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Evaluation of the St. Lucia Geothermal Resource

Macroeconomic Models

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CONTENTS

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by

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ABSTRACT

A macroeconometric model describing the St. Lucian economy was developed using 1970 to 1982 economic data. It comprises 32 equations estimated by ordinary least squares that describe consumption, production, foreign trade, and investment and close the model. The level of government spending is exogenous. The model illuminates the key variables that influence the level of output in St. Lucia and it can be used for short-term forecasts.

The results of macroeconometric forecasts for the period 1983 through 1985 show an increase in gross domestic product (GDP) for 1983 and 1984 with a decline in 1985. The rate of population growth is expected to exceed GDP growth so that a small decline in per capita GDP will occur. We forecast that garment exports will increase, providing needed employment and foreign exchange.

To obtain a longer-term but more general outlook on St. Lucia's economy, and to evaluate the benefit of geothermal energy development, we applied a nonlinear programming model. The model maximizes discounted cumulative consumption.

For the next 30 years, results show a 3% per year increase in GNP that is relatively insensitive to whether geothermal energy is installed or whether the price of oil increases by as much as 2% per year. If geothermal energy is installed, discounted cumulative consumption is increased by 2% to 4% and annual consumption by 3% to 9% by 2012, depending on the price of oil. In addition, installation of geothermal capacity markedly decreases energy costs and the demand for imported petroleum. With geothermal, energy costs as a percentage of GNP are decreased, thus leaving more funds to be spent for consumption and investment.

I. MACROECONOMETRIC MODEL

The Construction of Macroeconometric Models in the Context of Developing Countries

The modeling of macroeconomic activity is based upon the idea of a circular flow of goods and services through an economy. In the most simple form of the circular flow, households provide resources in the form of labor and capital and firms utilize these resources to produce goods. The rents and wages paid the households for their resources are then used to purchase the goods produced by the firms. This simple model can be made more complex by adding a credit market, government purchases, or international trade (Figure 1).

The economic analysis portion of the report is centered on a discussion of the methodology used and the analysis of the unique situation posed by the St. Lucian economy. The macroeconometric model was developed for short-run analysis,and the nonlinear optimizing model was used to evaluate energy-economy interactions in the long run.

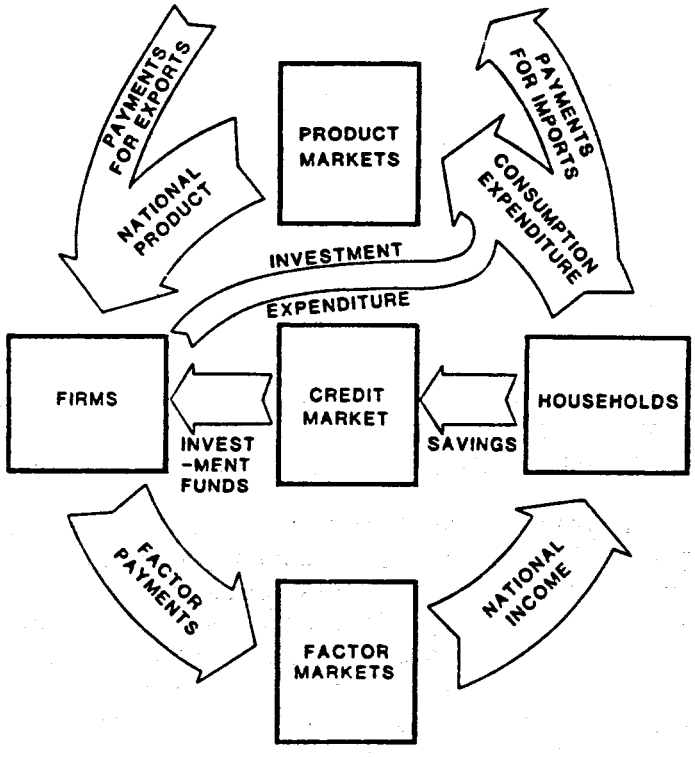

Fig. 1. Circular flow of payments in an economy.

We begin with a summary of the models' findings. The next sections detail: the focus of a short-term macroeconometric model approach for developing countries; followed by the model structure and the necessary data to support the model. The short-term model section concludes with results and forecasts of the model. The last section comprises appendices that detail the model code, and describe the data base developed for the Government of St. Lucia.

A. Summary of Model Findings

Short-term Macroeconometric Model. We see the St. Lucian economy growing slowly through 1984. The growth in the post-84 period is reversed due to declines in banana exports as a result of the approximate 5-year banana production cycle (planting mats, maturation, followed by yield declines). This, coupled with increases in the population and a somewhat restricted growth in employment, results in lowered per capita disposable incomes. On the positive side, increased exports of garments will provide more employment and foreign exchange. The forecast increase in re-exports is questionable due to the lack of solid information about the sector.

B. The Construction of Macroeconometric Models in The Context of Developing Countries

The construction of large-scale macroeconometric models in developed countries has been an on-going process for nearly two decades. However, the transfer of these techniques and projects to developing countries has occurred in the relatively recent past. The reasons for the delay in transfer are fairly obvious: a lack of sufficient or disaggregated time-series data, lack of computing facilities, and finally a shortage of well-trained applied econometricians in one location to sustain an effort of this sort.

To be useful and usable in a developing country, macroeconometric models should fulfill certain requirements. Size and computing facilities, once prime considerations, are no longer limiting factors due to the profusion of microcomputers and software. Thus, models should be designed to take advantage of this new technology. However, the size of the model is now limited by data availability rather than computing facilities. In all probability, data do not exist in detailed enough form to support a large multisector model. Further, the data that do exist may only support forecasts for a relatively short period. A rule of thumb is the forecast period should not exceed one-fourth the length of the time series used in model construction.

The application of models or paradigms of developed countries to developing countries is value-laden and can result in misapplication of economic tools. In most developing countries,demand exists but supply is either slow or unable to respond to changes in demand or quantity demanded. Thus, the application of Keynesian demand-oriented models to a developing country is an emphasis on the wrong component.

The focus in developing countries should be on the producing sectors. In most cases,we see traditional agriculture as the leading or dominant sector. Its linkages are to agricultural employment and the earning of foreign exchange through exports of the primary commodities. Other producing sectors of varying degrees of importance reflect a country's orientation towards a developing manufacturing sector or a tourism and associated services sector.

Capital markets in developing countries are generally embryonic and themselves a potential contributor/cause of underdevelopment. In most developing countries, the capital markets consist of a few large commercial banks which are more suited to providing short-term operating funds rather than longer-term investment. Thus, capital markets should be examined in the context of the intended application of the proposed model.[1]

There are still other structural characteristics desirable for a model of a developing country. The foreign sector, for example, plays an important role in such an economy. Given the emphasis on supply, exports cannot be considered as merely foreign demand of domestic goods. For exports to materialize, production must first take place.

C. Discussion of the St. Lucia Short-Term Policy Model

C.1. Model Overview. The econometric model presented in this report contains 28 equations and was constructed specifically as linear in both parameters and variables. Moreover, it is a completely "real model" in that there is no consideration given to the monetary sector and consequently no consideration given to the determination of prices and wages. All dollar values are expressed as real 1977 Eastern Caribbean dollars. The monetary and price sectors and government expenditures were excluded from the model because of the difficulty in modeling the structural change of the recent past. The present model structure is such that government expenditure is an exogenous variable and may be changed by the analysts.

The model consists of 28 equations, 21 behavorial and 7 definitional, and is based on the national income accounting identity:

$$Y = C + I + G + (X - M), \tag{1}$$

where

Y = National income,

C = Consumption expenditure,

I = Investment expenditure,

G = Government expenditure,

X = Exports, and

M = Imports.

In general terms, the construction of a macroeconometric model involves the establishment of a system of national income accounting identities appropriate to the model builders' needs. The model builders must then determine which economic variables are to be explained and forecasted by the system (endogenous variables) and those that are to be determined outside the model (predetermined variables).

