointed out in chapter VII, results from the different policy changes should be interpreted with caution due to divergence of base model results from actual values from the base year.

VIII.2. Inward-Oriented Policy Instruments

VIII.2.1. Food Self-Sufficiency

A policy of food self-sufficiency has been proclaimed and encouraged by several Dominican government administrations. The explicit goal of the Dominican government is to obtain self-sufficiency in basic food crops (SEA). This policy was analyzed by eliminating all imports of rice, beans, corn and cooking oil from the model. Results are presented in table VIII.1. and appendices C.1.A. through

C.7.A.

A policy of food self-sufficiency increases domestic production of the commodities being imported, rice and peanuts. The increase is more significant in the case of peanut oil because most of the cooking oil is being imported while the country produced most of the rice consumed and in some cases has been self-sufficient as explained in chapter II.

Even when domestic production of the previously imported commodities increases, domestic prices do not change. In that sense, there is no gain for consumers but government spending increases because the additional domestic produc spending increases because the additional domestic production receives subsidized government machine services and credit. This suggests that a policy of food self-sufficiency is achieved at the expense of taxpayers. If the objective of the government is to assure a stable supply of food to the population and to save foreign exchange, then it has to evaluate the gain of that policy against the cost of government involvement in the agricultural sector through subsidy. There is the need to evaluate returns from government spending in the agricultural as compared to another sector of the economy. Because the model used here is of a partial equilibrium nature, it was not possible to evaluate the effects of policies on other sectors of the economy.

Table VIII.1. Effects of Food Self-Sufficiency on Target Variables.

Target Variables	Base model	Food self-sufficiency	Percent change (%)
Production (MT)	1,681,315	1,705,251	1.42
Sector income (DR$000)	769,483	895,267	16.35
Employment (000 Man/Day)	65,842	66,905	1.61
Export revenue (DR$000) (*)	1,181,339	1,181,339	.00
Government spending (DR$000)	305,162	391,478	28.29
Total surplus (DR$000)	3,663,064	3,652,916	-.28
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
Producer surplus (DR$000)	696,277	686,129	-1.46

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00.

Sector income increases by 16.35% while employment increases by 1.6%. Consumer surplus is not affected by the policy of self-sufficiency but the value of the objective function decreases. This result occurs because the rent that accrued to the importers of previously imported commodities is now eliminated. That rent is included in the model as part of the total surplus received by the agricultural sector. [1]

VIII.2.2. Exchange Rate Change

As explained in chapter IV, traditional export crops were penalized during 1984-1986 through an exchange rate differential. Originally the exchange rate differential was set at 36% of the export price. That rate was reduced to 18% and subsequently to 5%. Tables VIII.2. VIII.3. and VIII.4. depict results obtained for the policy simulations using an exchange rate differential of 5%, 18% and 36% respectively. Additional results are contained in appendices C.1.B. through C.7.C.

In terms of the effects on production, an export tax

· The supply curves for the commodities which are both imported .nd produced domestically can be seen as two-step supply func- .ions. The first step consists of the amount supplied by imports. 'he second step which is above the imported quantity is the omestic production. When imports are eliminated, the supply 'unctions for these commodities become perfectly elastic.

Table VIII.2. Effects of a 5 Percent Penalty on Traditional Export Crops on Target Variables.

Target variables	Base model	Exchange rate change (5%)	Percent change (%)
Production (MT)	1,681,315	1,681,315	.00
Sector income (DR$000)	769,483	716,674	-6.86
Employment (000 Man/Day)	65,842	65,842	.00
Export Revenue (DR$000) (*)	1,181,339	1,128,511	-4.47
government spending (DR$000)	305,162	305,162	.00
Total surplus (DR$000)	3,663,064	3,605,310	-1.58
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
Producer surplus (DR$000)	696,277	638,523	-8.29

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00. However, the price received by exportes is reduced 5% of the equivalent export price, So even when foreign exchange earnings do not change with respect to the base model, export revenues received by exporters decline by 5%.

Table VIII.3. Effects of a 18 Percent Penalty on Traditional Export Crops on Target Variables.

Target variables	Base model	Exchange rate change (18%)	Percent change (%)
Production (MT)	1,681,315	1,681,315	.00
Sector income (DR$000)	769,483	566,418	-26.39
Employment (000 Man/Day)	65,842	65,842	.00
Export Revenue (DR$000) (*)	1,181,339	978,254	-17.19
Government spending (DR$000)	305,162	305,162	.00
Total surplus (DR$000)	3,663,064	3,455,053	-5.68
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
Producer surplus (DR$000)	696,273	488,266	-29.87

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00. Price received by exporters is reduced 18% of the equivalent export price. So even when foreign exchange earnings do not change with respect to the base model, export revenues received by exporters decline by 18%.

Table VIII.4. Effects of a 36 Percent Penalty on Traditional Export Crops on Target Variables.

Target variables	Base model	Exchange rate change (36%)	Percent change (%)
Production (MT)	1,681,315	1,615,494	-3.91
Sector income (DR$000)	769,483	530,688	-31.03
Employment (000 Man/Day)	65,842	61,991	-5.85
Export Revenue (DR$000) (*)	1,181,339	619,971	-47.52
Government spending (DR$000)	305,162	297,519	-2.50
Total surplus (DR$000)	3,663,064	3,277,446	-10.53
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
Producer surplus (DR$000)	696,273	310,660	-55.38

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00. The price received by exporters is reduced by 36% of the equivalent export price. Foreign exchange earnings decline due to the reduction in tobacco exports. Export revenues received by exporters decline due to both decline in tobacco exports and the exchange rate penalty of 36%.

through exchange rate overvaluation of either 5% or 18% does not affect the amount of domestic production for any of the crops selected compared to the base model. Even when producers are being penalized, prices are still high enough to insure positive returns. The only change is in export revenues received by the producers of the traditional export crops and the subsequent decline in producer surplus and sector income. When an exchange rate differential of 5% is applied, sector income decreases by 6.86%. The decrease is 26.4% when an exchange differential of 18% is applied. Producer surplus decreases 8.3% with an exchange differential of 5% and about 29.9% when the exchange rate differential is 18%. Although foreign exchange earnings do not change, revenues received by exporters of traditional exports decline by the level of the exchange rate differential. Export revenues decrease by 4.5% and 17.2% respectively when the exchange rate differentials of 5% and 18% are imposed.

Production of other crops is not affected by the imposition of a penalty of 5% or 18% on traditional export crops. Other target variables such as government spending and employment are not affected by the above policy.

When the exchange rate differential is increased to 36%, production of tobacco does not occur. As a consequence, foreign exchange earnings and export revenues are reduced. Export revenues decline by about 47%. But the reduction in tobacco production is not replaced in the model by increased production of other crops. Therefore, total production, sector income and employment decline by 4%, 13% and 31% respectively while consumer surplus declines by 55%. Government spending declines as well due to the reduction in tobacco production which uses some of the subsidized services and financing provided by the government.

From the above discussion of inward-oriented policies it can be concluded that the agricultural sector is not very responsive to a policy penalizing traditional export crops because little substitution is achieved. However, when a policy of self-sufficiency is adopted, domestic production is enhanced. The model exhibits some rigidity due to the imposition of upper bounds on exports. This rigidity reduces the ability of the model to reflect substitution of outputs and changes in production levels and resource use resulting from changes in exchange rates. Another possible explanation is that in the short-run the excess of production factors such as land and labor introduces some rigidities in domestic prices and it is the supply quantity that adjusts to the aggregate demand. That result differs from the neoclassical view which assumes that factors are fully used and the system is driven to equilibrium by input and output prices (Sarris).

VIII.3. Outward-Oriented Policy Instruments

VIII.3.1. Fertilizer Price Change

The first outward-oriented policy consisted of reducing the price of fertilizer from DR$1588.40/MT to DR$1365.59/MT. The latter price was the border price of fertilizer adjusted to reflect transportation cost and converted to Dominican pesos. Results of the fertilizer price change are presented in table VIII.5. and appendices C.1.D. to C.7.D.

Overall, production increased and equilibrium prices declined as a consequence of the reduction in the price of fertilizer especially of those crops that use fertilizer more intensively. Specifically, production of sugar, coffee, rice, plantain and tomato increased with the major increase obtained for coffee (1.8%), sugar (0.95%) and rice (0.16%). Consumption of coffee is the most affected increasing 3.5% as a consequence of the fertilizer price change. Other changes in domestic consumption occurred for sugar (1.66%), rice (0.16%), and plantain (0.58%). Domestic prices tend to decline for those crops which experienced increases in production with the biggest change occurring for coffee, rice and sugar.

Export and import quantities and values were not affected by the change in fertilizer price. Export quanti-

Table VIII.5. Effects of Fertilizer Price Change on Target Variables.

Target variables	Base model	Fertilizer price change	Percent change (%)
Production (MT)	1,681,315	1,687,063	.34
Sector income (DR$000)	769,484	782,236	1.66
Employment (000 Man/Day)	65,842	65,896	.08
Export Revenue (DR$000) (*)	1,181,339	1,186,385	.43
Government spending (DR$000)	305,162	307,427	.74
Total surplus (DR$000)	3,663,064	3,688,364	.69
Consumer surplus (DR$000)	2,966,787	2,983,570	.57
Producer surplus (DR$000)	696,277	704,794	1.22

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00.

ties are constrained by the upper bound imposed in the model meaning that increased export quantities cannot be achieved. In the case of imports, the reduction in fertilizer price was not sufficient to make domestic production of the imported crops cheaper than imports.

Sector income and employment were positively affected by the change. Employment increased 0.08% while sector income increased by 1.66%. Both consumers and producers benefit from a policy of fertilizer price reduction. Total surplus increased by 0.69%, with consumer surplus increasing by 0.57% and producer surplus by 1.22%. However, the reduction in fertilizer price causes government outlays to increase. Government spending increases by 0.74 % due to the increase in production of crops which demand government subsidized inputs.

VIII.3.2. Elimination of Government Subsidies

When the policy of no subsidy in the agricultural sector was adopted for the model, all subsidies provided to producers such as government machine services, credit and direct production subsidies were eliminated and results were compared to the base model results. This policy is an outward-oriented strategy where the country attempts to reduce market distortions. Results from that analysis are shown in table VIII.6. and appendices C.1.E. through C.7.E.

Table VIII.6. Effects of Elimination of Government Subsidy on Target Variables.

Target variables	Base model	Elimination government subsidy	Percent change (%)
Production (MT)	1,681,315	1,577,928	-6.15
Sector income (DR$000)	769,483	579,477	-24.69
Employment (000 Man/Day)	65,842	64,796	-1.59
Export revenue (DR$000) (*)	1,181,339	1,174,457	-.58
Government spending (DR$000)	305,162	0	-100.00
Total surplus (DR$000)	3,663,064	3,403,195	-7.09
Consumer surplus (DR$000)	2,966,791	2,823,781	-4.82
Producer surplus (DR$000)	696,273	579,415	-16.78

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00.

Crops which enjoy government protection through machine services and subsidized credit are the most affected by the policy of no government subsidy. Production of sugar, rice, cassava and plantain are negatively affected by a policy of market liberalization while coffee production increases. Sugar production decreases about 22% compared to the base model solution. Rice production decreases 2%, cassava decreases by 3.5% and plantain by 2.4%. On the other hand, coffee production increases by 1.8% when a policy of no government subsidy is carried out.

While reductions in sugar, rice, and plantain production result in reduced domestic consumption, reduction of cassava production results in the total elimination of exports without changing domestic consumption. On the other hand, increased coffee production results in increased domestic consumption. Coffee export did not increase because the upper bound for coffee export was already exhausted.

The above results can be compared to results obtained in the estimation of nominal and effective rates of protection in chapter four. Results from chapter four showed that crops were penalized through output price and exchange rate distortions. To estimate effective rates of protection fertilizer was the only input included. Although some government subsidies were being chanelled through subsidized machine services and subsidized credits, they were not accounted for in the measurement of protection. That may show that two different policies were in effect aimed a opposite goals. Subsidies provided to producers tend to reduce the negative effects of the exchange rate penalty and keeping domestic prices lower than border prices. The removal of output price and exchange rate distortions to obtain a more comprehensive measure of liberalization may have led to different results from those obtained from elimination of government subsidies alone.

A policy of elimination of government subsidies tends to reduce both sector income and employment. Sector income is reduced by 24.7%, while employment is reduced by 1.6%. The value of the objective function is also lowered by 7% with the elimination of government subsidies. Both producers and consumers are adversely affected when all government intervention policies are eliminated. Consumers are penalized through increases in the price level of sugar, rice, plantain and tomato. Sugar prices increase 31% compared to the base model price, while rice, plantain and tomato prices increase by 12.9%, 9.3% and 1.13%, respectively. Surplus accrued to consumer declines by 4.8% while producer surplus declines by 16.78% (see table VIII.6).

Government spending is reduced completely by the case of the no-government subsidy scenario compared to the base case. Therefore, reduction in production and sector income should be evaluated against the saving of government outlays which can be used for other programs within the agricultural sector (i.e. more research and extension) or outside the sector.

All of the above results deal with short-run effects. In the short-run, the model has little flexibility to adjust to policy changes which bring about changes in relative prices. Some of the above policies may affect the structure of agricultural production and other sectors of the economy in the medium and long term. However, these effects can not be assessed here because the model is static in nature. Annual crops, which are mainly food crops, have faster speeds of adjustment than perennial crops such as coffee. To assess the medium and long term impacts of the above policies, dynamic adjustment processes need to be included in the model.

VIII.4. Change in External Market Conditions

VIII.4.1. Elimination of US Sugar Quota.

The model was solved under the condition of no sugar quota for the country. That was seen as a plausible event based on the previous intention of the United States under the 1985 Food Security Act to gradually reduce sugar quotas (USGAO). Results from this market condition change are depicted in table VIII.7. and appendices C.1.F to C.7.F.

When the quota is eliminated from the model, there are

Table VIII.7. Effects of Elimination of Sugar Export Quota on Target Variables.

Target variables	Base model	No sugar quota	Percent change (%)
Production (MT)	1,681,315	1,504,604	-10.51
Sector income (DR$000)	769,483	579,477	-24.69
Employment (000 Man/Day)	65,842	64,850	-1.51
Export revenue (DR$000) (*)	1,181,339	657,951	-44.30
Government spending (DR$000)	305,162	205,009	-32.82
Total surplus (DR$000)	3,663,064	3,458,526	-5.58
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
Producer surplus (DR$000)	696,273	491,740	-29.38

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00.

no exports of sugar and domestic production of sugar decreases almost 43%. Export earnings also decline considerably reaching only 56% of the level achieved with the base model. Sector income is severely affected with the reduction of the quota and is only 56% of the sector income obtained with the base model while employment declines by 1.5%. Although consumer surplus is not affected by this policy, producer surplus is reduced by 29% in comparison to the level achieved with the base model. Domestic prices are not altered with a scenario where the sugar quota is eliminated because production declines only by the amount of the quota. Domestic consumption of sugar and the rest of the commodities was not altered by the elimination of the sugar quota.

VIII.4.2. Increase in US Sugar Quota

The case of an increase in sugar quota was evaluated using as a reference level the quota assigned to the Dominican Republic for 1990. The quota assigned to the Dominican Republic increased from 176,710 tons in 1988 to 508,170 tons in 1990. Table VIII.8. and Appendices C.1.G. to C.7.G. show results from this market condition change.

When the sugar quota is increased to the level assigned to the country for the year 1990, sugar production and export earnings almost double. Total surplus also in-

Table VIII.8. Effects of an Increase in Sugar Export Quota on Target Variables.

Target variables	Base model (DR$000)	Increase sugar quota (DR$000)	Percent change (%)
Production (MT)	1,681,315	2,012,774	19.71
Sector income (DR$000)	2,744,744	3,983,188	45.12
Employment (000 Man/Day)	65,842	67,702	2.83
Export revenue (DR$000) (*)	1,181,339	2,177,439	84.32
Government spending (DR$000)	305,162	491,342	61.01
Total surplus (DR$000)	3,663,064	4,046,723	10.47
Consumer surplus (DR$000)	2,966,787	2,966,787	.00
producer surplus (DR$000)	696,273	1,079,936	55.10

(*) Foreign exchange earnings are not included because export prices were converted to Dominican pesos using the exchange rate DR$6.14/US$1.00.

creases with the increase occurring in producer surplus (55%). Employment increases by 3%. Domestic prices are not affected by the increased level of the quota. Most of the benefits from an increase in the quota go to the producers.

Because an increase in sugar quota is an external event over which the government does not have control, nothing can be said regarding the possibility of using it as a policy instrument. However, some conclusions can be drawn as to the intention of the government to devote most of the sugar fields to the production of alternative crops. Sugar is still the main export commodity in the country and some of the land being used to grow sugarcane, is best suited for that kind of crop. Sugar production has been declining since 1984 due to the reduction in acreage and the closing of some mills and deterioration of others. As a consequence, problems in meeting both domestic demand and the sugar quota have originated in 1990 (EIU). The decision to reduce sugarcane plantations may also be unwise in light of the latest improvement in the world market price for sugar and the possibility of better prices coming from the results of the GATT talks (EIU).

Results obtained with different sugar quota levels suggest that any policy to diversify the agricultural export base in the Dominican Republic should include sugar as part of the group of crops to be encouraged. Instead of defining crops as traditional and non-traditional, the emphasis should be in terms of a group of crops which show comparative advantage in production for export.

VIII.5. Policy Instruments and Target Variables

From the above discussion it can be concluded that different policy instruments can be used to achieve a specific policy goal and that a single policy instrument cannot satisfy several policy goals at once. Policies such as a lower fertilizer price, food self-sufficiency, and an increase in the US sugar export quota have a positive impact on the level of agricultural production. However, their impacts on domestic prices tend to be different. A decrease in the price of fertilizer induces an increase in production and domestic consumption of those crops which use fertilizer most intensively. As a consequence of an increase in production of the crops which use fertilizer, their prices tend to decline. Food self-sufficiency and an increase in the sugar quota increase domestic production but domestic prices are not altered. The unresponsiveness of prices is due to the excess of land and labor exhibited in the model which allows an increase in supply without any change in the level of domestic prices.

If the objective of the government is to increase income in the agricultural sector, then several policy instruments can be used to achieve that goal. Food self-sufficiency is the policy action that increases sector income the most but at a cost of larger subsidies. Although an increase in the sugar quota increased sector income, it is not a scenario controlled by policy makers. Reduction in the price of fertilizer has the effect of increasing sector income too.

A policy of eliminating government subsidies results in a large decline in sector income. Similarly a policy of exchange rate differential has a negative impact in the generation of income for the sector. The impact is more significant when the difference in exchange rate is 36% because production of tobacco becomes unprofitable and no production is achieved. Sector income is less affected when the exchange rate differential is only 5 percent. The largest decline in sector income occurs when the sugar quota is completely eliminated.

An important policy objective is to increase employment in the country. A policy of food self-sufficiency tends to generate more employment than any other policy evaluated in this study. In that sense, some policy makers may favor this policy to reduce the level of unemployment in the rural sector. However, this policy also demands the greatest government spending through subsidies to production activities. Two target variables (production and employment) are increased with a policy of self sufficiency, but the increase in government spending is the highest of any policy considered. Government spending increases 28.2% compared to increases in employment of 1.61% and production of 2.68%. The question is how efficient is the government in the creation of employment via the policy of self-sufficiency. The increased government spending may cause increases in inflation and have other undesirable effects that are outside the scope of this model.

Employment tends to be adversely affected by the elimination of government subsidies and by a penalty on traditional export crops of 36%. However, while employment declines by 1.59% in the case of no government subsidy, government spending for the subsidized inputs is completely eliminated. Again, the evaluation of this policy in terms of performance of the target variables will depend on the objective identified by the policy makers.

Another important possible result of any policy is redistribution of income among economic agents in the economy. Policy makers are concerned with the effects on consumers and producers of certain policies. As explained in chapter II, the government has pursued a policy of cheap food to favor urban consumers. At the same time, subsidies provided to agricultural production tend to benefit producers. In some cases, a specific policy may benefit producers without having an impact on consumers' welfare. In other cases, a gain in producer surplus comes at the expense of consumers or vice versa.

When the fertilizer price is lowered to correspond to market levels, both consumers and producers benefit. In this specific case, there is no government spending because the domestic price of fertilizer was a distorted price charged by the domestic fertilizer industry. If the government decides to subsidize fertilizer use, then results from the policy should be evaluated in terms of the government spending to provide the subsidy. Because the government has some budget limitation, government spending increases come at the expense of reducing other government programs. On the other hand, a policy of eliminating subsidies hurts both consumers and producers but benefits taxpayers. In the long run the elimination of market distortions may result in better allocation of resources and increases in production brought about by the price mechanism. Finally, a policy of exchange rate differential on traditional export crops penalizes producers of those crops exclusively and increases government revenues.

VIII.6. Summary

This chapter discussed the impacts of several policy and market condition changes on the agricultural sector. It showed that there is no single policy instrument that can be used to achieve all the government objectives. However, when more than one policy instrument is in place these instruments may offset each other. That is the case when a policy of input subsidy counteracts a policy of exchange rate penalties for export crops. Similarly, external market conditions may affect the performance of some policies carried out in a small country such as the Dominican Republic. Although the linkage between the agricultural sector and the world is not modeled in detail in this study, it can be seen how a change in conditions for the principal export commodity greatly affects the performance of the agricultural sector. Foreign exchange earnings are closely related to prices received in the world market and the quotas allocated to the country. In the case of non-traditional agricultural exports, it seems that the country is in a position to produce for export and that its ability to increase exports is only constrained by the availability of an export market.

Chapter IX. Conclusions and Recommendations

IX.1 Introduction

This chapter presents a summary of the dissertation and conclusions from the different policy scenarios evaluated in chapter VIII. Then some limitations of the model and suggestions regarding the use of the model for further policy analysis are presented.

IX.2. Summary of the Study

The purpose of this study has been to analyze the impact of some agricultural and trade policies as well as market conditions in the agricultural sector of the Dominican Republic. Specific objectives of this study were: i) the development of a sectoral programming model to evaluate the impacts of alternative policies on production, agricultural income and employment and resource use; ii) the computation of measures of protection for important agricultural commodities in the Dominican Republic; iii) the analysis of the impacts of inward-oriented policies such as food self-sufficiency and exchange rate penalties on traditional export crops; iv) the analysis of the impacts of outward-oriented policies such as a change of fertilizer price and elimination of government subsidies; and, v) the analysis of the impacts of changes in external market conditions on the Dominican agricultural sector.

The Dominican Republic is a small open economy which depends on a few traditional agricultural exports to generate foreign exchange with sugar, coffee, cocoa, and tobacco providing roughly two thirds of the total foreign exchange earnings during the 1980's. With a relatively young population of 6.7 million, the country is facing a high rate of unemployment (25%) and underemployment along with high inflation rates (more than 40% in 1988), devaluation of the national currency, and record high budget deficits. Despite efforts to promote economic development and achieve self-sufficiency in food production, the economy still remains stagnant and Gross National Product has not increased at the rate achieved during the late 1960's and early 1970's. Export prices for the main export commodities have been declining reducing the foreign exchange available to pay for imports. For example, the price of sugar has been low in the world market and sugar returns were further reduced by a reduction in the quota available for exporting sugar to the United States.

Under the above circumstances, it was seen as necessary to initiate programs to diversify the economic export base and reduce government spending to help bring down the deficit. The question of what policies to pursue to enhance economic growth has centered around two development strategies: an inward-oriented strategy versus an outward-oriented strategy.

Policies promoting exports and a more open economy have coexisted with policies favoring import-substitution activities. In the agricultural sector, the goal of promoting non-traditional exports is carried out along with the explicit policy of food self-sufficiency. Government instruments used to implement policy goals include food price policy, agricultural input policy such as machine services and subsidized credit, and foreign exchange rate policy.

An inward-oriented strategy has been promoted in the country since the 1960's under the premises that economic linkages and long term growth are strengthened when this policy is pursued. Other arguments for an inward-oriented strategy are the potential to develop entrepreneurial skills and the advantage of creating a domestic industrial base. In the agricultural sector, a policy of food self-sufficiency would increase food security in the country.

On the other hand, an outward-oriented strategy is based on the notion of comparative advantage and relies on the market and reduced government intervention. Advocates of this strategy point out that countries promoting outward-oriented activities have achieved better macroeconomic performance than countries which are strongly inward-oriented. It is argued that in order to compete in the international market, producers have to be more efficient which stimulates faster growth and development.

Although the outward-oriented strategy has been gaining support, there still exists strong opposition. Specifically, there is no consensus about the notion that outward-oriented economies tend to perform better than inward-oriented economies. For small open economies, where economic performance depends on external market conditions, the effects of price volatility for the new non-traditional export commodities concern policymakers.

To analyze the impacts of output price and input price policies and foreign exchange controls, measures of nominal and effective rates of protection for several crops are reported in chapter IV. Nominal rates of protection estimate the differences between domestic prices and border prices caused by market interventions. Due to the existence of a dual exchange rate in the country, two types of nominal rates of protection were calculated. The first one was calculated using the official exchange rate to convert border prices into Dominican pesos. This is called the direct nominal rate of protection because it takes into consideration only price distortions. The second one used the parallel exchange rate to make the conversion for the border prices. This is called the total nominal rate of protection because it includes both price distortions and exchange rate distortions. In general, except for beans, traditional export crops and food crops were penalized during the 1984-1988 period as reported by both the direct and total rates of protection.

Effective rates of protection, considered a more complete measure of protection, refer to the differences between the value added with market intervention and the value added without market intervention. Effective rates of protection include price interventions in both output and input markets. Similar to the nominal rates of protection, two different sets of effective rates of protection were estimated to account for the two exchange rates. Results from the estimation of effective rates of protection for the period 1984-1988, showed that traditional export commodities (sugar and coffee) were penalized in the Dominican Republic while some food crops (beans) enjoyed some level of protection.

Justifications for the use of a sector programming model to evaluate different policy scenarios are presented in chapter V. The sector model is evaluated against econometric models and general equilibrium models of the whole economy in terms of its ability to provide results with sufficient level of details. Other criteria used to evaluate the model against alternative models include ease of interpretation, availability of data, and introduction of special characteristics of the agricultural sector.

The main advantage of a sector programming model with respect to the other model evaluated is that the impact of sectoral and economy-wide policy changes can be evaluated without time-series data. Prices and quantities are obtained endogenously in the model and substitution among activities results from changes in relative prices.

The objective function maximized is consumer and producer surplus obtained under a competitive market. Five elements considered in the model include consumer behavior, producer preferences, resource endowment, the production alternatives available to producers and finally policies such as price support, input subsidy, export and import taxes and quotas affecting the structure of the market.

A sector programming model is characterized by an objective function, a set of resource constraints depicting land, water and labor constraints, supply-demand balance equations introduced to force the model to reach an equilibrium, and miscellaneous equations such as export and import quotas.

Policy changes are introduced to a sector model via modification of the coefficients in the objective function or by varying some technical coefficients in the input/output matrix or by changing the value of the right hand side of the appropriate equation.

An empirical sector model was developed to analyze the impact of changes in policies and market conditions. Traditional export crops are represented by sugar, coffee and tobacco. Food crops include rice, beans, plantain, cassava and corn. Non-traditional export crops are represented by salad tomato. Linear demand equations are modeled for all crops except tobacco. In addition alternative production techniques are included for all crops. Fixed resources are composed of three different types of land (land A, B and tree crop land), irrigated land and labor. For machine services and credit, two sources, government and private, were specified. Likewise, upper bounds were imposed for export and import commodities. Processing and marketing costs are also included in the model.

The model specification and validation are described in chapter VII. The model was validated using production, capacity, price, and marginal cost tests. Except for sugar, the model overestimates production for all crops. This results because the model tends to choose production techniques with higher yields than the average yield observed during the base year. Other possible explanations are the failure of the model to account for some market imperfections such as access to extension services.

The model underestimates prices for eight of the ten commodities included in the model. Price differences between the base model and the base year tend to be greater than production differences due to the low values of the demand elasticities.

The model was not adjusted to reduce the differences between the base year and the model. Instead, it was assumed that results reflect the choice of the production techniques that would be made if they were available to all producers. Therefore, the model can be used to make policy recommendations based on relative changes and at a sectoral level.

Results from the base model were used to evaluate the impacts of policy changes categorized as inward-oriented and outward-oriented as well changes in external market conditions. Policies classified as inward-oriented consisted of a policy of food self-sufficiency and a penalty on traditional export crops through an exchange rate differential. Outward-oriented policies instruments consisted of a change in fertilizer price to reflect the border price and the elimination of government subsidies in the agricultural sector. To evaluate the effects of external market conditions the elimination of the US export sugar quota and a quota increase to the level assigned in 1990 were evaluated.

If a policy of food self-sufficiency is adopted, production, agricultural income and employment would increase. Production increases are achieved in those crops which were previously imported. Domestic prices are not altered in the short run by a policy of food self-sufficiency.

On the other hand, when traditional exports are penalized by an exchange rate differential of 36%, domestic production of tobacco is reduced and there is no increased production of other crops. Sector income and employment are negatively affected by this policy.

A reduction in the fertilizer price increases domestic production, sector income, and employment. On the other hand, these target variables are reduced when all government subsidies to agriculture are eliminated. However, government spending could then be diverted to other programs within or outside the agricultural sector.

Changes in external market conditions have strong effects on the performance of the agricultural sector and the economy. As was seen in chapter VIII, a change in the level of US export sugar quota, brings about significant changes in the level of variables such as production, sector income, and foreign exchange earnings.

This study contributes to an understanding of the effects of different policy instruments on a complex agricultural sector. One of the contribution of this study is the provision of an analytical framework useful in the evaluation of policy changes in the Dominican Republic. It also provides a detailed description of the structure of the agricultural sector which is helpful when analyzing the disaggregated effects of any policy.

This study complements and differs from other studies of the Dominican agricultural sector in several ways. In relation to the study carried out by Greene and Roe, the agricultural sector is represented in a more detailed fashion including more agricultural activities. The assessment of protection or disprotection to the agricultural sector goes beyond the estimation of nominal and effective rates of protection. Other inputs, apart from fertilizer, are included within the sector model framework.

This study also differs from the Domingo model developed by Stocker and Li and the Dominican ministry of agriculture in two main aspects. First, demand functions are not linearized, but rather the model is solved in its quadratic form using the GAMS package. Second, labor requirements and availability are introduced on a monthly basis instead of annually.

Results from this model suggests that resources such as land and labor are not a constraint in the Dominican Republic. Thus, any policy aimed at enhancing economic growth in the country should stress the intensive use of these resources. Similarly, fertilizer was not a constraint in the model but the level of use is very low. When the price of fertilizer was lowered to reflect border price level, agricultural production increased suggesting that production can be increased by a higher use of fertilizer.

A policy of self-sufficiency also shows that increases in the production of the crops that are now imported is possible which may reduce the gap between domestic production and consumption.

IX.3. Suggestion for Further Research

The sector model developed in this study can be used as an analytical tool by policy makers and analysts to assess the impacts of different policies. However, further refinement of the model would make it more useful for such analyses. For instance, the introduction of farm sizes and regional differences would greatly enhance the model's simulation capability. In addition, the introduction of risk in the production of crops and demand cross-price elasticities would also improve the model.

The model could be made more flexible to reflect changes in relative prices if the upper bounds on import and exports was relaxed and the external market explicitly modeled. The addition of cross-price effects in demand for the selected crops may allow more crop substitution in the model.

The model could be enriched by the introduction of more crop and livestock activities. Some crops such as corn and peanut meal are used to feed livestock. In addition, part of the land devoted to livestock has the potential for cropping activities. At the beginning of the study, livestock was contemplated as one of the model's activities. However, due to the lack of reliable data, it was impossible to account for that activity. Other crops such as cocoa and other fruits and vegetables can make the model more complete to assess the impacts of policy changes.

With the incorporation of the above elements, policy changes can be evaluated in a more disaggregated way. It may also reduce the discrepancy between the model results and actual data because the model would reflect resource availability such as land and labor as well as production techniques by regions and farm size.

The model could be used to analyze the impacts of other policy scenarios such as wage policy and output price support. Some price support scenarios can be introduced into the model by replacing the downward sloping demand schedules with alternative price levels. The impacts of a mix of policies can also be evaluated using the sector programming model.

Due to the partial nature of the model, the effects of the policies on other sectors of the economy could not be estimated. Introduction of the linkages with other sectors could enhance the ability of the model to assess the overall impact of a specific policy.

Measures of comparative advantage could be obtained from the model results by estimating the Domestic Resource costs of obtaining or saving a unit of foreign exchange. This might be useful in analyzing the advantages of traditional export crops versus non-traditional export crops and food crops.

The model could be used to evaluate the effects of new investment projects on specific rural areas or the entire agricultural sector. By categorizing resources such as land and irrigation water, the regional impacts of specific projects can be analyzed.