The model presented here, following Wold,[2,3] is structured and solved recursively. This approach was selected because the periodicity of the data is annual; thus, an instantaneous reaction of the different markets to supply or demand is not captured. Further, the thrust of the project was to aim the explanation in the sense of stimulus-response relationships. A flow chart of the model is presented in Figure 2, and a listing of the equations is in Appendix A. The following section deals with the data and sources and presents the estimated equations of the model.

C.2. Data. In an econometric model, the ability to accurately estimate a desired parameter increases as the number of observations increase. Also, as the number of observations increases, forecasts farther into the future are made possible. For a country of its level of development, St. Lucia possesses a good economic data base. Most variables required in our equations have been reported since at least 1970 on an annual basis. (Quarterly data for most variables are not available.) The year 1970 was chosen as the starting point of the model since data on key variables, such as gross domestic product (GDP) by sector do not go back farther than 1970. The time period of the model is thus 1970 through 1982. With the computerized data base and model framework given to St.

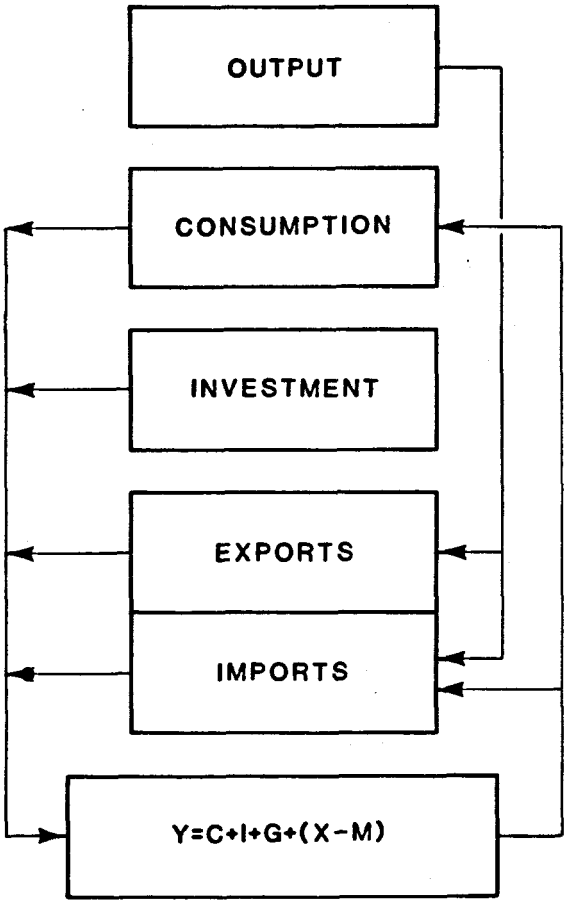

Fig. 2. Flow chart of the St. Lucia short-term econometric policy model.

Lucia and with the personal computer loaned to them,it is expected that the number of observations and, hence, the refinement of the model will grow. The economic statistics that have been computerized are tabulated in Appendix B.

With a few important exceptions that will be noted later, the main sources of data are the Annual Statistical Digest[4] and the National Accounts, 1977-1982[5] published by the Government of St. Lucia. In order to remove the effects of inflation and to explain the real changes that have taken place in the St. Lucian economy, all data were transformed to 1977 real dollars – the standard measure chosen in the National Accounts. For 1970 through 1976, the consumer price index for all items, normalized to 1977, was used as the deflator because a GDP-deflator was not reported for this period; a deflator derived directly from the National Accounts was used for 1977-1982. The CPI for all

items and the GDP deflator for 1977 through 1982 are very similar in value so we do not feel that we have introduced inconsistency into the data by using two different types of deflators.

The most serious problem encountered in building the economic data base was the sparseness of annual data on population and employment. The 1970 census, and estimates for 1979 and 1982 reported in the St. Lucia Economic Review (1982) were the main sources of data. The 1971 through 1978 data were generally interpolated using a compound growth rate calculated between the 1970 and 1979 data points. For a few variables in the population data base, such as agricultural labor, service labor, and government labor, additional data or information was available to refine the estimates.

The value of GDP by sector for 1975 through 1982 has been tabulated and reported by the government in either the 1981 Annual Statistical Digest or the National Accounts. For the period 1970 through 1973 no government estimates have been published for GDP by sector. GDP is an important variable that is used in several of the equations. In order to maximize the number of observations in the model, we relied upon figures in The Commonwealth Caribbean[6] for GDP by sector. Data for 1974 is interpolated. In general, the rate of growth from 1970 through 1973 is consistent with that exhibited by the 1975 through 1982 data. Thus, we do not feel that we have compromised the accuracy of the early data by reliance upon a nongovernment source.

Two other problems were encountered in construction of the economic data base. Consumption data are not directly reported. With the exception of food that is produced and consumed domestically, it was assumed that annual consumption of most goods equalled annual imports of those goods. Given the nature of the St. Lucian economy, this assumption is quite reasonable for the time period considered. As development of the manufacturing sector progresses, it is of course expected that the amount of import substitution will increase.

The last problem concerns investment data. Like consumption, investment was not directly reported for the 1970 through 1976 period. A similar approach to that used for consumption was tried - investment was assumed to equal imports of durables such as electrical machinery, farm equipment, etc., plus the GDP from construction to represent investment in buildings. However, when investment data constructed by this method was compared to investment data reported in the National Accounts, it was clear that our estimates of 1970 through 1976 data

were far too low. Therefore, we used only six observations (1977 through 1982) in our estimates of investment.

In concluding the discussion of data sources, we emphasize that, in general, the accuracy and availability of data are quite good. In an open economy such as St. Lucia's, the availability of good foreign trade data has been especially useful. The main data problems and their solutions have been described above. For a more detailed description of the computerized data and the data sources, the reader is referred to Appendix B.

D. Model Specifications

Each component in Figure 1 is represented by a set of behavorial equations estimated by Ordinary Least Squares. In the following section, each component block of equations is discussed and individual equations are presented along with a graph of the actual and fitted values. In all cases in the graphs, the solid line represents the actual value and the dashed line represents the fitted value. The ordinate (Y-axis) is expressed in millions of 1977 EC$.

D.1. Output (GDP). (Refer to Tables I-V and Figures 3-6.) In most macroeconometric models, the general form of the output equations is that of an aggregate production function where output is dependent upon capital and labor. Disaggregated data on investment for the various sectors of the economy were not available; thus, the equations that appear are not production functions in the strictest sense of the term; rather, they are equations that predict dollar value of output for various output groups.

Only in the services sector where we used real investment in vehicles (imported value) does the equation resemble a production function. Output in the tourism sector is dependent upon the number of tourist arrivals while output in the industrial sector was found to be a function of labor employed. Imported capital equipment was tried as an explanatory variable but was insignificant.

The agricultural sector is an important contributor to the St. Lucian economy. Initial investigations indicated nominal output to be related to the unemployment rate. The final equation related output to lagged average output per worker and lagged depreciated investment in terms of imported implements, fertilizer, and agricultural chemicals. Both variables are highly significant.

D.2. Private Personal Consumption Expenditure (PCE). (Refer to Tables VI-X and Figures 7-10.) Equations in this block exhibit the general characteristics of demand equations; income, population, and relative prices are the significant variables. A classic example is consumption of food and beverages.