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Appendix A.1. Nominal and Rates of Protection for Sugar (using average border price)

		Units (*)	1984	1985	1986	1987	1988
A.-	Production, Sugarcane	1000 MT	10271.40	10000.00	8964.09	8170.91	7303.63
B.-	Production, raw sugar	1000 MT	1078.00	1050.00	853.72	778.18	695.58
C.-	Conversion cane/sugar	Percent	10.50	10.50	10.50	10.50	10.50
D.-	Producer price, sugarcane	DR$/MT	24.00	23.00	27.47	31.91	31.91
E.-	Producer price, raw sugar	DR$/MT	228.57	219.05	261.62	303.87	303.90
F.-	Border price, export (FOB)	US$/MT	328.19	264.55	297.97	233.66	239.72
G.-	Official Exchange Rate (***)	DR$/US$	1.48	1.99	1.86	3.84	6.14
H.-	Border price (OER) for raw sugar	DR$/US$	485.72	526.45	554.22	897.26	1471.65
I.-	Border price (OER) for sugarcane	DR$/MT	51.00	55.28	58.19	94.21	154.52
J.-	Processing cost, sugar	DR$/MT	18.96	24.78	27.44	31.87	45.87
K.-	Processsing cost (sugarcane)	DR$/MT	1.9908	2.6019	2.880824	3.346514	4.816067
L.-	Border price of sugarcane evaluated at farmgate at OER and adjusted for processing cost.	DR$/MT	49.01	52.68	55.31	90.87	149.71
M.-	Direct Nominal Producer Protection	Percent	-51.03	-56.34	-50.34	-64.89	-78.69
N.-	Parallel Exchange Rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
O.-	Border price (PER)	DR$/MT	928.22	824.23	865.74	898.38	1474.60
P.-	Border price at farmgate (PER)	DR$/MT	97.46308	86.54436	90.90279	94.33029	154.8333
Q.-	Border price at farmgate and PER adjusted for processing cost	DR$/MT	95.47	83.94	88.02	90.98	150.02
R.-	Total Nominal Rate of Protection	Percent	-74.86	-72.60	-68.79	-64.93	-78.73
S.-	Fert/sugar coefficient	Ratio	.01	.01	.01	.01	.01
T.-	Actual price fertilizer	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
U.-	Fertilizer border price	US$/MT	171.30	203.15	190.00	194.00	222.00
V.-	Fertilizer border price (OER)	DR$/MT	171.30	631.80	353.40	744.96	1362.86
W.-	Feretilizer border price (PER)	DR$/MT	484.49	632.93	552.05	745.89	1365.59
Y.-	Actual fert. price*fert/sugar coeff.	DR$/MT	5.73	7.21	11.42	15.64	19.86
Z.-	BP. fert(OER)*fert/sugar coeff.	DR$/MT	2.14	7.90	4.42	9.31	17.04
AA.-	BP fert(PER)*fert/sugar coeff.	DR$/MT	6.06	7.91	6.90	9.32	17.07
AB.-	Value added (distorted)	DR$/MT	18.27	15.79	16.05	16.27	12.06
AC.-	Value added (OER)	DR$/MT	46.87	44.78	50.89	81.55	132.67
AD.-	Value added (PER)	DR$/MT	89.42	76.03	81.12	81.66	132.95
AE.-	Effective Rate of Protection (OER)	Percent	-61.02	-64.73	-68.47	-80.05	-90.91
AF.-	Effective Rate of Protection (PER)	Percent	-79.57	-79.23	-80.22	-80.08	-90.93

(*) MT = Metric ton; RD$ = Dominican peso; US$ = US Dollar
(**) The official exchange rate for traditional export crops was different than for other activities. For instance, in 1984 there was an incentive of 48% over the official exchange rate. In 1985-86, traditional export crops were penalized with a tax of 36% over the market exchange rate.

Appendix A.2. Nominal and Effective Rates of Protection for Sugar (using world market prices).

		Units (*)	1984	1985	1986	1987	1988
A.-	Production, sugarcane	1000 MT	10271.40	10000.00	8964.09	8170.91	7303.63
B.-	Production, raw sugar	1000 MT	1078.50	1050.00	853.72	778.18	695.58
C.-	Conversion cane/sugar	PERCENT	10.50	10.50	10.50	10.50	10.50
D.-	Producer price, sugarcane	DR$/MT	24.00	23.00	27.47	31.91	31.91
E.-	Producer price, raw sugar	DR$/MT	228.57	219.05	261.62	303.87	303.90
F.-	Border price, sugar (FOB)	US$/MT	113.96	88.88	133.10	147.62	223.96
G.-	Official exchange rate (**)	DR$/US$	1.48	1.99	1.86	3.84	6.14
H.-	Border price (OER), raw sugar	DR$/US$	168.66	176.87	247.57	566.86	1374.89
I.-	Border price (OER), sugarcane	DR$/MT	17.71	18.57	25.99	59.52	144.36
J.-	processing cost, sugar	DR$/MT	18.96	24.78	27.44	31.87	45.87
K.-	Processing cost, sugarcane	DR$/MT	1.9908	2.6019	2.880824	3.346514	4.816067
L.-	Border price of sugarcane evaluated at farmgate (OER) and adjusted for processing cost	DR$/MT	15.72	15.97	23.11	56.17	139.55
M.-	Direct Nominal Rate of Protection	Percent	52.69	44.02	18.85	-43.20	-77.13
N.-	Parallel exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
O.-	Border price (PER), raw sugar	DR$/MT	322.31	276.91	386.72	567.57	1377.65
P.-	Border price, sugarcane	DR$/MT	33.84287	29.07603	40.60582	59.59478	144.6527
Q.-	Border price at farmgate and PER adjusted for processing cost	DR$/MT	31.85	26.47	37.72	56.25	139.84
R.-	Total Nominal Rate of Protection	Percent	-24.65	-13.12	-27.18	-43.28	-77.18
S.-	Fert/sugar coefficient	Ratio	.01	.01	.01	.01	.01
T.-	Actual fertilizer price	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
U.-	Fertilizer border price (FOB)	US$/MT	171.30	203.15	190.00	194.00	222.00
V.-	Fertilizer border price (OER)	DR$/MT	171.30	631.80	353.40	744.96	1362.86
W.-	Fertilizer border price (PER)	DR$/MT	484.49	632.93	552.05	745.89	1365.59
Y.-	Actual fert. price*fert/sugar coeff.	DR$/MT	5.73	7.21	11.42	15.64	19.86
Z.-	BP. fert(OER)*fert/sugar coeff.	DR$/MT	2.14	7.90	4.42	9.31	17.04
AA.-	BP. fert(PER)*fert/sugar coeff.	DR$/MT	6.06	7.91	6.90	9.32	17.07
AB.-	Value added (distorted)	DR$/MT	18.27	15.79	16.05	16.27	12.06
AC.-	Value added (OER)	DR$/MT	13.58	8.07	18.70	46.86	122.51
AD.-	Value added (PER)	DR$/MT	25.80	18.56	30.82	46.92	122.77
AE.-	Effective Rate of Protection (OER)	Percent	34.56	95.66	-14.17	-65.29	-90.16
AF.-	Effective Rate of Protection (PER)	Percent	-29.17	-14.92	-47.94	-65.33	-90.18

(*) MT = Metric ton; RD$ = Dominican peso; US$ = US Dollar

(**) The official exchange rate for traditional export crops was different than for other activities. For instance, in 1984 there was an incentive of 48% over the official exchange rate. In 1985-86 traditional export crops were penalized with a tax of 36% over the market exchange rate.

Appendix A.3. Nominal and Effective Rates of Protection for Coffee (*)

		Units	1984	1985	1986	1987	1988
A.-	Production, green coffee	1000 MT	35.91	52.36	62.55	47.27	50.32
B.-	Production, cherry coffee	1000 MT	75.74	110.45	131.92	99.71	106.13
C.-	Conversion cherry/green coffee	Percent	.47	.47	.47	.47	.47
D.-	Producer price, green coffee	DR$/MT	2041.60	2629.00	4059.00	5656.20	8430.40
E.-	Producer price, cherry coffee	DR$/MT	967.92	1246.41	1924.37	2681.60	3996.85
F.-	Border price, export (FOB)	US$/MT	2746.26	2807.20	3639.46	2152.99	2461.93
G.-	Official exchange rate (**)	DR$/US$	1.48	1.99	1.86	3.84	6.14
H.-	Border price (OER) for green coffee	DR$/US$	4064.46	5586.33	6754.84	8277.81	15113.80
I.-	Border price (OER), cherry coffee	DR$/MT	1926.96	2648.48	3202.47	3924.51	7165.45
J.-	Processing cost, cherry coffee	DR$/MT	122.19	165.12	187.32	171.80	245.97
K.-	Border price of coffee evaluated at farmgate and OER adjusted for marketing cost.	DR$/MT	1804.77	2483.36	3015.15	3752.71	6919.48
M.-	Direct Nominal Rate of Protection	Percent	-46.37	-49.81	-36.18	-28.54	-42.24
N.-	Parallel exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
O.-	Border price (PER), green coffee	DR$/MT	7767.25	8746.11	10574.45	8277.81	15144.08
P.-	Border price (PER), cherry	DR$/MT	3682.45	4146.53	5013.35	3924.51	7179.81
Q.-	Border price at farmgate and PER adjusted for processing cost	DR$/MT	3560.26	3981.41	4826.03	3752.71	6933.84
R.-	Total Nominal Rate of Protection	Percent	-72.81	-68.69	-60.13	-28.54	-42.36
S.-	Fert/coffee coefficient	Ratio	2.50	2.50	2.50	2.50	2.50
T.-	Actual fertilizer price	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
U.-	fertilizer border price	US$/MT	171.30	203.15	190.00	194.00	222.00
V.-	fertilizer border price (OER)	DR$/MT	171.30	631.80	352.64	745.89	1362.86
W.-	fertilizer border price (PER)	DR$/MT	484.49	632.93	552.05	745.89	1365.59
Y.-	actual fert. price*fert/coffee coeff.	DR$/MT	1146.00	1441.25	2284.50	3127.75	3971.00
Z.-	BP. fert(OER)*fert/coffee coeff.	DR$/MT	428.25	1579.50	881.60	1864.73	3407.15
AA.-	BP. fert (PER)*fert/coffee coeff.	DR$/MT	1211.22	1582.34	1380.11	1864.73	3413.97
AB.-	Value added (distorted)	DR$/MT	895.60	1187.75	1774.50	2528.45	4459.40
AC.-	Value added (OER)	DR$/MT	1376.52	903.86	2133.55	1887.98	3512.34
AD.-	Value added (PER)	DR$/MT	2349.04	2399.08	3445.91	1887.98	3519.87
AE.-	Effective Rate of Protection (OER)	Percent	-34.94	31.41	-16.83	33.92	26.96
AF.-	Effective Rate of Protection (PER)	Percent	-61.87	-50.49	-48.50	33.92	26.69

MT = Metric ton; DR$ = Dominican peso; US$ = US Dollar

(*) Maintenance of already established plantations.

(**) The official exchange rate for traditional export crops was different than for other activities. For instance, in 1984 there was an incentive of 48% over the official exchange rate In 1985-86, traditional export crops were penalized with a tax of 36% over the market exchange rate.

Appendix A.4. Nominal and Effective Rate of Protection for Tobacco (*)

		Units	1984	1985	1986	1987	1988
A.-	Production, Tobacco	1000 MT	20.00	25.41	11.68	22.55	25.91
B.-	Production, dry tobacco	1000 MT	15.60	19.82	9.11	17.59	20.21
C.-	Conversion green/dry tobacco	PERCENT	78.00	78.00	78.00	78.00	78.00
D.-	Producer price, dry tobacco	DR$/MT	1144.00	3295.60	3280.20	5552.80	
E.-	Producer price, tobacco	DR$/MT	892.32	2570.57	2558.56	4331.18	
F.-	Border price, export (FOB)	US$/MT	1496.02	1269.42	1198.46	1293.71	1208.76
G.-	Official exchange rate (**)	DR$/US$	1.48	1.99	1.86	3.84	6.14
H.-	Border price (OER) for dry tobacco	DR$/US$	2214.11	2526.16	2229.14	4967.84	7420.61
I.-	Border price (OER) for tobacco	DR$/MT	1727.00	1970.40	1738.73	3874.91	
J.-	Marketing cost, tobacco (***)	DR$/MT	269.64	374.50	458.39	526.55	753.87
K.-	Border price of tobacco evaluated at farmgate and OER and adjusted for marketing cost	DR$/MT	1457.36	1595.90	1280.34	3348.37	
L.-	Direct Nominal Rate of Protection	Percent	-38.77	61.07	99.83	29.35	
M.-	Parallel exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
N.-	Border price (PER), dry tobacco	DR$/MT	4231.19	3955.02	3482.14	4974.05	7435.47
O.-	Border price (PER), dry tobacco	DR$/MT	3300.32	3084.92	2716.07	3879.76	5799.67
O.-	Border price at farmgate and PER adjusted for marketing cost	DR$/MT	3030.68	2710.42	2257.68	3353.21	5045.80
P.-	Total Nominal Rate of Protection	Percent	-70.56	-5.16	13.33	29.17	-100.00
Q.-	Fert/tobacco coefficient	Ratio	.04	.04	.04	.04	.04
R.-	Actual fertilizer price	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
S.-	Fertilizer border price	US$/MT	171.30	203.15	190.00	194.00	222.00
T.-	fertilizer border price (OER)	DR$/MT	171.30	631.80	353.40	744.96	1362.86
U.-	Fertilizer border price (PER)	DR$/MT	484.49	632.93	552.05	745.89	1365.59
V.-	Actual fert. price*fert/toba. coeff.	DR$/MT	20.47	25.75	40.81	55.88	70.94
W.-	BP. fert(OER)*fert/toba coeff.	DR$/MT	7.65	28.22	15.78	33.27	60.87
Y.-	BP. fert(PER)*fert/toba coeff.	DR$/MT	21.64	28.27	24.66	33.31	60.99
Z.-	Value added (distorted)	DR$/MT	871.85	2544.82	2517.74	4275.31	-70.94
AA.-	Value added (OER)	DR$/MT	1449.71	1567.68	1264.56	3315.10	-60.87
AB.-	Value added (PER)	DR$/MT	3009.05	2682.15	2233.02	3319.90	4984.81
AC.-	Effective Rate of Protection (OER)	Percent	-39.86	62.33	99.10	28.96	
AD.-	Effective Rate of Protection (PER)	Percent	-71.03	-5.12	12.75	28.78	

MT = Metric ton; DR$ = Dominican peso; US$ = US Dollar
(*) Dryland, Low level of inputs, Mechanized, Land A
(**) The official exchange rate for traditional export crops was different than for other activities. For instance, in 1984 there was an incentive of 48% over the official exchange rate. In 1985-86, traditional export crops were penalized with a tax of 36% over the market exchange rate.

(***) This value was calculated from a figure obtained for 1985. Values for the other years were obtained by multiplying the 1985 value by the Producer Price Index for Inputs (1985 = 100).

Appendix A.5. Nominal and Effective Rates of Protection for Rice, Technique 3 (*).

		Units	1984	1985	1986	1987	1988
A.-	Production, Rough rice	1000 MT	506.60	493.80	461.24	512.97	425.44
B.-	Production, polished rice	1000 MT	326.76	318.50	297.50	330.86	274.41
C.-	conversion rough/polished rice	Percent	64.50	64.50	64.50	64.50	64.50
D.-	producer price, polished rice	DR$/MT	746.24	1134.98	1004.08	1326.38	1050.06
E.-	Producer price, rough rice	DR$/MT	481.32	732.06	647.63	855.52	677.29
F.-	Mktg. margin farmgate/wholesale (**)	DR$/MT	127.81	177.52	217.28	249.59	357.35
G.-	Border Price, import (CIF) (***)	US$/MT	418.00	426.00	255.50	453.50	356.70
H.-	Official exchange rate	DR$/US$	1.00	3.11	2.90	3.84	6.14
I.-	Border price (OER) for polished rice	DR$/MT	418.00	1324.86	740.95	1741.44	2190.14
J.-	Border price (OER) for rough rice	DR$/MT	269.61	854.53	477.91	1123.23	1412.64
K.-	Border price of rough rice at farmgate (OER) adjusted for mktg. cost	DR$/MT	141.80	677.02	260.63	873.64	1055.29
M.-	Direct Nominal Rate of Protection	Percent	239.45	8.13	148.49	-2.07	-35.82
O.-	Paralle exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
P.-	Border price polished rice (PER)	DR$/MT	1182.94	1329.12	743.51	1743.62	2194.17
Q.-	Border price rough rice (PER)	DR$/MT	763.00	857.28	479.56	1124.63	1415.24
R.-	Border price of rough rice at farmgate adjusted for marketing cost.	DR$/MT	635.18	679.77	262.28	875.04	1057.89
S.-	Total Nominal Rate of Protection	Percent	-24.22	7.69	146.93	-2.23	-35.98
T.-	Fert/rice coefficient	Ratio	.10	.10	.10	.10	.10
U.-	Actual price fertilizer	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
V.-	Fertilzer border price	DR$/MT	171.30	203.15	190.00	194.00	222.00
W.-	Fertilizer border price (OER)	DR$/MT	171.30	631.80	551.00	744.96	1363.08
Y.-	Fertilizer border price (PER)	DR$/MT	484.78	633.83	552.90	745.89	1365.59
Z.-	Fert. price (actual)*fert/rice coeff.	DR$/MT	43.87	55.17	87.46	119.74	152.02
AA.-	BP (OER)*fert/rice coeff.	DR$/MT	16.39	60.47	52.73	71.30	130.46
AB.-	BP fert(PER)*fert/rice coeff	1000 MT	46.40	60.66	52.92	71.39	130.70
AC.-	Value added (distorted)	DR$/MT	437.45	676.89	560.17	735.78	525.27
AD.-	Value added (OER)	DR$/MT	125.40	616.55	207.89	802.34	924.84
AE.-	Value added (PER)	DR$/MT	588.79	619.10	209.36	803.65	927.20
AF.-	Effective Rate of Protection (OER)	Percent	248.84	9.79	169.45	-8.30	-43.20
AG.-	Effective Rate of Protection (PER)	Percent	-25.70	9.33	167.57	-8.45	-43.35

(*) Irrigated land, High level of inputs, Semi-mechanized, Land A

(**) MT = Metric ton; DR$ = Dominican peso ; US$ = US Dollar

Appendix A.6. Nominal and Effective Rates of Protection for Rice, Technique 6 (*).