TABLE I

REGRESSION AND VARIABLE VALUES FOR
OUTPUT: SERVICES

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RGDPSRV

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
@C	0	20655	4978.5	4.1488
SRVLAB	0	4.6045	.63616	7.2379
D72	0	9166.8	2296.3	3.992
RINVVEH	0	1.3493	.30639	4.4037

R-SQUARE = .93489
R-SQUARE (CORRECTED) = .91318
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 1.3128
SUM OF SQUARED RESIDUALS = 40527902

STD ERROR OF REGRESSION = 2122.1

YEAR	RGDPSRV	SRVLAB	D72	RINVVEH
1970	62020	7282	0	4475.9
1971	67634	7408	0	8494.1
1972	69172	7451	1	3737.1
1973	55520	7359	0	2901.1
1974	54067	7279	0	2031.8
1975	60221	7693	0	2720.2
1976	65144	8268	0	2039.9
1977	65900	8762	0	3410.7
1978	73800	9295	0	8194.1
1979	74100	9738	0	6806.4
1980	73600	9816	0	7054.2
1981	75100	9884	0	5960.2
1982	73100	9943	0	4716.3

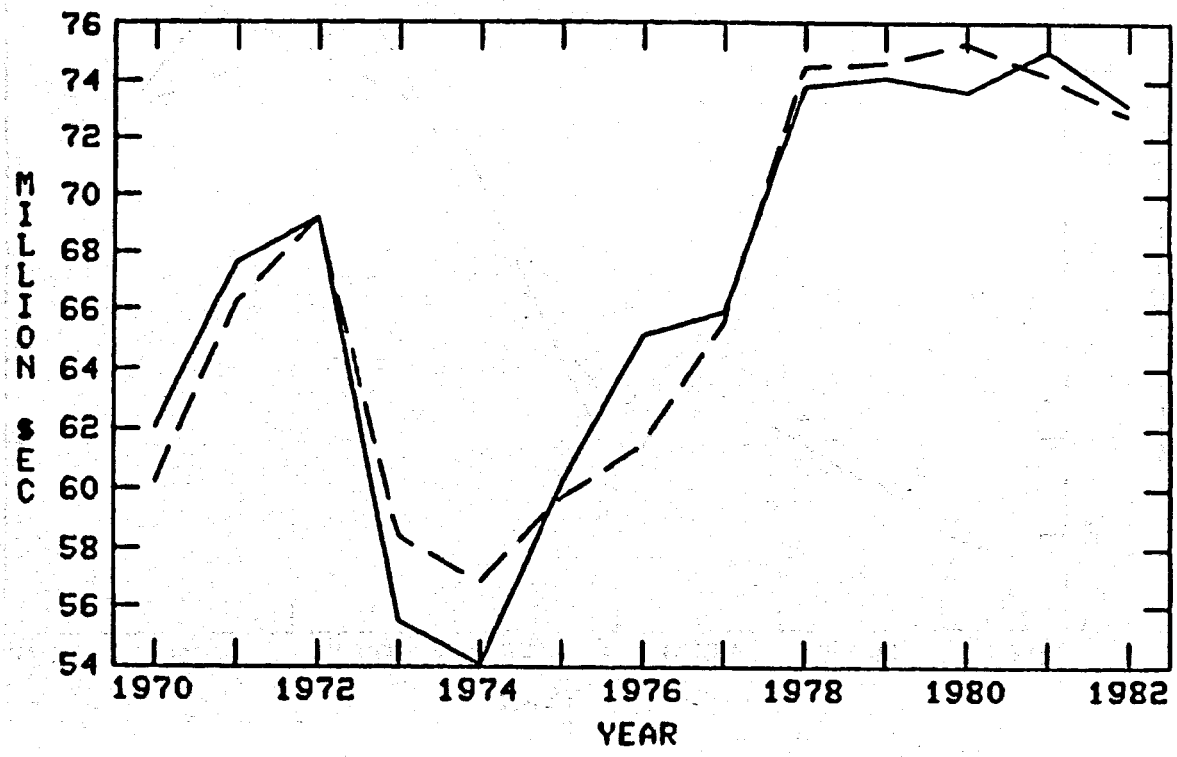

Fig. 3. Comparison of actual and fitted time series for Output: Services.

TABLE II

REGRESSION AND VARIABLE VALUES FOR
OUTPUT: TOURISM

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RGDPTOU

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-9541	1159.7	-8.2274
TARRIVE	0	.21369	.014158	15.093

R-SQUARE = .95304
R-SQUARE (CORRECTED) = .94975
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 1.6797
SUM OF SQUARED RESIDUALS = 10850467

STD ERROR OF REGRESSION = 993.18

YEAR	RGDPTOU	TARRIVE
1970	1432	45902
1971	2008	51888
1972	3177	61284
1973	4176	67678
1974	5306	73820
1975	3239	66278
1976	6851.5	75885
1977	10700	89488
1978	11600	105473
1979	12500	102417
1980	13300	99450
1981	11100	96569
1982	11600	98181

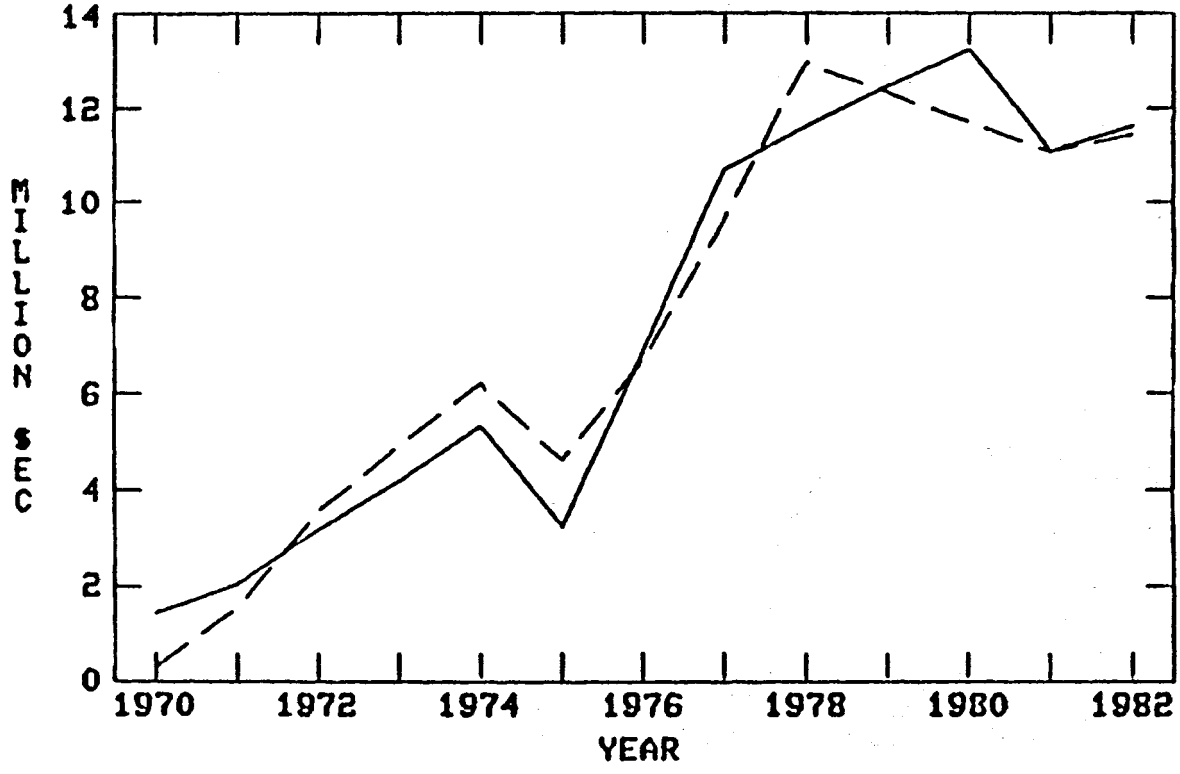

Fig. 4. Comparison of actual and fitted time series for Output: Tourism.