		Units	1984	1985	1986	1987	1988
A.-	Production, Rough rice	1000 MT	506.60	493.80	461.24	512.97	425.44
B.-	Production, polished rice	1000 MT	326.76	318.50	297.50	330.86	274.41
C.-	conversion rough/polished rice	Percent	64.50	64.50	64.50	64.50	64.50
D.-	producer price, polished rice	DR$/MT	746.24	1134.98	1004.08	1326.38	1050.06
E.-	Producer price, rough rice	DR$/MT	481.32	732.06	647.63	855.52	677.29
F.-	Mktg. margin farmgate/wholesale (**)	DR$/MT	127.81	177.52	217.28	249.59	357.35
G.-	Border Price, import (CIF) (***)	US$/MT	418.00	426.00	255.50	453.50	356.70
H.-	Official exchange rate	DR$/US$	1.00	3.11	2.90	3.84	6.14
I.-	Border price (OER) for polished rice	DR$/MT	418.00	1324.86	740.95	1741.44	2190.14
J.-	Border price (OER) for rough rice	DR$/MT	269.61	854.53	477.91	1123.23	1412.64
K.-	Border price of rough rice at farmgate (OER) adjusted for mktg. cost	DR$/MT	141.80	677.02	260.63	873.64	1055.29
M.-	Direct Nominal Rate of Protection	Percent	239.45	8.13	148.49	-2.07	-35.82
O.-	Paralle exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
P.-	Border price polished rice (PER)	DR$/MT	1182.94	1329.12	743.51	1743.62	2194.17
Q.-	Border price rough rice (PER)	DR$/MT	763.00	857.28	479.56	1124.63	1415.24
R.-	Border price of rough rice at farmgate adjusted for marketing cost.	DR$/MT	635.18	679.77	262.28	875.04	1057.89
S.-	Total Nominal Rate of Protection	Percent	-24.22	7.69	146.93	-2.23	-35.98
T.-	Fert/rice coefficient	Ratio	.16	.16	.16	.16	.16
U.-	Actual price fertilizer	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
V.-	Fertilzer border price	DR$/MT	171.30	203.15	190.00	194.00	222.00
W.-	Fertilizer border price (OER)	DR$/MT	171.30	631.80	551.00	744.96	1363.08
Y.-	Fertilizer border price (PER)	DR$/MT	484.78	633.83	552.90	745.89	1365.59
Z.-	Fert. price (actual)*fert/rice coeff.	DR$/MT	73.34	92.24	146.21	200.18	254.14
AA.-	BP (OER)*fert/rice coeff.	DR$/MT	27.41	101.09	88.16	119.19	218.09
AB.-	BP fert(PER)*fert/rice coeff	1000 MT	77.56	101.41	88.46	119.34	218.49
AC.-	Value added (distorted)	DR$/MT	407.98	639.82	501.42	655.34	423.14
AD.-	Value added (OER)	DR$/MT	114.39	575.93	172.47	754.44	837.20
AE.-	Value added (PER)	DR$/MT	557.62	578.35	173.81	755.70	839.40
AF.-	Effective Rate of Protection (OER)	Percent	256.67	11.09	190.73	-13.14	-49.46
AG.-	Effective Rate of Protection (PER)	Percent	-26.83	10.63	188.49	-13.28	-49.59

(*) Dryland, medium level of inputs, mechanized, land B.

(**) MT = Metric ton; DR$ = Dominican peso ; US$ = US Dollar

Appendix A.7. Nominal and Effective Rate of Protection for Beans (*)

		Units	1984	1985	1986	1987	1988
A.-	Production, beans	1000 MT	46.45	36.86	25.18	38.59	43.77
B.-	Producer price, beans	DR$/MT	1724.80	2841.30	2441.34	3333.44	4759.48
C.-	Border price, import (CIF)	US$/MT	452.68	543.56	570.04	493.70	502.84
D.-	Official exchange rate	DR$/US$	1.00	3.11	2.90	3.84	6.14
E.-	Border price (OER) for beans	DR$/MT	452.68	1690.47	1655.40	1895.81	3086.93
F.-	Mktg. margin farmgate/wholesale	DR$/MT	113.57	157.74	189.40	221.78	316.85
G.-	Border price of beans evaluated at farmgate and OER and adjusted for marketing cost	DR$/MT	339.11	1532.73	1465.99	1674.03	2770.09
H.-	Direct Nominal Rate of Protection	Percent	408.63	85.37	66.53	99.13	71.82
I.-	Parallel exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
J.-	Border price (PER) for beans	DR$/MT	1280.31	1693.52	1656.25	1898.18	3093.12
K.-	Border price at farmgate and PER adjusted for mktg. cost	DR$/MT	1166.74	1535.78	1466.85	1676.40	2776.27
M.-	Total Nominal Rate of Protection	Percent	47.83	85.01	66.43	98.85	71.43
N.-	Fert./beans coefficient	Ratio	.11	.11	.11	.11	.11
O.-	Actual fertilizer price	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
P.-	Fertilizer border price	US$/MT	171.30	203.15	190.00	194.00	222.00
Q.-	fertilizer border price (OER)	DR$/MT	171.30	631.80	551.76	744.96	1362.86
R.-	Fertilizer border price (PER)	DR$/MT	484.49	632.94	552.05	745.89	1365.59
S.-	Actual fert. price*fert/beans coeff.	DR$/MT	51.13	64.31	101.93	139.56	177.18
T.-	BP. fert (OER)*fert/beans coeff.	DR$/MT	19.11	70.47	61.55	83.10	152.02
U.-	BP. fert (PER)*fert/beans coeff.	DR$/MT	54.04	70.60	61.58	83.20	152.33
V.-	Value added (distorted)	DR$/MT	1673.67	2776.99	2339.41	3193.88	4582.30
W.-	Value added (OER)	DR$/MT	320.00	1462.26	1404.45	1590.93	2618.07
Y.-	Value added (PER)	DR$/MT	1112.70	1465.17	1405.27	1593.19	2623.95
Z.-	Effective Rate of Protection (OER)	Percent	423.02	89.91	66.57	100.76	75.03
AA.-	Effective Rate of Protection (PER)	Percent	50.42	89.53	66.47	100.47	74.63

MT = Metric ton; DR$ = Dominican peso; US$ = US Dollar

(*) Irrigated, High level of inputs, Mechanized, Good quality land (Type A)

Appendix A.8. Nominal and Effective Rates of Protection for Corn (*)

	Units	1984	1985	1986	1987	1988
A.- Production, corn	1000 MT	93.43	66.93	47.20	42.94	56.58
B.- Producer price, corn	DR$/MT	396.00	489.50	545.82	553.96	1023.88
C.- Border price, import (CIF)	US$/MT	151.12	123.21	103.64	205.07	229.63
D.- Official exchange rate	DR$/US$	1.00	3.11	2.90	3.84	6.14
E.- Border price (OER) for corn	DR$/MT	151.12	383.18	300.97	787.47	1409.70
F.- Mktg. margin farmgate/wholesale	DR$/MT	56.87	78.98	96.67	111.05	158.99
G.- Border price of corn evaluated at farmgate and OER and adjusted for marketing cost	DR$/MT	94.25	304.20	204.30	676.42	1250.71
H.- Direct Nominal Rate of Protection	Percent	320.14	60.91	167.17	-18.10	-18.14
I.- Parallel exchange rate	DR$/US$	2.83	3.12	2.91	3.84	6.15
J.- Border price (PER), corn	DR$/MT	427.41	383.87	301.13	788.45	1412.52
K.- Border price of corn evaluated at farmagate and PER and adjusted for marketing cost.	DR$/MT	370.55	304.89	204.45	677.41	1253.54
M.- Total Nominal Rate of Protection	Percent	6.87	60.55	166.96	-18.22	-18.32
N.- Fert/corn coefficient	Ratio	.01	.01	.01	.01	.01
O.- Actual fertilizer price	DR$/MT	458.40	576.50	913.80	1251.10	1588.40
P.- fertilizer border price	US$/MT	171.30	203.15	190.00	194.00	222.00
Q.- fertilizer border price (OER)	DR$/MT	171.30	631.80	551.76	744.96	1362.86
R.- Fertilizer border price (PER)	DR$/MT	484.49	632.94	552.05	745.89	1365.59
S.- Actual fert. price*fert/corn coeff.	DR$/MT	4.72	5.94	9.41	12.89	16.36
T.- BP. fert (OER)*fert/corn coeff.	DR$/MT	1.76	6.51	5.68	7.67	14.04
U.- BP. fert (PER)*fert/corn coeff.	DR$/MT	4.99	6.52	5.69	7.68	14.07
V.- Value added (distorted)	DR$/MT	391.28	483.56	536.41	541.07	1007.52
W.- Value added (OER)	DR$/MT	92.49	297.70	198.62	668.75	1236.67
Y.- Value added (PER)	DR$/MT	365.56	298.37	198.77	669.72	1239.47
Z.- Effective Rate of Protection (OER)	Percent	323.05	62.44	170.07	-19.09	-18.53
AA.- Effective Rate of Protection (PER)	Percent	7.04	62.07	169.87	-19.21	-18.71

MT = Metric ton; DR$ = Dominican peso; US$ = US Dollar

(*) Irrigated land, Medium level of inputs, Mechanized, Good quality land (Type A)

Appendix B. Sector Model Program in GAMS Format

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SET
ACT ACTIVITIES
/PEA1, PEA2, PEA3, PEA4, PEA5, RICE1, RICE2, RICE3,
RICE4, RICE5, RICE6, RICE7,
CASS1, CASS2, CASS3, CASS4, CASS5, CASS6, CASS7,
TOBA1, TOBA2, TOBA3, TOBA4, TOBA5,
BEAN1, BEAN2, BEAN3, BEAN4, BEAN5,
BEAN6, BEAN7, BEAN8, BEAN9,
CORN1, CORN2, CORN3, CORN4, CORN5, CORN6,
CORN7, CORN8, CORN9,
PLANT1, PLANT2, PLANT3, PLANT4,
TOMA1, TOMA2, TOMA3,
CANE1, CANE2, CANE3,
COFFE1, COFFE2, COFFE3, COFFE4,
PEAPROD, RICEPOL, CASSPROD, TOBAPROD, BEANPROD,
CORNPROD, PLANTPROD, TOMAPROD, CANEPROD, COFFEPROD,
IMPEAOIL, IMPRICE, IMPBEAN, IMPCORN,
EXPCASS, EXPTOBA, EXPPLANT, EXPTOMA, EXPSUGUS,
EXPSUWM, EXPHONEY,  EXPCOFFE,
DEPEAOIL, DERICE, DECASS, DEBEAN,
DECORN, DEPLANT, DETOMA, DESUGAR, DECOFFE,
DEMOLASS,
COINDUS, COWHOL, CORETAIL, COCHEM, COFERT, COPLOG, COPLOC,
COCROSG, COCROSC, CORABG, CORABC, COLEVG, COLEVC, COHARRG,
COHARRC, COPLANG, COPLANC, COHARVG, COHARVC, COOTH,
PEAFING, PEAFINC, RICEFING, RICEFINC, CASSFING, CASSFINC,
TOBAFING, TOBAFINC, BEANFING, BEANFINC, CORNFING, CORNFINC,
PLANTFING, PLANTFINC, TOMAFING, TOMAFINC,  CANEFINC,
COFFEFING, COFFEFINC,
COIRR, cogosub/

DEM(ACT) COMMODITY WITH ENDOGENOUS PRICES
/DEPEAOIL, DERICE, DECASS, DEBEAN,
DECORN, DEPLANT, DETOMA, DESUGAR, DECOFFE/

PI PURCHASED INPUT
/CHEM, FERT, PLOW, CROSS, RABLD, LEVEL, HARROW, PLANT,
HARV, OTHER/

MSGOV MACHINE SERVICE BY THE GOVERNMENT
/PLOWGO, CROSSGO, RABLDGO, LEVGO, HARRGO, PLANGO,
HARVGO/

LAND LAND CLASSIFICATION
/ALAND, BLAND, AIRRIG, BIRRIG, PCLAND/

TRAB MONTHLY LABOR
/JANLAB, FEBLAB, MARLAB, APRLAB, MAYLAB, JUNLAB,
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JULLAB, AUGLAB, SEPLAB, OCTLAB, NOVLAB, DECLAB/

CW CREDIT AND WATER
/PEACAP, RICECAP, CASSCAP, TOBACAP, BEANCAP,
CORNCAP, PLANTCAP, TOMACAP, CANECAP, COFFECAP, IRRIG/

TRANS TRANSFER AND TRANSFORMATION
/PEANUT,PEAOIL,  RICEPROD, POLPROD,
CASSAVA, CASSABAL, PROTAB, TABACI,
BEAN, BEANBAL, CORN, CORNBAL, PLANTAIN, PLANTBAL,
TOMATO, TOMABAL, CANE, CANEBAL, MOLASS, HONEY,
COFFEE, COFFEEBAL,
INDUSTRI, WHOLESAL, RETAIL, gosub/

CANTMX  QUANTITY CONSTRAINTS
/IMPEAOILMX, IMPRICEMX, IMPBEANMX, IMPCORNMX,
 EXPCASSMX, EXPTOBAMX, EXPPLANTMX, XPSUGUSMX,
 EXPCOFFEMX, EXPTOMAMX,
 PEACAPMX, RICECAPMX, CASSCAPMX, TOBACAPMX, BEANCAPMX,
 CORNCAPMX, PLANTCAPMX, TOMACAPMX, COFFECAPMX/

CRVPAR DEMAND CURVE FOR ENDOGENOUS PRICES
/PRICE, QUANTITY, ELASTIC, SLOPE, INTERCEPT/;

PARAMETER
FACT(PI) PURCHASED INPUT CONSTRAINTS
/CHEM 0, FERT 0, PLOW 0, CROSS 0, RABLD 0, LEVEL 0,
HARROW 0, PLANT 0, HARV 0, OTHER 0/;

PARAMETER
MSGOVMX(MSGOV) GOVT MACHINE SERVICE CONSTRAINT
/PLOWGO 5146.44, CROSSGO 19904.82, RABLDGO 2318.94,
LEVGO 21494.38, HARRGO 15931, PLANGO 3038.1,
HARVGO 1477.79/;

PARAMETER
TIERRA(LAND) LAND CONSTRAINT
/ALAND 375310, BLAND 878930, AIRRIG 102500,
 BIRRIG 102500, PCLAND 175825/;

PARAMETER
OBRERO(TRAB) LABOR CONSTRAINT
/JANLAB 18729624, FEBLAB 18513307, MARLAB 18794855,
APRLAB 18437770, MAYLAB 18373193, JUNLAB 18113494,
JULLAB 18276991, AUGLAB 18609086, SEPLAB 18477553,
OCTLAB 18392030, NOVLAB 17940750, DECLAB 18344119/;

PARAMETER
FINAGUA(CW) CREDIT AND IRRIGATION CONSTRAINT
/PEACAP 0, RICECAP 0, CASSCAP 0,
TOBACAP 0, BEANCAP 0, CORNCAP 0,
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PLANTCAP 0, TOMACAP 0, CANECAP 0, COFFECAP 0,
IRRIG 0/;

PARAMETER
VALTRA(TRANS) TRANSFER AND TRANSFORMATION VALUES
/PEANUT 0,PEAOIL 0,  RICEPROD 0, POLPROD 0,
 CASSAVA 0, CASSABAL 0, PROTAB 0, TABACI 0,
 BEAN 0, BEANBAL 0, CORN 0, CORNBAL 0, PLANTAIN 0,
 PLANTBAL 0, TOMATO 0, TOMABAL 0,
 CANE 0, CANEBAL 0, MOLASS 0, HONEY 0,
 COFFEE 0, COFFEEBAL 0,
 INDUSTRI 0, WHOLESAL 0, RETAIL 0, gosub 0/;

PARAMETER
LIMIT(CANTMX) QUANTITY LIMIT VALUES
/IMPEAOILMX 23392.1, IMPRICEMX 545.4,
IMPBEANMX 22636, IMPCORNMX 399500,
EXPCASSMX 5681.08, EXPTOBAMX 26136,
EXPPLANTMX 1167.49, XPSUGUSMX 176710,
EXPCOFFEMX 26102.4, EXPTOMAMX 7606,
PEACAPMX 1408000, RICECAPMX 306477000,
CASSCAPMX 12346170, TOBACAPMX 40224500,
BEANCAPMX 25663830, CORNCAPMX 5064210,
PLANTCAPMX 21915960, TOMACAPMX 16404980,
COFFECAPMX 40193000.97/;