TABLE III

REGRESSION AND VARIABLE VALUES FOR
OUTPUT: INDUSTRIAL

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RGDPIND

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-10874	1800.2	-6.0408
MFGLAB	0	6.7994	.50956	13.344

R-SQUARE = .94182
R-SQUARE (CORRECTED) = .93653
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 1.1261
SUM OF SQUARED RESIDUALS = 24740801

STD ERROR OF REGRESSION = 1499.7

YEAR	RGDPIND	MFGLAB
1970	6091.4	2171
1971	6309.9	2343
1972	5581.8	2529
1973	5003.5	2729
1974	7009.3	2945
1975	10677	3179
1976	13486	3431
1977	15000	3703
1978	17000	3996
1979	16800	4313
1980	19700	4380
1981	19200	4448
1982	20600	4517

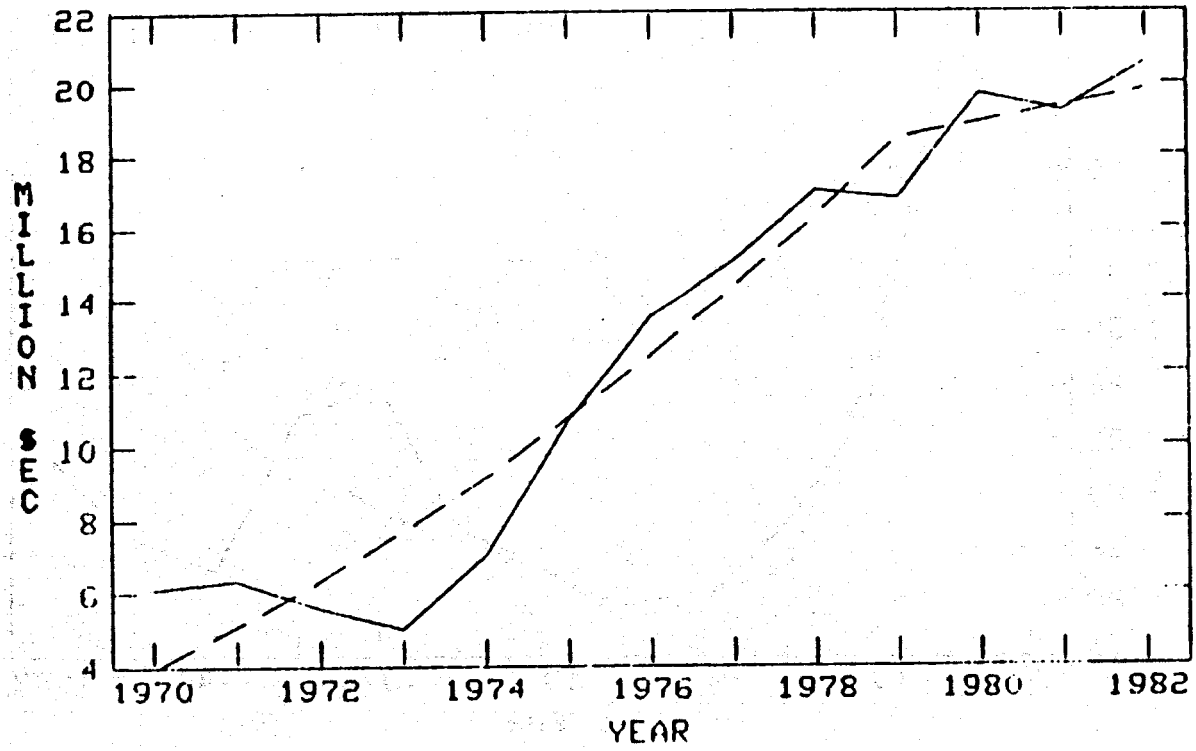

Fig. 5. Comparison of actual and fitted time series for Output: Industrial.

TABLE IV

REGRESSION AND VARIABLE VALUES FOR
OUTPUT: AGRICULTURAL

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RGDPAGR

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
ROUTUKR	1	6059.3	558.33	10.853
RCUMAGIN	1	1.8592	.24412	7.616
D71	0	16268	2795	5.8202

R-SQUARE = .87823
R-SQUARED (COMPUTED ABOUT ZERO) = .99411
R-SQUARE (CORRECTED) = .9928
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 1.832
SUM OF SQUARED RESIDUALS = 45908017

STD ERROR OF REGRESSION = 2258.5

YEAR	RGDPAGR	ROUTUKR	RCUMAGIN	D71
****	*******	*******	********	***
1970	37310	3.5717	1732.8	0
1971	41131	3.9925	2259.1	1
1972	27050	2.6619	2709.5	0
1973	22947	2.2894	3550	0
1974	20066	2.0299	4093	0
1975	19314	1.9809	4958.5	0
1976	21425	2.0694	5302.4	0
1977	22700	2.065	5835	0
1978	28000	2.3985	5994.2	0
1979	26900	2.1701	6482.7	0
1980	21200	1.6845	7156.1	0
1981	22400	1.753	7911	0
1982	25200	1.9425	8082.7	0

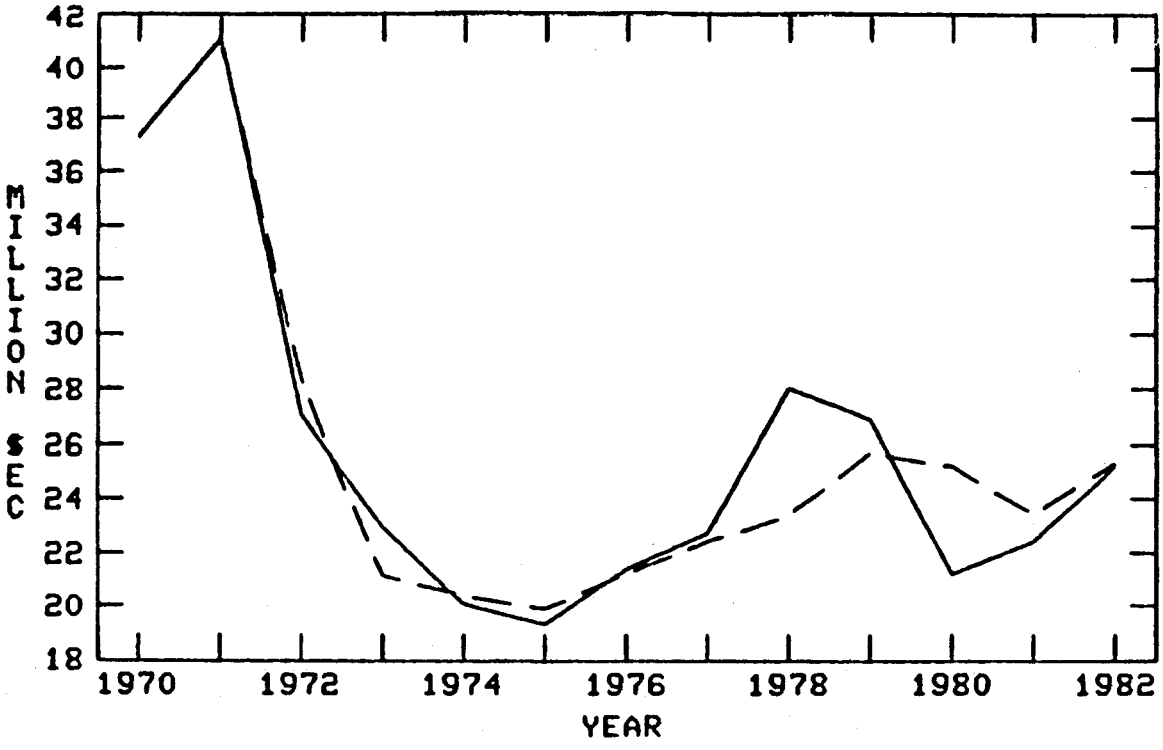

Fig. 6. Comparison of actual and fitted time series for Output: Agricultural.