PARAMETER
ACTCO(ACT) OBJT FUNCTION VALUES
/PEA1 0, PEA2 0, PEA3 0, PEA4 0, PEA5 0,
RICE1 0, RICE2 0, RICE3 0, RICE4 0, RICE5 0,
RICE6 0, RICE7 0,
CASS1 0, CASS2 0, CASS3 0, CASS4 0, CASS5 0,
CASS6 0, CASS6 0, CASS7 0,
TOBA1 0, TOBA2 0, TOBA3 0, TOBA4 0, TOBA5 0,
BEAN1 0, BEAN2 0, BEAN3 0, BEAN4 0, BEAN5 0,
BEAN6 0, BEAN7 0, BEAN8 0, BEAN9 0,
CORN1 0, CORN2 0, CORN3 0, CORN4 0, CORN5 0,
CORN6 0, CORN7 0, CORN8 0, CORN9 0,
PLANT1 0, PLANT2 0, PLANT3 0,
TOMA1 0, TOMA2 0, TOMA3 0,
CANE1 0, CANE2 0, CANE3 0,
COFFE1 0, COFFE2 0, COFFE3 0, COFFE4 0,
DEMOLASS 0.45,
IMPEAOIL -1903.46, IMPRICE -761.21,
IMPBEAN -3090, IMPCORN -520,
EXPCASS 1884.3, EXPTOBA 8979, EXPPLANT 1284.3,
EXPTOMA 1689.8, EXPHONEY 4.81,
EXPSUWM 1369.24, EXPSUGUS 2976.6,
EXPCOFFE 15140,
PEAPROD 0, RICEPOL 0, CASSPROD 0, TOBAPROD 0,
BEANPROD 0, CORNPROD 0, PLANTPROD 0, TOMAPROD 0,
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COFFEPROD 0,
COINDUS -1.00, COWHOL -1.00,
CORETAIL -1.00, COCHEM -1.00, COFERT -1588.40, COPLOG -95.4,
COPLOC -190.80, COCROSG -71.55, COCROSC -127.20, CORABG -39.75,
CORABC -55.65, COLEVG -127.20, COLEVC -127.20, COHARRG -39.75,
COHARRC -63.60, COPLANG -47.70, COPLANC -120.55,
COHARVG -39.75, COHARVC -63.60, COOTH -1.00,
PEAFING -0.17, RICEFING -0.17, CASSFING -0.17, TOBAFING -0.17,
PEAFINC -0.36, RICEFINC -0.36, CASSFINC -0.36, TOBAFINC -0.36,
BEANFING -0.17, CORNFING -0.17, PLANTFING -0.17, TOMAFING -0.17,
BEANFINC -0.36, CORNFINC -0.36, PLANTFINC -0.36, TOMAFINC -0.36,
CANEFINC -0.18, COFFEFING -0.17, COFFEFINC -0.36,
COIRR -1.00,  cogosub 1.00/;


TABLE INPUSE(PI,ACT) PURCHASED INPUT USE
              PEA1     PEA2     PEA3     PEA4     PEA5
CHEM         223.6    252.4    153.4    268.8    200.2
FERT
PLOW                      1        1        1        1
CROSS            1        1        1        1        1
RABLD            1
LEVEL            1
HARROW                    1
PLANT
HARV
OTHER                          83.95     63.6
   +        RICE1    RICE2    RICE3   RICE4   RICE5   RICE6
CHEM      1358.59  7762.96  7448.78  592.41  422.51  303.94
FERT         0.65     6.73     0.69     .43     .09     .09
PLOW         1.00     1.09     1.09            1.00    1.06
CROSS        1.00     1.09     1.09            1.00    1.06
RABLD        1.00
LEVEL        1.00     1.00                             1.00
HARROW       1.00     1.00                             1.00
PLANT
HARV         1.00
OTHER
  +         RICE7   CASS1  CASS2   CASS3   CASS4
CHEM       314.62  141.75 186.38    0.00     0.0
FERT          .50   0.002
PLOW                 1.00   1.00    1.00
CROSS                1.00   1.00    1.00
RABLD                       1.00    1.00
LEVEL
HARROW               1.00   1.00    1.00
PLANT
HARV
OTHER               50.88
   +       CASS5   CASS6   CASS7   TOBA1   TOBA2
CHEM      102.38   136.5    0.00 1039.43 1042.26
```

FERT	0.003			0.44	0.47	
PLOW	1.00	1.00		1.02	1.00	
CROSS	1.00	1.00		1.02	1.00	
RABLD		1.00				
LEVEL						
HARROW	1.00			1.00	1.00	
PLANT						
HARV						
OTHER				475.09	306.08	
+	TOBA3	TOBA4	TOBA5	BEAN1	BEAN2	BEAN3
CHEM	1050.99	486.06	344.71	521.62	571.35	938.50
FERT	0.13	0.06	0.20	0.20	0.007	0.05
PLOW	1.00			1.00	1.00	1.00
CROSS	1.00	1.00		1.00	1.00	1.00
RABLD					1.00	1.00
LEVEL						
HARROW	1.00	1.00		1.00		
PLANT				1.00		
HARV						
OTHER	85.86	547.2	60.57	54.30	94.67	42.71
+	BEAN4	BEAN5	BEAN6	BEAN7	BEAN8	BEAN9
CHEM	411.30	328.52	385.08	288.64	707.27	235.84
FERT	0.001	0.17				
PLOW	1.00		1.00	1.00	1.00	
CROSS			1.00	1.00	1.00	
RABLD						
LEVEL						
HARROW			1.00			
PLANT						
HARV						
OTHER	72.42	74.60	68.27	48.85	47.25	86.32
+	CORN1	CORN2	CORN3	CORN4	CORN5	CORN6
CHEM	204.96	106.20	22.18	24.02	68.71	70.56
FERT	0.076				0.076	
PLOW	1.00	1.00	1.00	1.00	1.00	1.00
CROSS	1.00	1.00	1.00	1.00	1.00	1.00
RABLD						
LEVEL						
HARROW	1.00		1.00		1.00	
PLANT						
HARV						
OTHER	50.4	120.33	23.05		105.9	55.65
+	CORN7	CORN8	CORN9	PLANT1	PLANT2	PLANT3
CHEM	48.05	36.96	14.78	518.84	0.00	3.82
FERT	0.21			0.86	0.86	0.42
PLOW	1.00			1.00		1.00
CROSS	1.00			1.00		1.00
RABLD				1.00		1.00
LEVEL				1.00		
HARROW	1.00			1.00		1.00
PLANT						

HARV				
OTHER				181.26

+	PLANT4
CHEM	776.00
FERT	0.59
PLOW	1.00
CROSS	1.00
RABLD	
LEVEL	
HARROW	
PLANT	
HARV	
OTHER	508.5

+	TOMA1	TOMA2	TOMA3	CANE1	CANE2	CANE3
CHEM	2280.00	2401.3	871.44	106.6	106.6	106.6
FERT	1.12	1.17	0.32	0.5	0.5	0.5
PLOW	1.00	1.00		0.2	0.2	0.2
CROSS	1.00	1.00				
RABLD						
LEVEL	1.00					
HARROW						
PLANT				0.2	0.2	0.2
HARV						
OTHER	437.89	312.60	206.2			

+	COFFE1	COFFE2	COFFE3	COFFE4
CHEM				
FERT	0.00	0.30	0.87	1.12
PLOW				
CROSS				
RABLD				
LEVEL				
HARROW				
PLANT				
HARV				
OTHER		47.70	79.5	524.7

+	COCHEM	COFERT	COPLOG	COPLOC	COCROSG	COCROSC
CHEM	-1					
FERT		-1				
PLOW			-1	-1		
CROSS					-1	-1
RABLD						
LEVEL						
HARROW						
PLANT						
HARV						
OTHER						

+	CORABG	CORABC	COLEVG	COLEVC	COHARRG	COHARRC
CHEM						
FERT						
PLOW						
CROSS						

```
RABLD           -1       -1
LEVEL                             -1       -1
HARROW                                              -1       -1
PLANT
HARV
OTHER
        +  COPLANG  COPLANC  COHARVG  COHARVC   COOTH
CHEM
FERT
PLOW
CROSS
RABLD
LEVEL
HARROW
PLANT           -1       -1
HARV                              -1       -1
OTHER                                              -1;


TABLE GOVMACH(MSGOV,ACT) GOVT MACHINE REQUIREMENT
            COPLOG  COCROSG   CORABG   COLEVG  COHARRG
PLOWGO           1
CROSSGO                   1
RABLDGO                            1
LEVGO                                       1
HARRGO                                               1
PLANGO
HARVGO
        +  COPLANG  COHARVG
PLOWGO
CROSSGO
RABLDGO
LEVGO
HARRGO
PLANGO           1
HARVGO                    1;

TABLE LANDUSE(LAND,ACT) LAND REQUIREMENT
              PEA1     PEA2     PEA3     PEA4     PEA5
ALAND            1                          1
BLAND                     1        1                 1
AIRRIG
BIRRIG
   +      RICE1   RICE2   RICE3   RICE4   RICE5   RICE6
ALAND      1.00            1.00    1.00    1.00
BLAND              1.00                            1.00
AIRRIG     1.00            1.00    1.00    1.00
BIRRIG             1.00
   +      RICE7   CASS1   CASS2   CASS3   CASS4
ALAND      1.00    1.00     1.0    1.00    1.00
BLAND
```

```
AIRRIG      1.00      1.00      1.00      1.00      1.00
BIRRIG
   +       CASS5     CASS6     CASS7     TOBA1     TOBA2     TOBA3
ALAND       1.00                          1.00      1.00      1.00
BLAND                 1.00      1.00
AIRRIG                                    1.00
BIRRIG
   +       TOBA4     TOBA5     BEAN1     BEAN2     BEAN3     BEAN4
ALAND                           1.00      1.00      1.00      1.00
BLAND       1.00      1.00
AIRRIG                          1.00      1.00      1.00      1.00
BIRRIG
   +       BEAN5     BEAN6     BEAN7     BEAN8     BEAN9
ALAND                 1.00                1.00
BLAND       1.00                1.00                1.00
AIRRIG
BIRRIG
   +       CORN1     CORN2     CORN3     CORN4     CORN5     CORN6
ALAND       1.00      1.00      1.00      1.00      1.00      1.00
BLAND
AIRRIG      1.00      1.00      1.00      1.00      1.00
BIRRIG
   +       CORN7     CORN8     CORN9     PLANT1     PLANT2     PLANT3
ALAND                 1.00                 1.00       1.00       1.00
BLAND       1.00                1.00
AIRRIG                                     1.00       1.00       1.00
BIRRIG
   +       PLANT4
ALAND        1.00
BLAND
AIRRIG
BIRRIG
   +       TOMA1     TOMA2     TOMA3     CANE1     CANE2     CANE3
ALAND       1.00      1.00      1.00
BLAND                                     1.25      1.25      1.25
AIRRIG      1.00      1.00      1.00                1.25
BIRRIG
   +       COFFE1    COFFE2     COFFE3     COFFE4
ALAND
BLAND
AIRRIG
BIRRIG
PCLAND      1.02       1.04       1.05       1.10 ;

TABLE LABOR(TRAB,ACT) LABOR REQUIREMENT
               PEA1       PEA2       PEA3       PEA4       PEA5
JANLAB                    7.54       9.76
FEBLAB                    5.58       1.81
MARLAB                   11.23      10.88       2.66
APRLAB        20.29                            11.34
MAYLAB         1.43                                0
```

JUNLAB	9.32			14.46		
JULLAB						
AUGLAB						
SEPLAB					3.63	
OCTLAB					9.52	
NOVLAB					0	
DECLAB					27.31	

+	RICE1	RICE2	RICE3	RICE4	RICE5	RICE6
JANLAB						
FEBLAB						
MARLAB	14.70	1.79				
APRLAB	3.41	26.99	27.50			
MAYLAB	8.81	10.06	7.90		99.30	
JUNLAB	16.89	1.95	9.85		5.78	
JULLAB	5.10	30.42	8.55		1.92	
AUGLAB			40.85	61.30	4.18	17.72
SEPLAB				3.85	2.73	1.31
OCTLAB				22.36	60.26	11.09
NOVLAB				4.04		0.54
DECLAB				26.69		15.34

+	RICE7	CASS1	CASS2	CASS3	CASS4
JANLAB		24.3	15.4	13.5	15.93
FEBLAB		3.75	5.8	1.13	0.72
MARLAB		15.03	11.98	14.62	0.00
APRLAB		2.52	3.42		31.12
MAYLAB		15.04		13.5	0.72
JUNLAB		1.22	24.28	1.13	0.00
JULLAB	52.13	22.87		0.00	0.00
AUGLAB	31.05			22.00	19.87
SEPLAB	5.82				
OCTLAB	45.83				
NOVLAB			25.51	9.09	28.14
DECLAB			11.98	13.5	15.93

+	CASS5	CASS6	CASS7	TOBA1	TOBA2
JANLAB	6.81	0.00	0.00	13.18	77.08
FEBLAB	0.00	0.00	16.78	104.23	
MARLAB	0.00	11.28	30.29		
APRLAB	0.00		16.59		
MAYLAB	11.92		0.00		
JUNLAB			16.59		
JULLAB		22.96	0.00		
AUGLAB	15.17	11.88	0.00		
SEPLAB	8.00	0.00	0.00		23.23
OCTLAB	7.57	11.89	0.00	15.8	25.50
NOVLAB	0.76	0.00	0.00	41.12	17.73
DECLAB	6.81	2.56	0.00	11.2	31.29

+	TOBA3	TOBA4	TOBA5	BEAN1	BEAN2	BEAN3
JANLAB	27.37	11.03	27.82	0.00	17.92	17.65
FEBLAB	20.97	23.37	18.20	8.71		15.12
MARLAB	78.96	5.04	17.85			
APRLAB	31.30	5.04	17.20			

MAYLAB	28.98					
JUNLAB						
JULLAB						
AUGLAB						
SEPLAB						
OCTLAB						
NOVLAB				15.33	11.77	
DECLAB		17.55	24.70	8.64	16.01	9.94

+	BEAN4	BEAN5	BEAN6	BEAN7	BEAN8	BEAN9
JANLAB	27.01		18.60		23.56	12.77
FEBLAB	26.44		18.63		5.16	
MARLAB		34.40			18.53	
APRLAB		12.13		5.36		
MAYLAB		2.88		7.65		
JUNLAB		15.97		29.16		
JULLAB						
AUGLAB						
SEPLAB						
OCTLAB						
NOVLAB						46.21
DECLAB	18.97		31.04			15.10

+	CORN1	CORN2	CORN3	CORN4	CORN5	CORN6
JANLAB					12.16	2.78
FEBLAB				41.12	2.00	0.00
MARLAB				10.46	0.00	11.74
APRLAB				23.05	9.23	
MAYLAB	9.53	20.84	12.87			
JUNLAB	10.19	14.45	8.26			
JULLAB	1.72	3.57	8.26			
AUGLAB	6.54	13.10	29.35			
SEPLAB						
OCTLAB						
NOVLAB						
DECLAB						15.31

+	CORN7	CORN8	CORN9	PLANT1	PLANT2	PLANT3
JANLAB				32.60	18.29	60.25
FEBLAB				8.48	7.69	24.41
MARLAB	29.02	15.72		6.38	5.30	0.00
APRLAB	33.95	9.27		5.30	8.48	17.02
MAYLAB	0.00	9.27		3.06	6.36	3.00
JUNLAB	10.21	5.02		2.12	9.44	18.15
JULLAB				3.18	5.25	9.41
AUGLAB			31.17	3.18	8.48	0.00
SEPLAB			10.37	4.51	5.30	30.76
OCTLAB			8.32	3.18	6.10	0.00
NOVLAB				4.47	5.30	0.00
DECLAB				7.70	5.30	29.67

+	PLANT4
JANLAB	19.81
FEBLAB	0.00
MARLAB	0.00

```
APRLAB     5.95
MAYLAB     0.00
JUNLAB     5.95
JULLAB     0.00
AUGLAB     5.95
SEPLAB     0.00
OCTLAB     5.95
NOVLAB     0.00
DECLAB     3.98
 +        TOMA1   TOMA2   TOMA3  CANE1   CANE2   CANE3
JANLAB                             2.7     2.7     2.7
FEBLAB    26.89                    2.7     2.7     2.7
MARLAB    39.85                    2.7     2.7     2.7
APRLAB    89.14           38.82    2.7     2.7     2.7
MAYLAB    71.53           16.88
JUNLAB    44.24           30.91
JULLAB                    29.52
AUGLAB                    48.94
SEPLAB           100.41
OCTLAB            66.73
NOVLAB            48.79            2.7     2.7     2.7
DECLAB            23.04            2.7     2.7     2.7
 +        COFFE1   COFFE2   COFFE3   COFFE4
JANLAB     15.9     17.5    28.62    44.52
FEBLAB     15.9     17.5    28.62    44.52
MARLAB     15.9     17.5    28.62    44.52
APRLAB     15.9     17.5    28.62    44.52
MAYLAB
JUNLAB
JULLAB
AUGLAB
SEPLAB
OCTLAB
NOVLAB
DECLAB     15.9     17.5    28.62    44.52     ;

TABLE CWATER(CW,ACT) CREDIT AND WATER REQUIREMENT
              PEA1     PEA2     PEA3     PEA4     PEA5
PEACAP      296.27   286.29   249.75      281   341.91
IRRIG
  +        RICE1     RICE2   RICE3    RICE4   RICE5   RICE6
RICECAP  2327.82   2539.37 2262.39  2020.66  2266.7  1021.9
IRRIG      15.42     16.22   11.45    16.70    6.68
  +         RICE7   CASS1   CASS2    CASS3    CASS4
RICECAP   2110.61
CASSCAP            2397.1 2723.69  2369.51  2556.51
IRRIG       19.08    15.1            47.7      14.0
    +       CASS5   CASS6   CASS7   TOBA1   TOBA2
CASSCAP   1794.67  1909.4 1817.66
TOBACAP                            7074.9  6626.2
IRRIG                                8.27
```

```
 +         TOBA3    TOBA4    TOBA5    BEAN1    BEAN2    BEAN3
TOBACAP   5640.2   2561.2   2734.2
BEANCAP                               572.4    538.4    638.4
IRRIG                                  8.27     9.54     5.57
 +         BEAN4    BEAN5    BEAN6    BEAN7    BEAN8    BEAN9
BEANCAP   592.18   638.38   591.37   411.67   550.43   421.33
IRRIG      14.31
 +         CORN1    CORN2    CORN3    CORN4    CORN5    CORN6
CORNCAP   485.77   583.79   600.30   684.63   417.45   401.11
IRRIG      21.94             19.08     2.54
 +         CORN7    CORN8    CORN9    PLANT1    PLANT2    PLANT3
CORNCAP   820.91   309.56   381.64
PLANTCAP                             4658.80   3520.53   5544.19
IRRIG                                  17.49     17.49     10.49
 +          PLANT4
PLANTCAP    552.48
IRRIG
 +           TOMA1    TOMA2     TOMA3    CANE1    CANE2    CANE3
TOMACAP    4545.46  4233.46   2169.43
CANECAP                                  595.0    595.0    595.0
IRRIG         8.90    10.97     10.97
 +         COFFE1    COFFE2    COFFE3    COFFE4
COFFECAP   152.64    209.88    605.79    1090.7
IRRIG
 +        PEAFING  PEAFINC RICEFING RICEFINC CASSFING  CASSFINC
PEACAP     -1.00     -1.00
RICECAP                       -1.00    -1.00
CASSCAP                                           -1.00     -1.00
TOBACAP
BEANCAP
IRRIG
 +          TOBAFING    TOBAFINC   BEANFING BEANFINC CORNFING
TOBACAP        -1.00       -1.00
BEANCAP                               -1.00    -1.00
CORNCAP                                                 -1.00
 +           CORNFINC  PLANTFING  PLANTFINC TOMAFING TOMAFINC
CORNCAP        -1.00
PLANTCAP                   -1.00      -1.00
TOMACAP                                        -1.00    -1.00
IRRIG
 +          CANEFINC  COFFEFING   COFFEFINC  COIRR
TOMACAP
CANECAP       -1.00
COFFECAP                  -1.00       -1.00
IRRIG                                        -1.00    ;

TABLE TRANRE(TRANS,ACT) TRANSFER ROWS REQUIREMENT
              PEA1      PEA2      PEA3      PEA4      PEA5
PEANUT        -.70     -1.09     -1.13     -1.29      -.77
PEAOIL
RICEPROD
```

POLPROD	
CASSAVA	
CASSABAL	
INDUSTRI	
WHOLESAL	
RETAIL	
GOSUB	

+	RICE1	RICE2	RICE3	RICE4	RICE5	RICE6
RICEPROD	-8.01	-8.09	-8.08	-6.36	-2.53	-3.25
POLPROD						
INDUSTRI						
WHOLESAL						
RETAIL						
GOSUB						

+	RICE7	CASS1	CASS2	CASS3	CASS4	CASS5
RICEPROD	-3.17					
POLPROD						
CASSAVA		-8.67	-8.41	-8.08	-7.46	-5.23
CASSABAL						
INDUSTRI						
WHOLESAL						
RETAIL						

+	CASS6	CASS7	TOBA1	TOBA2	TOBA3	TOBA4
CASSAVA	-5.33	-8.37				
CASSABAL						
PROTAB			-1.22	-1.21	-1.08	-1.06
TABACI						
INDUSTRI						
WHOLESAL						
RETAIL						

+	TOBA5	BEAN1	BEAN2	BEAN3	BEAN4	BEAN5
PROTAB	-0.997					
TABACI						
BEAN		-1.2	-1.66	-1.08	-1.08	-0.64
BEANBAL						
INDUSTRI						
WHOLESAL						
RETAIL						

+	BEAN6	BEAN7	BEAN8	BEAN9	CORN1	CORN2
BEAN	-0.60	-0.65	-0.78	-0.88		
BEANBAL						
CORN					-1.69	-1.71
CORNBAL						
INDUSTRI						
WHOLESAL						
RETAIL						

+	CORN3	CORN4	CORN5	CORN6	CORN7	CORN8
CORN	-1.94	-1.96	-2.07	-1.71	-1.33	-1.58
CORNBAL						
INDUSTRI						
WHOLESAL						

RETAIL

+	CORN9	PLANT1	PLANT2	PLANT3	PLANT4	TOMA1
CORN	-0.25					
CORNBAL						
PLANTAIN		-11.93	-9.38	-5.76	-7.55	
PLANTBAL						
TOMATO						-18.49
TOMABAL						
INDUSTRI						
WHOLESAL						
RETAIL						

+	TOMA2	TOMA3	CANE1	CANE2	CANE3
TOMATO	-21.86	-26.54			
TOMABAL					
CANE			-34.19	-47.7	-43.73
CANEBAL					
MOLASS					
HONEY					
INDUSTRI					
WHOLESAL					
RETAIL					

+	COFFE1	COFFE2	COFFE3	COFFE4
COFFEE	-0.25	-0.36	-0.72	-1.44
COFFEEBAL				

+	PEAPROD	RICEPOL	DEPEAOIL	DERICE
PEANUT	1.00			
PEAOIL	-.45		1.00	
RICEPROD		1.00		
POLPROD		-0.65		1.00
INDUSTRI	77.72	124.52		
WHOLESAL	270.3	35.00		
RETAIL	131.09	90.20		
GOSUB		-13.67		

+	CASSPROD	DECASS	TOBAPROD	BEANPROD
CASSAVA	1.00			
CASSABAL	-0.99	1.00		
PROTAB			1.00	
TABACI			-0.72	
BEAN				1.00
BEANBAL				-0.99
INDUSTRI			1993.5	
WHOLESAL	267.3		1482.0	316.21
RETAIL	645.7			1399.7

+	DEBEAN	CORNPROD	DECORN	PLANTPROD	DEPLANT
BEAN					
BEANBAL	1.00				
CORN		1.00			
CORNBAL		-0.99	1.00		
PLANTAIN				1.00	
PLANTBAL				-0.99	1.00
INDUSTRI					

WHOLESAL		232.32		110.52	
RETAIL		1315.89		280.12	

+	TOMAPROD	DETOMA	CANEPROD	DESUGAR	DEMOLASS
TOMATO	1.00				
TOMABAL	-0.99	1.00			
CANE			1.00		
CANEBAL			-0.11	1.00	
MOLASS			-6.63		1.00
HONEY			-0.3		
INDUSTRI			58.4		
WHOLESAL	204.98		99.0		0.14
RETAIL	1172.67		72.0		
GOSUB			-59.2		

+	COFFEPROD	DECOFFE
COFFEE	1.00	
COFFEEBAL	-0.90	1.00
INDUSTRI	1540.0	
WHOLESAL	495.00	
RETAIL		
GOSUB		

+	IMPEAOIL	IMPRICE	EXPCASS	EXPTOBA	IMPBEAN
PEAOIL	-1.00				
POLPROD		-1.00			
CASSABAL			1.00		
TABACI				1.00	
BEANBAL					1.00
GOSUB		-20.7			

+	IMPCORN	EXPPLANT	EXPTOMA	EXPSUGUS	EXPSUWM
PEAOIL					
POLPROD					
CASSABAL					
TABACI					
BEANBAL					
CORNBAL	1.00				
PLANTBAL		1.00			
TOMABAL			1.00		
CANEBAL				1.00	1.00
WHOLESAL				80.28	80.28
GOSUB					

+	EXPHONEY	EXPCOFFE
HONEY	1.00	
COFFEEBAL		1.00
INDUSTRI		198.00
WHOLESAL	0.33	1936.00
GOSUB		

+	COINDUS	COWHOL	CORETAIL	COGOSUB
PEANUT				
PEAOIL				
RICEPROD				
POLPROD				
INDUSTRI	-1.00			

```
WHOLESAL              -1.00
RETAIL                             -1.00
GOSUB                                         1.00;

TABLE QUOTA(CANTMX,ACT)
               IMPEAOIL   IMPRICE   IMPBEAN   IMPCORN
IMPEAOILMX         1.00
IMPRICEMX                   1.00
IMPBEANMX                             1.00
IMPCORNMX                                       1.00
   +         EXPCASS    EXPTOBA   EXPPLANT  EXPSUGUS
EXPCASSMX       1.00
EXPTOBAMX                 1.00
EXPPLANTMX                           1.00
XPSUGUSMX                                      1.00
  +         EXPCOFFE   EXPTOMA
EXPCOFFEMX      1.00
EXPTOMAMX                 1.00
      +     PEAFING   RICEFING   CASSFING   TOBAFING
PEACAPMX      1.00
RICECAPMX                1.00
CASSCAPMX                           1.00
TOBACAPMX                                      1.00
      +     BEANFING   CORNFING   PLANTFING   TOMAFING
BEANCAPMX      1.00
CORNCAPMX                 1.00
PLANTCAPMX                            1.00
TOMACAPMX                                        1.00
   +        COFFEFING
COFFECAPMX       1.00  ;

TABLE CURVE(CRVPAR,ACT)
          DEPEAOIL   DERICE  DECASS    DEBEAN
PRICE      2875.15     2750    1430    7722.0
QUANTITY  27135.29   274954  120999     68409
ELASTIC       -.954   -0.698  -0.887    -0.778
SLOPE       -0.111   -0.014  -0.013    -0.145
INTERCEPT 5888.934 6689.828 3042.18  17647.45
   +          DECORN    DEPLANT   DETOMA   DESUGAR
PRICE        1628.00     1480.0   2948.0   1477.08
QUANTITY      456727      22725    21558  259177.5
ELASTIC       -0.887     -0.887   -0.983    -0.895
SLOPE         -0.004     -0.073   -0.139    -0.006
INTERCEPT     3463.4    3148.55  5946.98   3127.45
   +        DECOFFE
PRICE          5830
QUANTITY      24217
ELASTIC       -1.02
SLOPE        -0.236
INTERCEPT 11545.69;
```

```
POSITIVE VARIABLES
X(ACT);

VARIABLES
SURPLUS   CONSUMER PLUS PRODUCER SURPLUS;

EQUATIONS
OBJT              OBJECTIVE FUNCTION
TAREA(LAND)       LAND AVAILABILITY
MANOBRA(TRAB)     LABOR AVAILABILITY
INBALANCE(PI)     PURCHASE INPUT BALANCE
CREDIT(CW)        CREDIT AVAILABILITY
MACHINE(MSGOV)    GOVT MACH SERVICE AVAILABILITY
TRANSFER(TRANS)   TRANSFER AND TRANSFORMATION ROWS
TOPE(CANTMX)      UPPER BOUNDS FOR IMPORT-EXPORT  ;

OBJT.. SURPLUS =E=
         SUM(ACT, CURVE("INTERCEPT",ACT)*X(ACT)
         +0.5*CURVE("SLOPE",ACT)*X(ACT)**2)
         +SUM(ACT, ACTCO(ACT)*X(ACT));

TAREA(LAND).. SUM(ACT, LANDUSE(LAND,ACT)*X(ACT)) =L= TIERRA(LAND);
MANOBRA(TRAB).. SUM(ACT, LABOR(TRAB,ACT)*X(ACT)) =L= OBRERO(TRAB);
INBALANCE(PI).. SUM(ACT, INPUSE(PI,ACT)*X(ACT)) =L= FACT(PI);
CREDIT(CW).. SUM(ACT, CWATER(CW,ACT)*X(ACT)) =L= FINAGUA(CW);
MACHINE(MSGOV).. SUM(ACT, GOVMACH(MSGOV,ACT)*X(ACT)) =L= MSGOVMX(MSGOV);
TRANSFER(TRANS).. SUM(ACT, TRANRE(TRANS,ACT)*X(ACT)) =L= VALTRA(TRANS);
TOPE(CANTMX).. SUM(ACT, QUOTA(CANTMX,ACT)*X(ACT)) =L= LIMIT(CANTMX);

X.L("DEPEAOIL")= 27135;
X.L("DERICE")= 274954;
X.L("DECASS")= 120999;
X.L("DEBEAN")= 68409;
X.L("DECORN")= 45727;
X.L("DEPLANT")= 22725;
X.L("DETOMA")= 21558;
X.L("DESUGAR")= 259177;
X.L("DECOFFE")= 24217;



MODEL ISA /ALL/;
SOLVE ISA USING NLP MAXIMIZING SURPLUS;