TABLE V

DEFINITIONS FOR OUTPUT VARIABLES

RGDPSRV = real gross domestic product (GDP) from the service sector. For 1970-1973, this includes the following: transportation, distribution, finance, services and professional, rent of dwellings, and miscellaneous services. The 1974 datum is estimated. For 1975-1982, RGDPSRV is the sum of RGDP from electricity and water, wholesale and retail trade, transport and communications, banking, insurance, real estate, miscellaneous or "other" services, and imputed bank services (a negative value).

RGDPTOU = real GDP from the tourism sector. This was equated to RGDP from hotels and restaurants.

RGDPIND = real GDP from the mining and manufacturing sectors.

RGDPAGR = real GDP from the agricultural sector.

The sources for gross domestic product data are:

1970-1973 = Table SA2.11 in the Commonwealth of the Caribbean, World Bank.
1974 = constructed by computing the percentage increase from 1973 to 1975.
1975-1976 = Table 55 in the 1981 Annual Statistical Digest.
1977-1982 = Table 3, "Gross Domestic Product at Factor Cost by Kind of Activity: At Current Prices," and Table 7, "Gross Domestic Product at Factor Cost by Kind of Activity: At 1977 Prices," in St. Lucia's National Accounts 1977-1982.

SRVLAB = number of people employed in the services industry. This includes electricity and commerce, transport, and services (as reported in Ref. Nos. 1 and 5) but does not include people employed in tourism or by the government.

RINVVEH = real investment in vehicles. It is imports of vehicles minus private autos (PCECAR). Data for deflated imports of motor vehicles are from the table, "Imports of Selected Commodities," in the 1976 and 1982 Annual Statistical Digests. Imports of cars are from Table 15, "Preliminary Summary Tables of External Trade," 1980 and 1982.

MFGLAB = number of people employed in mining and manufacturing.

ROUTWKR = real gross domestic product from the agricultural sector divided by agricultural labor.

RCUMAGIN = cumulative sum of agricultural investment depreciated by 10% per year.

TARRIVE = number of total tourist arrivals from the tables "Passenger Arrivals and Departures by Air and Sea...," in the 1972, 1976, and 1982 Annual Statistical Digests. Data were not reported for 1979 and 1980 and had to be estimated.

TABLE VI

REGRESSION AND VARIABLE VALUES FOR
CONSUMPTION: FOOD & BEVERAGE

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RPCEFBV

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	7457.6	4815.7	1.5486
TARRIVE	0	.23748	.038988	6.0911
RPDY	1	.10831	.037319	2.9021

R-SQUARE = .87897
R-SQUARE (CORRECTED) = .85208
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 2.398
SUM OF SQUARED RESIDUALS = 44572700

STD ERROR OF REGRESSION = 2225.4

YEAR	RPCEFBV	TARRIVE	RPDY
1970	32647	45902	137366
1971	36278	51888	143499
1972	35815	61284	127307
1973	35953	67678	101614
1974	35492	73820	98623
1975	35268	66278	104910
1976	36606	75885	119128
1977	40662	89488	123292
1978	46730	105473	140281
1979	44517	102417	149261
1980	47194	99450	147319
1981	51316	96569	151202
1982	45589	98181	153629

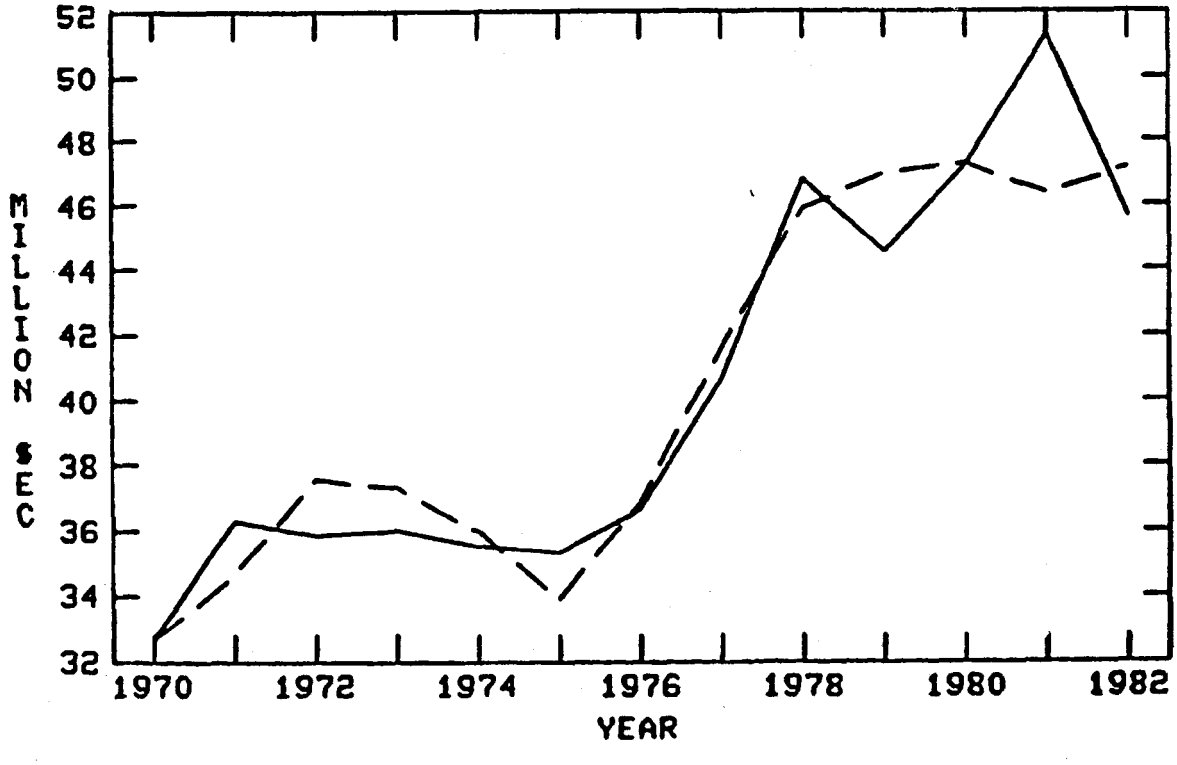

Fig. 7. Comparison of actual and fitted time series for Consumption: Food & Beverage.

TABLE VII

REGRESSION AND VARIABLE VALUES FOR
CONSUMPTION: FUEL & LIGHT

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RPCEFLI

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-8737.9	701.22	-12.461
POP	0	.11036	.0082166	13.431
D7982	0	661.42	104.13	6.3515
FLRATIO	0	-1208.4	343.88	-3.514

R-SQUARE = .98452
R-SQUARE (CORRECTED) = .97936
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 2.469
SUM OF SQUARED RESIDUALS = 121463

STD ERROR OF REGRESSION = 116.17

YEAR	RPCEFLI	POP	D7982	FLRATIO
1970	1312.6	100893	0	.83297
1971	1665.7	102908	0	.80255
1972	2051.7	104962	0	.75509
1973	2204.7	107058	0	.69509
1974	2361.8	109196	0	.86572
1975	2392.2	111376	0	.77008
1976	2863.1	113600	0	.82625
1977	3002.6	115500	0	.87586
1978	3018.2	117500	0	1.105
1979	3592.7	118400	1	1.1268
1980	2942.5	120300	0	1.2263
1981	3387.9	122200	0	1.1146
1982	4258.8	124000	1	1.1465