DISPLAY X.L, X.M;
```

Appendix C.1.A. Production, Exports, Imports and Consumption under the Food Self-Sufficiency Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Self	Reference	Self	Reference	Self	Reference	Self
Sugar	408,140	408,140	176,710	176,710	N.I.	N.I.	231,430	231,430
Coffee	54,836	54,835	26,102	26,102	N.I.	N.I.	28,733	38,733
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I.	---	---
Rice (*)	413,335	413,880	N.E.	N.E.	545	0	413,880	413,880
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,135	1,167	1,167	N.I.	N.I.	33,968	33,968
Peanuts (**)	8,638	32,029	N.E.	N.E.	23,392	0	32,029	32,029
Tomato	39,685	39,685	7,606	7,606	N.I.	N.I.	32,080	32,079
Total		1,705,251						

Note: N.E. = no export ; N.I. = no import; Self = Food Self-Sufficiency Scenario; Reference = base model.
(*) Rice refers to polished rice.
(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.A. Seasonal Labor Use under the Food Self-Sufficiency Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,638	18,730	35.44
February	4,522	18,513	24.43
March	9,626	18,795	51.21
April	6,959	18,438	37.74
May	2,579	18,373	14.03
June	1,778	18,113	9.81
July	65	18,277	.35
August	6,166	18,609	33.13
September	402	18,478	2.17
October	2,260	18,392	12.29
November	6,268	17,941	34.93
December	8,825	18,344	48.11

Appendix C.3.A. Area Harvested and Labor Use under the Food Self-sufficiency Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	84,848	27	2,291	30	68,727
Coffee	171,178	148	25,283	30	758,490
Tobacco	36,409	106	3,851	30	115,529
Rice	102,900	118	12,167	30	365,007
Beans	121,670	74	9,013	30	270,399
Corn	272,810	39	10,716	30	321,479
Cassava	19,632	80	1,575	30	47,264
Plantain	3,784	91	345	30	10,363
peanuts	62,989	22	1,414	30	42,423
Tomato	1,510	165	249	30	7,478
Total	877,730		66,905		2,007,160

Appendix C.4.A. Consumer Surplus Estimation under the Food Self-Sufficiency Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	1,739	231,430	160,682
Coffee	11,546	4,765	28,733	97,420
Rice	6,690	896	413,880	1,199,072
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	669	33,967	42,113
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,488	32,079	71,522
Total				2,966,786

Note: To calculate consumer surplus the following formula was used:

$CS = ½*(\delta - Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.A. Domestic Sales, Export and Import Values and Gross Income under the Food Self-Sufficiency Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	231,430	1,739	402,422	176,710	2,977	526,066				928,488
Molass	24,600,000	0	11,070		0					11,070
Honey		0		1,113,100	5	5,354				5,354
Coffee	28,733	4,765	136,902	26,102	15,140	395,184				532,087
Tobacco				26,136	8,979	234,675				234,675
Rice	413,880	896	370,642	.00	0	0	0	761	.00	370,642
Beans	106,000	2,277	241,377	.00	0	0	0	0	.00	241,377
Corn	426,730	1,756	749,543	.00	0	0	0	0	.00	749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703	0	0	.00	167,890
Plantain	33,968	669	22,721	1,167	1,284	1,498	0	0	.00	24,219
Peanuts	32,029	2,334	74,744				0	1,904	.00	74,744
Tomato	32,079	1,488	47,730	7,606	1,690	12,854				60,584
Total	26,061,839		2,214,338			1,186,335			.00	3,400,673

Appendix C.6.A. Total Financing under the Food Self-Sufficiency Scenario.

Activity (*)	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	50,485	.18	9,087	6.48
Coffefing	40,193	.17	6,833	4.87
Coffefinc	230	.36	83	.06
Tobafing	40,224	.17	6,838	4.87
Tobafinc	59,326	.36	21,357	15.22
Ricefing	202,240	.17	34,381	24.50
Ricefinc		.36	0	.00
Beanfing	25,664	.17	4,363	3.11
Beanfinc	25,664	.36	9,239	6.58
Cornfing	5,064	.17	861	.61
Cornfinc	79,387	.36	28,579	20.36
Cassfing	12,346	.17	2,099	1.50
Cassfinc	23,339	.36	8,402	5.99
Plantfing	13,320	.17	2,264	1.61
Plantfinc		.36	0	.00
peafing	1,408	.17	239	.17
peafinc	14,323	.36	5,156	3.67
Tomafing	3,277	.17	557	.40
Tomafinc		.36	0	.00
Total			140,339	100.00

Note: Finc at the end of each crop means financing at the commercial interest rate. Fing is the financing of each crop at the subsidized financing of rice at the commercial interest rate. Ricefing is the case for financing of rice at the subsidized interest rate.

Appendix C.7.A. Costs of Production under the Food Self-Sufficiency Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of total direct cost
Chemicals	130,670	1	123,530	25.80
Fertilizer	113	1,588	179,126	37.42
Plowing (govt.)	5	95	491	.10
Plowing (private)	81	191	6,596	1.38
Crossing (govt.)	20	72	1,424	.30
Crossing (private)	49	127	362	.08
Leveling(govt.)	6	127	691	.14
Harrowing (govt.)	6	40	216	.05
Planting (govt.)	3	48	145	.03
Planting (private)	14	121	1,679	.35
Irrigation	1,706	1	1,706	.36
Other	26,303	1	22,441	4.69
Financing	140,339	1	140,339	29.31
Total direct cost			478,748	100.00
Processing	472,870	1	468,720	
Wholesale	751,400	1	737,320	
Retail	1,214,000	1	1,207,100	
Total			2,891,888	

Appendix C.1.B. Production, Exports, Imports and Consumption under 5 percent Penalty on Traditional Export Crops Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Exch5	Reference	Exch5	Reference	Exch5	reference	Exch5
Sugar	408,140	408,140	176,700	176,710	N.I.	N.I.	231,430	231,430
Coffee	54,835	54,835	26,102	26,102	N.I.	N.I.	28,733	38,733
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I.	---	---
Rice (*)	413,335	413,335	N.E.	N.E.	545	545	413,880	413,880
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,135	1,167	1,167	N.I.	N.I.	33,968	33,968
Peanuts (**)	8,638	8,638	N.E.	N.E.	23,392	23,392	32,029	32,029
Tomato	39,685	39,685	7,606	7,606	N.I.	N.I.	32,080	32,079
Total	1,681,315	1,681,315						

Note: N.E. = no export ; N.I. = no import; Exch5 = 5% penalty on traditional export crops scenario.
Reference = base model.
(*) Rice refers to polished rice.
(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.B. Seasonal Labor Use under the 5 percent and 18 percent Penalty on Traditional Export Crops Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,189	18,730	33.04
February	4,439	18,513	23.98
March	9,125	18,795	48.55
April	6,959	18,438	37.74
May	2,578	18,373	14.03
June	1,778	18,113	9.81
July	65	18,277	.35
August	6,161	18,609	33.11
September	401	18,478	2.17
October	2,257	18,392	12.27
November	6,267	17,941	34.93
December	8,821	18,344	48.09

Appendix C.3.B. Area Harvested and Labor Use under the 5 percent and 18 Percent Penalty on Traditional Export Crops.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	84,848	27.00	2,291	30	68,727
Coffee	171,178	147.70	25,283	30	758,490
Tobacco	36,409	105.77	3,851	30	115,529
Rice	102,642	118.24	12,136	30	364,092
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,575	30	47,264
Plantain	3,784	91.29	345	30	10,363
peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,478
Total	831,469		65,842		1,975,261

Appendix C.4.B. Consumer Surplus Estimation under the 5% and 18% and 36% Penalty on Traditional Export Crops Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	1,739	231,430	160,682
Coffee	11,546	4,765	28,733	97,420
Rice	6,690	896	413,880	1,199,072
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	669	33,968	42,114
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,488	32,079	71,522
Total				2,966,787

Note: to calculate consumer surplus the following formula was used:

$CS= ½*(\delta -Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.B. Domestic Sales, Export and Import Values and Gross Income under the 5 and 18 Percent Penalty on Traditional Export Crops Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	231,420	1,739	402,405	176,710	2,828	499,736				902,141
Molass	24,600,000	0	11,070		0					11,070
Honey		0		1,113,100	5	5,354				5,354
Coffee	28,733	4,765	136,902	26,102	14,383	375,425				512,327
Tobacco				26,136	8,530	222,940				222,940
Rice	413,880	896	370,642				545	761	415	370,227
Beans	106,000	2,277	241,377		0		0			241,377
Corn	426,730	1,756	749,543		0		0			749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703				167,890
Plantain	33,968	669	22,721	1,167	1,284	1,498				24,219
Peanuts	32,029	2,334	74,861				23,392	1,904	44,538	30,322
Tomato	32,079	1,488	47,656	7,606	1,690	12,854				60,510
Total	26,061,839		2,214,363			1,128,511			44,954	3,297,920

Appendix C.7.B. Costs of Production under the 5 and 18 Percent Penalty on Traditional Export Crops Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of total direct cost
Chemicals	123,530	1	123,530	43.41
Fertilizer	11	1,588	17,786	6.25
Plowing (govt.)	5	95	491	.17
Plowing (private)	35	191	6,596	2.32
Crossing (govt.)	20	72	1,424	.50
Crossing (private)	3	127	362	.13
Leveling(govt.)	5	127	691	.24
Harrowing (govt.)	5	40	216	.08
Planting (govt.)	3	48	145	.05
Planting (private)	14	121	1,679	.59
Irrigation	1,706	1	1,706	.60
Other	22,441	1	22,441	7.89
Financing	136,128	1	136,128	47.84
Total direct cost			284541.92	100.00
Processing	468720.00	1.00	468720	
Wholesale	737320.00	1.00	737320	
Retail	1207100.00	1.00	1207100	
Total			2697681.9	

Appendix C.1.C. Production, Exports, Imports and Consumption under the 36 Percent Penalty On Traditional Export Crops Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Exch36	Reference	Exch36	Reference	Exch36	Model	Exch36
Sugar	408,140	408,140	176,710	176,710	N.I.	N.I.	231,430	231,430
Coffee	54,836	54,835	26,102	26,102	N.I.	N.I.	28,733	38,733
Tobacco	26,136	0	26,136	0	N.I.	N.I.	---	---
Rice (*)	413,335	413,335	N.E.	N.E.	545	545	413,880	413,880
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,135	1,167	1,167	N.I.	N.I.	33,968	33,968
Peanuts (**)	8,638	8,638	N.E.	N.E.	23,392	23,392	32,029	32,029
Tomato	39,685	39,685	7,606	7,606	N.I.	N.I.	32,080	32,079
Total		1,615,494						

Note: N.E. = no export ; N.I. = no import; Exch36 = 36% penalty on traditional export crops scenario.
base model.

(*) Rice refers to polished rice.

(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.C. Seasonal Labor Use under the 36 Percent Penalty on Traditional Export Crops Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	5,176	18,730	27.63
February	3,776	18,513	20.40
March	8,475	18,795	45.09
April	6,332	18,438	34.34
May	2,579	18,373	14.03
June	1,778	18,113	9.81
July	65	18,277	.35
August	6,161	18,609	33.11
September	401	18,478	2.17
October	2,257	18,392	12.27
November	6,267	17,941	34.93
December	7,922	18,344	43.19

Appendix C.3.C. Area Harvested and Labor Use under the 36 Percent Penalty on Traditional Export Crops Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	84,848	27.00	2,291	30	68,727
Coffee	171,178	147.70	25,283	30	758,490
Tobacco	0	105.77	0	30	0
Rice	102,642	118.24	12,136	30	364,092
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,575	30	47,264
Plantain	3,784	91.29	345	30	10,363
peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,478
Total	795,060		61,991		1,859,732

Appendix C.5.C. Domestic Sales, Export and Import Values and Gross Income under the 36 Percent Penalty On Traditional Export Crops Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	231,420	1,739	402,405	176,710	1,905	336,633				739,037
Molass	24,600,000	0	11,070		0					11,070
Honey		0		1,113,100	5	5,354				5,354
Coffee	28,733	4,765	136,902	26,102	9,690	252,928				389,831
Tobacco				0	5,747	0				0
Rice	413,880	896	370,642				545	761	415	370,227
Beans	106,000	2,277	241,377		0		0			241,377
Corn	426,730	1,756	749,543		0		0			749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703				167,890
Plantain	33,968	669	22,721	1,167	1,284	1,498				24,219
Peanuts	32,029	2,334	74,861				23,392	1,904	44,538	30,322
Tomato	32,079	1,488	47,656	7,606	1,690	12,854				60,510
Total	26,061,839		2,214,363			619,971			44,954	2,789,380

Appendix C.6.C. Total Financing Costs under the 36 Percent Penalty on Traditional Export Crops Scenario.

Activity	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	50,485	.18	9,087	8.42
Coffefing	40,193	.17	6,833	6.33
Coffefinc	230	.36	83	.08
Tobafing	0	.17	0	.00
Tobafinc	0	.36	0	.00
Ricefing	201,980	.17	34,337	31.81
Ricefinc		.36	0	.00
Beanfing	25,664	.17	4,363	4.04
Beanfinc	25,601	.36	9,216	8.54
Cornfing	5,064	.17	861	.80
Cornfinc	79,387	.36	28,579	26.48
Cassfing	12,346	.17	2,099	1.94
Cassfinc	23,339	.36	8,402	7.78
Plantfing	13,320	.17	2,264	2.10
Plantfinc		.36	0	.00
peafing	1,408	.17	239	.22
peafinc	2,834	.36	1,020	.95
Tomafing	3,277	.17	557	.52
Tomafinc		.36	0	.00
Total			107,941	100.00

Appendix C.7.C. Costs of Production under the 36 Percent Penalty on Traditional Export Crops Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of total direct cost
Chemicals	110,980	1	110,980	41.22
Fertilizer	11	1,588	16,753	6.22
Plowing (govt.)	5	95	491	.18
Plowing (private)	35	191	6,596	2.45
Crossing (govt.)	20	72	1,424	.53
Crossing (private)	3	127	362	.13
Leveling(govt.)	5	127	691	.26
Harrowing (govt.)	5	40	216	.08
Planting (govt.)	3	48	145	.05
Planting (private)	14	121	1,679	.62
Irrigation	1,706	1	1,706	.63
Other	20,236	1	20,236	7.52
Financing	107,941	1	107,941	40.09
Total direct cost			269,222	100.00
Processing	396,360	1	396,360	
Wholesale	683,530	1	683,530	
Retail	1,207,100	1	1,207,100	
Total			2,556,212	

Appendix C.1.D. Production, Exports, Imports and Consumption under the Fertilizer Price Change Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	FPC	Referemce	FPC	Reference	FPC	Model	FPC
Sugar	408,140	412,000	176,700	176,710	N.I.	N.I.	231,430	235,290
Coffee	54,836	55,839	26,102	26,102	N.I.	N.I.	28,733	29,737
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I	---	---
Rice (*)	413,335	414,015	N.E.	N.E.	545	545.4	413,880	414,560
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,334	1,167	1167	N.I.	N.I.	33,968	34,167
Peanuts (**)	8,638	8,638	N.E.	N.E.	23,392	23,392	32,029	32,030
Tomato	39,685	39,690	7,606	7,606	N.I.	N.I.	32,080	32,084
Total		1,687,063						

Note: N.E. = no export ; N.I. = no import; FPC = Fertilizer price change scenario.
Reference = base model.
(*) Rice refers to polished rice.
(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.D. Seasonal Labor under the Fertilizer Price Change Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,217	18,730	33.19
February	4,467	18,513	24.13
March	9,153	18,795	48.70
April	6,987	18,438	37.89
May	2,579	18,373	14.03
June	1,778	18,113	9.82
July	65	18,277	.35
August	6,166	18,609	33.14
September	402	18,478	2.18
October	2,261	18,392	12.29
November	6,270	17,941	34.95
December	8,855	18,344	48.27

Appendix C.3.D. Area Harvested and Labor Use under the Fertilizer Price Change Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	85,650	27.00	2,313	30	69,377
Coffee	171,110	147.70	25,273	30	758,188
Tobacco	36,409	105.77	3,851	30	115,529
Rice	102,984	118.24	12,177	30	365,305
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,575	30	47,264
Plantain	3,805	91.29	347	30	10,421
peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,478
Total	832,566		65,896		1,976,880

Appendix C.4.D. Consumer Surplus Estimation under the Fertilizer Price Change Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	1,716	235,290	166,087
Coffee	11,546	4,528	29,737	104,346
Rice	6,690	886	414,560	1,203,009
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	654	34,167	42,610
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,487	32,084	71,542
Total				2,983,570

Note: to calculate consumer surplus, the following formula was used:

$CS= ½*(\delta -Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.D. Domestic Sales, Export and Import Values and Gross Income under the Fertilizer Price Change Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	235,290	1,716	403,685	176,710	2,977	526,066				929,750
Molass	24,833,000	0	11,175		0					11,175
Honey		0		1,123,600	5	5,405				5,405
Coffee	29,737	4,528	134,641	26,102	15,140	395,184				529,825
Tobacco				26,136	8,979	234,675				234,675
Rice	414,560	886	367,317				545	761	415	366,902
Beans	106,000	2,277	241,377		0		0			241,377
Corn	426,730	1,756	749,543		0		0			749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703				167,890
Plantain	34,167	654	22,357	1,167	1,284	1,498				23,855
Peanuts	32,029	2,334	74,744				23,392	1,904	44,538	30,206
Tomato	32,084	1,488	47,737	7,606	1,690	12,854				60,592
Total			2,209,762			1,186,385			44,954	3,351,194

Appendix C.6.D. Total Financing Cost under the Fertilizer Price Change Scenario.

Activity (*)	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	50,962	.18	9,173	6.73
Coffefing	40,193	.17	6,833	5.02
Coffefinc	111	.36	40	.03
Tobafing	40,224	.17	6,838	5.02
Tobafinc	59,326	.36	21,357	15.68
Ricefing	202,300	.17	34,391	25.24
Ricefinc		.36	0	.00
Beanfing	25,664	.17	4,363	3.20
Beanfinc	25,601	.36	9,216	6.76
Cornfing	5,064	.17	861	.63
Cornfinc	79,387	.36	28,579	20.98
Cassfing	12,346	.17	2,099	1.54
Cassfinc	23,339	.36	8,402	6.17
Plantfing	13,396	.17	2,277	1.67
Plantfinc		.36	0	.00
peafing	1,408	.17	239	.18
peafinc	2,834	.36	1,020	.75
Tomafing	3,227	.17	549	.40
Tomafinc		.36	0	.00
Total			136,238	100.00

Note: Finc at the end of each crop means financing at the commercial interest rate. Fing is the financing of each crop at the subsidized financing of rice at the commercial interest rate. Ricefing is the case for financing of rice at the subsidized interest rate.

Appendix C.7.D. Costs of Production under the Fertilizer Price Change Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of direct total cost
Chemicals	123,720	1	123,720	27.34
Fertilizer	114	1,366	156,087	34.49
Plowing (govt.)	5	95	491	.11
Plowing (private)	35	191	6,697	1.48
Crossing (govt.)	20	72	1,424	.31
Crossing (private)	3	127	407	.09
Leveling(govt.)	6	127	738	.16
Harrowing (govt.)	6	40	231	.05
Planting (govt.)	3	48	145	.03
Planting (private)	14	121	1,700	.38
Irrigation	1,706	1	1,706	.38
Other	22,941	1	22,941	5.07
Financing	136,238	1	136,238	30.11
Total direct cost			452,525	100.00
Processing	472,620	1	472,620	
Wholesale	741,440	1	741,440	
Retail	1,209,800	1	1,209,800	
Total			2,876,385	

Appendix C.1.E. Production, Exports, Imports and Consumption under Elimination of Government Subsidy Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Subtax	Reference	Subtax	Reference	Subtax	Reference	Subtax
Sugar	408,140	318,600	176,700	176,710	N.I.	N.I.	231,430	141,890
Coffee	54,836	55,839	26,102	26,102	N.I.	N.I.	28,733	29,737
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I	---	---
Rice (*)	413,335	405,135	N.E.	N.E.	545	545	413,880	405,680
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	157,000	5,681	0	N.I.	N.I.	157,000	157,000
Plantain	35,135	34,285	1,167	1,167	N.I.	N.I.	33,968	33,118
Peanuts (**)	8,638	8,638	N.E.	N.E.	23,392	23,392	32,029	32,030
Tomato	39,685	39,565	7,606	7,606	N.I.	N.I.	32,080	31,959
Total		1,577,928						

Note: N.E. = no export ; N.I. = no import; Subtax = Elimination of subsidies/taxes scenario.
Reference = base model.
(*) Rice refers to polished rice.
(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.E. Seasonal Labor Use under the Elimination of Government Subsidy Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,163	18,730	32.90
February	4,403	18,513	23.78
March	9,080	18,795	48.31
April	6,922	18,438	37.54
May	2,578	18,373	14.03
June	1,765	18,113	9.75
July	64	18,277	.35
August	6,094	18,609	32.75
September	40	18,478	.21
October	2,213	18,392	12.03
November	6,215	17,941	34.64
December	8,737	18,344	47.63

Appendix C.3.E. Area Harvested and Labor Use under the Elimination of Government Subsidy Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	66,232	27.00	1,788	30	53,648
Coffee	171,110	147.70	25,273	30	758,188
Tobacco	36,409	105.77	3,851	30	115,529
Rice	98,670	118.24	11,667	30	350,002
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	18,947	80.25	1,520	30	45,615
Plantain	3,692	91.29	337	30	10,111
peanuts	16,986	22.45	381	30	11,440
Tomato	1,506	165.07	249	30	7,458
Total	808,032		64,796		1,943,871

Appendix C.4.E. Consumer Surplus Estimation under the Elimination of Government Subsidy Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	2,276	141,890	60,397
Coffee	11,546	4,528	29,737	104,346
Rice	6,690	1,010	405,680	1,152,042
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	731	33,118	40,032
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,505	31,959	70,986
Total				2,823,781

Note: to calculate consumer surplus the following formula was used:

$CS= ½*(\delta -Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.E. Domestic Sales, Export and Import Values and Gross Income under the Elimination of Government Subsidy Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	141,890	2,276	322,942	176,710	2,977	526,066				849,007
Molass	19,203,000	0	8,641		0					8,641
Honey		0		868,900	5	4,179				4,179
Coffee	29,737	4,528	134,640	26,102	15,140	395,184				529,824
Tobacco				26,136	8,979	234,675				234,675
Rice	405,680	1,010	409,859				545	761	415	409,443
Beans	106,000	2,277	241,377		0		0			241,377
Corn	426,730	1,756	749,543		0		0			749,543
Cassava	157,000	1,001	157,187	0	1,884	0				157,187
Plantain	33,118	731	24,209	1,167	1,284	1,498				25,707
Peanuts	32,029	2,334	74,744				23,392	1,904	44,538	30,206
Tomato	31,959	1,505	48,087	7,606	1,690	12,854				60,941
Total	20,567,143		2,171,228			1,174,457			44,954	3,300,731

Appendix C.6.E. Total Financing under the Elimination of Government Subsidy Scenario.

Activity	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	39,408	.36	14,187	6.93
Coffefinc	41,306	.36	14,870	7.26
Tobafinc	99,550	.36	35,838	17.50
Ricefinc	198,008	.36	71,283	34.80
Beanfinc	51,265	.36	18,455	9.01
Cornfinc	84,451	.36	30,402	14.84
Cassfinc	34,439	.36	12,398	6.05
Plantfinc	12,998	.36	4,679	2.28
peafinc	4,242	.36	1,527	.75
Tomafinc	3,267	.36	1,176	.57
Total			204,816	100.00

Appendix C.7.E. Costs of Production under the Elimination of Government Subsidy Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of total direct cost
Chemicals	120,370	1	120,370	23.96
Fertilizer	104	1,366	142,226	28.32
Plowing (private)	32	191	6,045	1.20
Crossing (private)	18	127	2,346	.47
Leveling(private)	1	127	174	.03
Harrowing (private)	1	40	54	.01
Planting (private)	13	121	1,597	.32
Irrigation	1,706	1	1,706	.34
Other	22,940	1	22,940	4.57
Financing	204,816	1	204,816	40.78
Total direct cost			502,275	100.00
Processing	421,330	1	421,330	
Wholesale	654,350	1	654,350	
Retail	1,143,300	1	1,143,300	
Total			2,721,255	

Appendix C.1.F. Production, Exports, Imports and Consumption under the Elimination of Sugar Quota Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Noquota	Reference	Noquota	Reference	Noquota	Reference	Noquota
Sugar	408,140	231,430	176,700	0	N.I.	N.I.	231,430	231,430
Coffee	54,836	54,835	26,102	26,102	N.I.	N.I.	28,733	28,733
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I.	---	---
Rice (*)	413,335	413,335	N.E.	N.E.	545	545	413,880	413,880
Beans	106,000	106,000	N.E.	N.E	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,135	1,167	1,167	N.I.	N.I.	33,968	33,968
Peanuts (**)	8,638	8,637	N.E.	N.E.	23,392	23,392	32,029	32,029
Tomato	39,685	39,685	7,606	7,606	N.I.	N.I.	32,080	32,079
Total		1,504,604						

Note: N.E. = no export ; N.I. = no import; Noquota = Elimination of the sugar quota scenario.
(*) Rice refers to polished rice.
(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.F. Seasonal Labor Use under the Elimination of Sugar Quota Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,090	18,730	32.51
February	4,340	18,513	23.44
March	9,026	18,795	48.02
April	6,859	18,438	37.20
May	2,579	18,373	14.03
June	1,778	18,113	9.81
July	65	18,277	.35
August	6,161	18,609	33.11
September	401	18,478	2.17
October	2,257	18,392	12.27
November	6,168	17,941	34.38
December	8,722	18,344	47.55

Appendix C.3.F. Area Harvested and Labor Use under the Elimination of Sugar Quota Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	48,112	27.00	1,299	30	38,971
Coffee	171,178	147.70	25,283	30	758,490
Tobacco	36,409	105.77	3,851	30	115,529
Rice	102,642	118.24	12,136	30	364,092
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,575	30	47,264
Plantain	3,784	91.29	345	30	10,363
peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,478
Total	840,736		64,850		1,945,506

Appendix C.4.F. Consumer Surplus Estimation under the Elimination of Sugar Quota Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	1,739	231,430	160,682
Coffee	11,546	4,765	28,733	97,420
Rice	6,690	896	413,880	1,199,072
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	669	33,968	42,114
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,488	32,079	71,522
Total				2,966,787

Note: To calculate consumer surplus, the following formula was used:

$CS= ½*(\delta -Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.F. Domestic Sales, Export and Import Values and Gross Income under the Elimination of Sugar Quota Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-				-7-
Sugar	231,430	1,739	402,422	0	2,977	0	0	0	0	402,422
Molass	13,949,000	0	6,277	0	0	0	0	0	0	6,277
Honey		0		631,180	5	3,036	0	0	0	3,036
Coffee	28,733	4,765	136,902	26,102	15,140	395,184	0	0	0	532,087
Tobacco				26,136	8,979	234,675	0	0	0	234,675
Rice	413,880	896	370,642	0	0	0	545	761	415	370,227
Beans	106,000	2,277	241,377	0	0	0	0	0	0	241,377
Corn	426,730	1,756	749,543	0	0	0	0	0	0	749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703				167,890
Plantain	33,968	669	22,721	1,167	1,284	1,498				24,219
Peanuts	32,029	2,334	74,744	0	0	0	23,392	1,904	44,538	30,206
Tomato	32,079	1,488	47,730	7,606	1,690	12,854				60,584
Total	15,410,839		2,209,545			1,184,017			44,954	2,822,542

Appendix C.6.F. Total Financing Costs under the Elimination of Sugar Quota Scenario.

Activity (*)	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	28,627	.18	5,153	3.90
Coffefing	40,193	.17	6,833	5.17
Coffefinc	230	.36	83	.06
Tobafing	40,224	.17	6,838	5.17
Tobafinc	59,326	.36	21,357	16.16
Ricefing	201,980	.17	34,337	25.97
Ricefinc		.36	0	.00
Beanfing	25,664	.17	4,363	3.30
Beanfinc	25,601	.36	9,216	6.97
Cornfing	5,064	.17	861	.65
Cornfinc	79,387	.36	28,579	21.62
Cassfing	12,346	.17	2,099	1.59
Cassfinc	23,339	.36	8,402	6.36
Plantfing	13,320	.17	2,264	1.71
Plantfinc		.36	0	.00
peafing	1,408	.17	239	.18
peafinc	2,834	.36	1,020	.77
Tomafing	3,277	.17	557	.42
Tomafinc		.36	0	.00
Total			132,202	100.00

Appendix C.7.F. Costs of Production under the Elimination of Sugar Quota Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of total direct cost
Chemicals	119,620	1	123,530	26.25
Fertilizer	94	1,588	179,126	38.06
Plowing (govt.)	5	95	491	.10
Plowing (private)	27	191	6,596	1.40
Crossing (govt.)	20	72	1,424	.30
Crossing (private)	3	127	362	.08
Leveling(govt.)	5	127	691	.15
Harrowing (govt.)	5	40	216	.05
Planting (govt.)	3	48	145	.03
Planting (private)	7	121	1,679	.36
Irrigation	1,706	1	1,706	.36
Other	22,441	1	22,441	4.77
Financing	132,202	1	132,202	28.09
Total direct cost			470,611	100.00
Processing	374,910	1	468,720	
Wholesale	562,450	1	737,320	
Retail	1,091,500	1	1,207,100	
Total			2,883,751	

Appendix C.1.G. Production, Exports, Imports and Consumption under the Increase in Sugar Quota Scenario.

	Production (MT)		Exports (MT)		Imports (MT)		Consumption (MT)	
Activity	Reference	Quotaup	Reference	Quotaup	Reference	Quotaup	Model	Quotaup
Sugar	408,140	739,600	176,700	508,170	N.I.	N.I.	231,430	231,430
Coffee	54,836	54,835	26,102	26,102	N.I.	N.I.	28,733	28,733
Tobacco	26,136	26,136	26,136	26,136	N.I.	N.I.	---	---
Rice (*)	413,335	413,335	N.E.	N.E.	545	545	413,880	413,880
Beans	106,000	106,000	N.E.	N.E.	.00	0	106,000	106,000
Corn	426,730	426,730	N.E.	N.E.	.00	0	426,730	426,730
Cassava	162,681	162,681	5,681	5,681	N.I.	N.I.	157,000	157,000
Plantain	35,135	35,135	1,167	1,167	N.I.	N.I.	33,968	33,968
Peanuts (**)	8,638	8,637	N.E.	N.E.	23,392	23,392	32,029	32,029
Tomato	39,685	39,685	7,606	7,606	N.I.	N.I.	32,080	32,079
Total		2,012,774						

Note: N.E. = no export ; N.I. = no import; Quotaup = Increase in sugar quota scenario.
base model.

(*) Rice refers to polished rice.

(**) peanuts are expressed in peanut oil equivalent.

Appendix C.2.G. Seasonal Labor Use under the Increase in Sugar Quota Scenario.

Month	Labor use (000 Man/Day)	Total labor available (000 Man/Day)	Percent of total labor available
January	6,375	18,730	34.03
February	4,625	18,513	24.98
March	9,311	18,795	49.54
April	7,145	18,438	38.75
May	2,579	18,373	14.03
June	1,778	18,113	9.81
July	65	18,277	.35
August	6,161	18,609	33.11
September	401	18,478	2.17
October	2,257	18,392	12.27
November	6,453	17,941	35.97
December	9,008	18,344	49.10

Appendix C.3.G. Area Harvested and Labor Used under the Increase in Sugar Quota Scenario.

Activity	Area harvested (Ha)	Labor use per hectare (Man/day)	Total labor used (000 Man/day)	Wage (DR$/day)	Total wage (DR$000)
Sugar	153,750	27.00	4,151	30	124,538
Coffee	171,178	147.70	25,283	30	758,490
Tobacco	36,409	105.77	3,851	30	115,529
Rice	102,642	118.24	12,136	30	364,092
Beans	121,670	74.08	9,013	30	270,399
Corn	272,810	39.28	10,716	30	321,479
Cassava	19,632	80.25	1,575	30	47,264
Plantain	3,784	91.29	345	30	10,363
peanuts	16,986	22.45	381	30	11,440
Tomato	1,510	165.07	249	30	7,478
Total	900,371		67,702		2,031,072

Appendix C.4.G. Consumer Surplus Estimation under the Increase in Sugar Quota Scenario.

Activity	Intercept	Equilibrium price (DR$/MT)	Equilibrium quantity (MT)	Consumer Surplus (DR$000)
Sugar	3,127	1,739	231,430	160,682
Coffee	11,546	4,765	28,733	97,420
Rice	6,690	896	413,880	1,199,072
Beans	17,647	2,277	106,000	814,627
Corn	3,463	1,756	426,730	364,197
Cassava	3,042	1,001	157,000	160,217
Plantain	3,149	669	33,968	42,114
peanuts	5,889	2,334	32,029	56,936
Tomato	5,947	1,488	32,079	71,522
Total				2,966,787

Note: To calculate consumer surplus the following formula was used:

$CS = ½*(\delta - Pe)*Qe$

where:

δ = demand intercept for crops i.

Pe = equilibrium price for crop i

Qe = equilibrium quantity for crop i.

Appendix C.5.G. Domestic Sales, Export and Import Values and Gross Income under the Increase in Sugar Quota Scenario.

Activity	Domestic sales (MT)	Price (DR$/MT)	Value of Domestic sales (DR$000)	Export quantity (MT)	Export price (DR$/MT)	Export earning (DR$000)	Import quantity (MT)	Import price (DR$/MT)	Import cost (DR$000)	Gross Income (DR$000)
	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
Sugar	231,430	1,739	402,422	508,170	2,977	1,512,822	0	0	0	1,915,244
Molass	44,578,000	0	20,060	0	0		0	0	0	20,060
Honey		0		2,017,100	5	9,702	0	0	0	9,702
Coffee	28,733	4,765	136,902	26,102	15,140	395,184	0	0	0	532,087
Tobacco				26,136	8,979	234,675	0	0	0	234,675
Rice	413,880	896	370,642	0	0	0	545	761	415	370,227
Beans	106,000	2,277	241,377	0	0	0	0	0	0	241,377
Corn	426,730	1,756	749,543	0	0	0	0	0	0	749,543
Cassava	157,000	1,001	157,187	5,681	1,884	10,703	0	0	0	167,890
Plantain	33,968	669	22,721	1,167	1,284	1,498	0	0	0	24,219
Peanuts	32,029	2,334	74,861	0			23,392	1,904	44,538	30,322
Tomato	32,079	1,488	47,656	7,606	1,690	12,854				60,510
Total	46,039,839		4,446,723			2,177,439			44,954	4,355,856

Appendix C.6.G. Total Financing under the Increase in Sugar Quota Scenario.

Activity	Total Financing (DR$000)	Interest rate (DR$)	Interest charges (DR$000)	Percent of total financing cost
Canefinc	91,484	.18	16,467	11.47
Coffefing	40,193	.17	6,833	4.76
Coffefinc	230	.36	83	.06
Tobafing	40,224	.17	6,838	4.76
Tobafinc	59,326	.36	21,357	14.88
Ricefing	201,980	.17	34,337	23.93
Ricefinc		.36	0	.00
Beanfing	25,664	.17	4,363	3.04
Beanfinc	25,601	.36	9,216	6.42
Cornfing	5,064	.17	861	.60
Cornfinc	79,387	.36	28,579	19.91
Cassfing	12,346	.17	2,099	1.46
Cassfinc	23,339	.36	8,402	5.85
Plantfing	13,320	.17	2,264	1.58
Plantfinc		.36	0	.00
peafing	1,408	.17	239	.17
peafinc	2,834	.36	1,020	.71
Tomafing	3,277	.17	557	.39
Tomafinc		.36	0	.00
Total			143,516	100.00

Appendix C.7.G. Costs of Production under the Increase in Sugar Quota Scenario.

Activity	Total units (000)	Unit Value (DR$)	Total cost (DR$000)	Percent of direct total cost
Chemicals	130,880	1	123,530	25.63
Fertilizer	147	1,588	179,126	37.17
Plowing (govt.)	5	95	491	.10
Plowing (private)	48	191	6,596	1.37
Crossing (govt.)	20	72	1,424	.30
Crossing (private)	3	127	362	.08
Leveling(govt.)	5	127	691	.14
Harrowing (govt.)	5	40	216	.04
Planting (govt.)	3	48	145	.03
Planting (private)	28	121	1,679	.35
Irrigation	1,706	1	1,706	.35
Other	22,441	1	22,441	4.66
Financing	143,516	1	143,516	29.78
Total direct cost			481,925	100.00
Processing	644,700	1	468,720	
Wholesale	1,065,300	1	737,320	
Retail	1,424,100	1	1,207,100	
Total			2,895,065	

Vita

Jesus Antonio De Los Santos was born in Azua, The Dominican Republic on the 10th of June of 1958. He attended primary school and high school at the Roman Baldorioti de Castro high school in Azua.

He earned a bachelor degree in agricultural economics from the Universidad Catolica Madre y Maestra/Instituto Superior de Agricultura in Santiago, The Dominican Republic. Upon graduation he received a scholarship to pursue master studies at Texas A&M, U.S.A. from where he graduated in December of 1982.

From 1983-1986 he occupied several positions at the Instituto Superior de Agricultura including instructor, Dean of study for the high school diploma program and Interim coordinator of the Center for Rural Development Administration (CADER). He also taught at the Universidad Catolica Madre y Maestra and the Universidad Technologica de Santiago, The Dominican Republic.

In 1986, he received a scholarship to pursue PhD studies in agricultural economics at Virginia Polytechnic Institute and State University, U.S.A. He received his PhD in 1990.

Mr. De Los Santos is married to Maritza Pena and has a son.