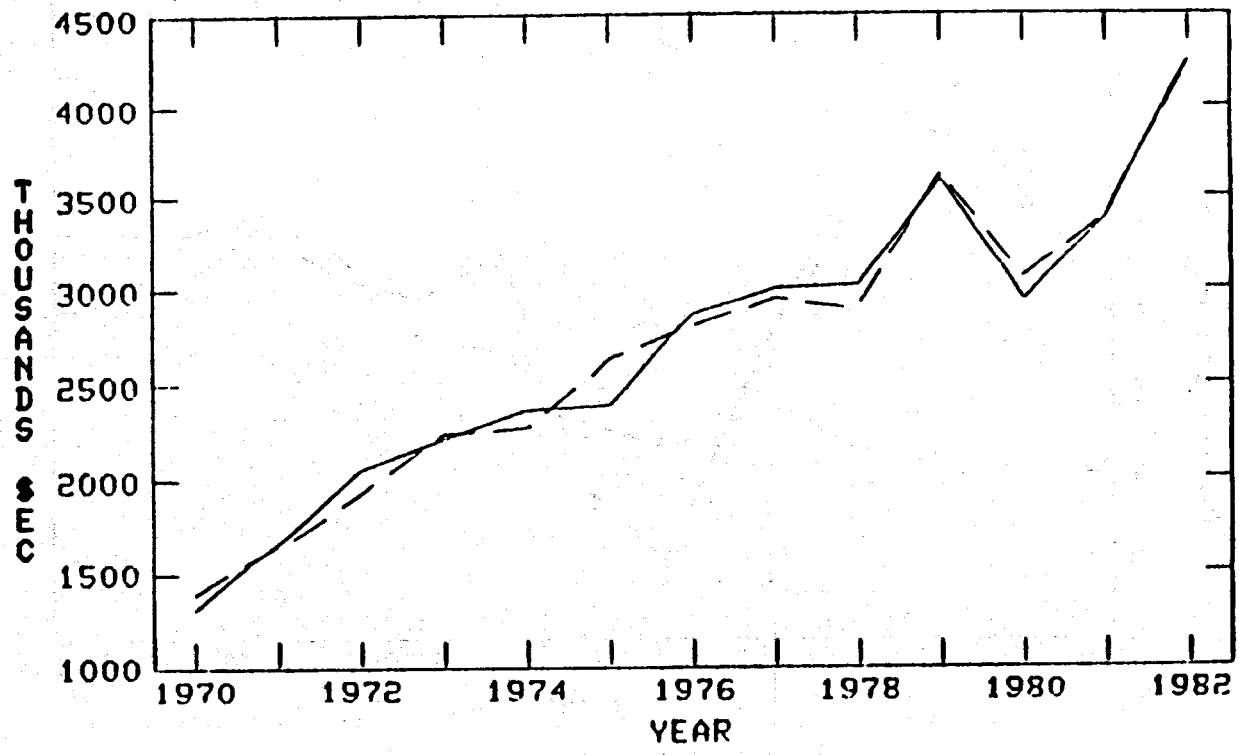

Fig. 8. Comparison of actual and fitted time series for Consumption: Fuel & Light.

TABLE VIII

REGRESSION AND VARIABLE VALUES FOR
CONSUMPTION: DURABLES

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RPCEDUR

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
PCGDPT	1	6566.9	152.71	43.003

R-SQUARE = .80439
R-SQUARED (COMPUTED ABOUT ZERO) = .99409
R-SQUARE (CORRECTED) = .99409
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 1.5172
SUM OF SQUARED RESIDUALS = 6332682

STD ERROR OF REGRESSION = 758.75

YEAR	RPCEDUR	PCGDPT
1970	9579.9	1.6829
1971	12039	1.7237
1972	11486	1.4992
1973	10130	1.1732
1974	8082.3	1.1164
1975	5948.2	1.1643
1976	6876.9	1.2962
1977	9739.3	1.3195
1978	9137.6	1.4757
1979	9387.2	1.5583
1980	10031	1.5137
1981	9251	1.5295
1982	9529.2	1.5315

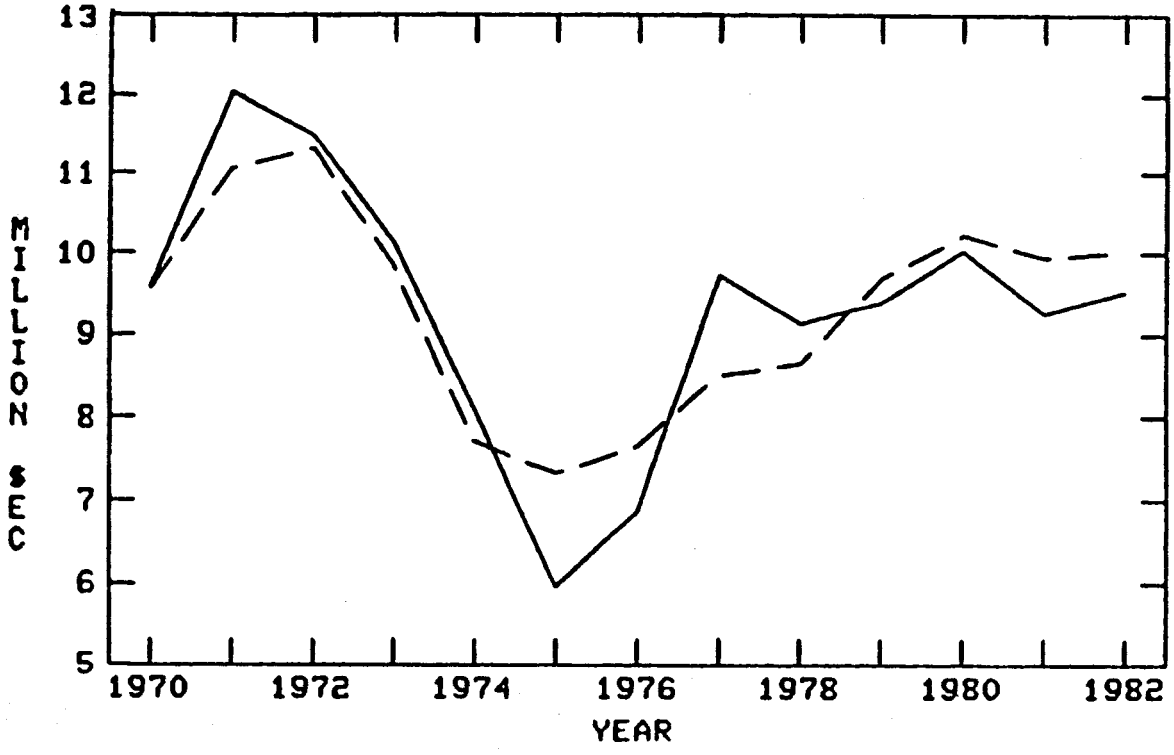

Fig. 9. Comparison of actual and fitted time series for Consumption: Durables.

TABLE IX

REGRESSION AND VARIABLE VALUES FOR
CONSUMPTION: NOT ELSEWHERE SPECIFIED

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RPCENES

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-8359.9	3721.3	-2.2465
RGDPIND	0	1.7142	.22076	7.7648

R-SQUARE = .90949
R-SQUARE (CORRECTED) = .89441
NUMBER OF OBSERVATIONS = 8
DURBIN WATSON STATISTIC= 2.1908
SUM OF SQUARED RESIDUALS = 23364777

STD ERROR OF REGRESSION = 1973.4

YEAR	RPCENES	RGDPIND
****	*******	*******
1975	12202	10677
1976	12856	13486
1977	14984	15000
1978	22100	17000
1979	19400	16800
1980	26702	19700
1981	26262	19200
1982	25680	20600

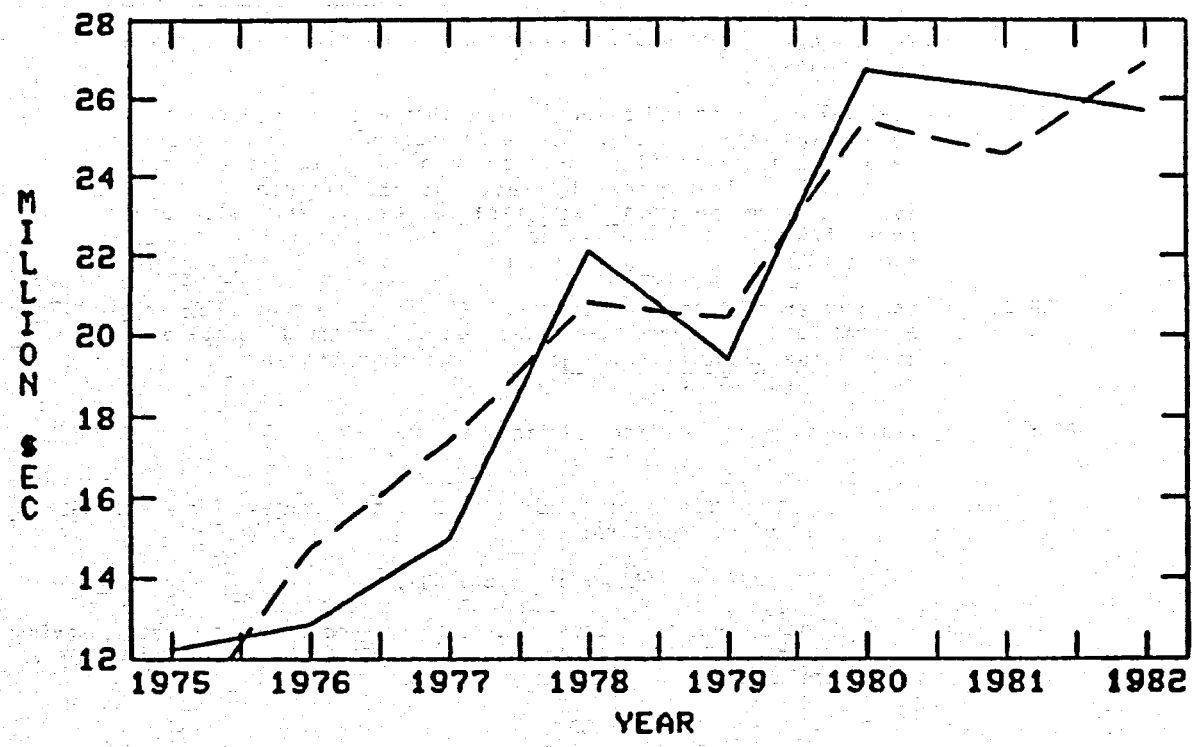

Fig. 10. Comparison of actual and fitted time series for Consumption: Not Elsewhere Specified.

TABLE X

DEFINITIONS FOR CONSUMPTION VARIABLES

RPCEFBV = real personal consumption expenditures of food and beverages:
PCEFB = imports of (beverages, food and tobacco - feedstuff) and value of output of domestically-consumed agricultural goods.

The value of imports of food items is from the following S.I.T.C. categories: Section 0 (food total) minus Division 0.08 (feeding stuff for animals); Division 1.11 (beverages); and Division 1.12 (tobacco). The data sources were "Annual Report of Overseas Trade of St. Lucia, 1970-1975," and Annual Statistical Digests.

The value of domestically consumed agricultural output is from The Commonwealth Caribbean, Table SA2.11 for 1970-1973. The data for 1974-1976 are estimated. Mr. Augustine of the St. Lucia Department of Statistics provided the 1977-1982 data.

RPCEFL1 = real personal consumption expenditures on electricity:
PCEFL = price of electricity/kWh • domestic use of electricity in kWh.

The price of electricity is derived from the price per 80 units reported in the table, "Average Retail Prices in Castries of Selected Commodities," from the 1976 and 1982 Annual Statistical Digests. The price per 80 units is assumed to be the price of 80 kWh; the price of electricity then equals the reported price for 80 units divided by 80.

The data on domestic use of electricity are from the tables, "Electricity Generation and Distribution - Northern Area and Southern Area," in the Annual Statistical Digests.

RPCEDUR = real personal consumption expenditures on clothing, shoes and automobiles.

RPCENES = real value of imported consumer goods that are not covered in the categories defined above. Data were available to us for the years 1975-1982 in the tables entitled, "Value of Imports, Domestic Exports and Re-Exports by Sections and Divisions [S.I.T.C. (R)j...," from the Annual Statistical Digests. The value of imports from Section 4 plus the following Divisions were summed to derive PCENES: Division 54, 55, 62, 76, 82, 83, 86, 88, and 89.

TARRIVE = the number of total tourist arrivals from the tables "Passenger Arrivals and Departures by Air and Sea...," in the 1972, 1976, and 1982 Annual Statistical Digests. Data were not reported for 1979 and 1980 and had to be estimated.

RPDY = real total personal disposable income.

PDY = total personal disposable income. It is derived from total GDP by use of the relation:

PDY = CONSUMPTION + SAVINGS.

World Bank estimates of private consumption plus domestic savings average 80.9% of GDP for the years 1975-1981. Therefore, PDY was defined as:

PDY = .809* GDP

TABLE X (cont.)

DEFINTIONS FOR CONSUMPTION VARIABLES

POP	=	population from the 1970 census and figures reported in the Annual Statistical Digests for 1976-1982 (Ref. Nos. 2 and 3). The 1971-1975 data are estimated by using compound growth rates between the 1970 and 1976 data.
FLRATIO	=	consumer price index for for fuel and lights divided by the consumer price index for all items.
PCGDPT	=	real total GDP divided by the population; a per capita GDP.
D7982	=	a dummy variable with a value of 1 for 1979 and 1982.
RGDPIND	=	real gross domestic product from the mining and manufacturing sectors.

This equation was estimated to be a function of tourist arrivals and personal disposable income. The expenditure on electricity equation shows a negative price effect while the consumption durables exhibit a positive income effect. These signs on price and income in the respective equations are consistent with theory.

Consumption not-elsewhere-specified (NES) was defined as a residual category. It included many items not counted in the other equations. Consumption NES was estimated to be a function of the level of economic activity in the industrial sector.

D.3. Investment (KAP). (Refer to Tables XI-XIII and Figures 11-12.) In most less-developed countries,financial sources consist entirely of a few commercial banks. But as far as banks are concerned, their source of funds is new deposits not their equity capital,and the former are withdrawable upon demand. Thus, commercial banks are more suited to the provision of short-term rather than long-term loans,which fit the needs of a service sector perfectly. This nonexistence of financial intermediaries other than commercial banks is tantamount to a financing bias in favor of the service sector.

The investment equations were estimated based upon six years of data and were reported in the preliminary issue of National Income Accounts. Data were reported as investment in buildings and construction and investment in machinery and transport. The data represent the outlay of producers on additions of new durable goods to their stocks of fixed assets less their net sales of used and scrapped goods. These equations are the least satisfying in the model.

D.4. Foreign Trade. The importance of the foreign trade sector to the economy of St. Lucia became readily apparent as we began building the macro model. Since St. Lucia is a small island economy,nearly all domestically produced goods and agricultural products are exported. Likewise, imports account for the majority of inputs used in domestic manufacturing and consumption. The positive side of this is that these data are probably the most reliable.

D.4.a. Exports (XPT). (Refer to Tables XIV-XX and Figures 13-18.) The volume of exports for a particular country is difficult to capture in just one equation because the quantity exported in any given year is dependent upon both domestic and international market conditions. Most desirable would be to have a structural model for each commodity that would model world supply and demand and consequently the determination of world prices. However, construction of a world commodity would require a major effort and be a project in itself. Any

TABLE XI

REGRESSION AND VARIABLE VALUES FOR
CAPITAL FORMATION: BUILDING AND OTHER CONSTRUCTION

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RKAPBLD

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
SC	0	-169367	16901	-10.021
UNEMP	0	17.24	1.2822	13.445
D82	0	-14697	3160.8	-4.6496

R-SQUARE = .98368
R-SQUARE (CORRECTED) = .97279
NUMBER OF OBSERVATIONS = 6
DURBIN WATSON STATISTIC= 3.3249
SUM OF SQUARED RESIDUALS = 22052349

STD ERROR OF REGRESSION = 2711.2

YEAR	RKAPBLD	UNEMP	D82
1977	31000	11528	0
1978	44775	12613	0
1979	70726	13764	0
1980	69521	13890	0
1981	70443	13942	0
1982	57140	13991	1

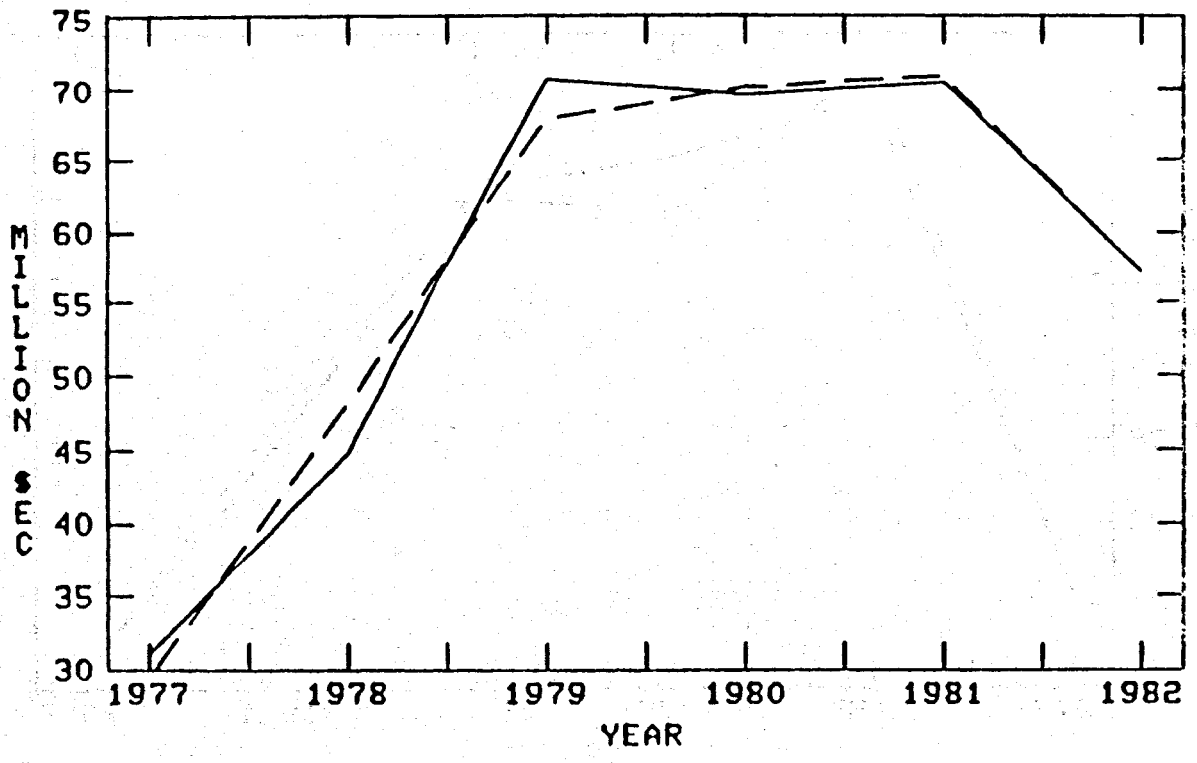

Fig. 11. Comparison of actual and fitted time series for Capital Formation: Building and Other Construction.

TABLE XII

REGRESSION AND VARIABLE VALUES FOR
CAPITAL FORMATION: MACHINERY AND TRANSPORT

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RKAPMAT

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	65199	6387.6	10.207
RGDPIND	1	-1.8593	.37122	-5.0085
D82	0	-7313.6	1591.9	-4.5942

R-SQUARE = .97812
R-SQUARE (CORRECTED) = .95623
NUMBER OF OBSERVATIONS = 5
DURBIN WATSON STATISTIC= 2.4317
SUM OF SQUARED RESIDUALS = 3105343

STD ERROR OF REGRESSION = 1246.1

YEAR	RKAPMAT	RGDPIND	D82
1977	24300	15000	0
1978	36408	17000	0
1979	34943	16800	0
1980	34166	19700	0
1981	27919	19200	0
1982	22187	20600	1

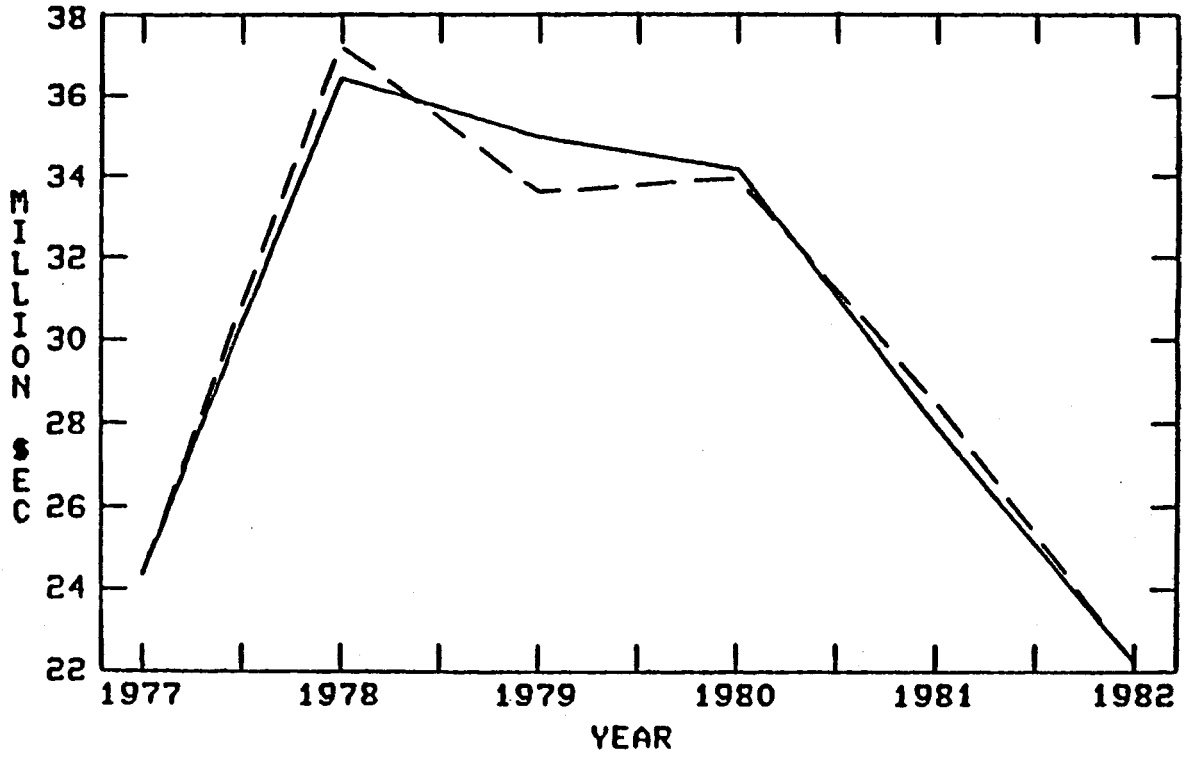

Fig. 12. Comparison of actual and fitted time series for Capital Formation: Machinery and Transport.

TABLE XIII

DEFINITIONS FOR INVESTMENT VARIABLES

RKAPBLD	=	real capital investment of building and other construction.
RKAPMAT	=	real capital investment of machinery and transport.
UNEMP	=	labor force minus the population employed.
D82	=	a dummy variable with the value of 1 for 1982.
RGDPIND	=	real gross domestic product from the mining and manufacturing sectors.

TABLE XIV

REGRESSION AND VARIABLE VALUES FOR
EXPORTS: BANANAS

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RXPTBAN

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	1400	2300.8	.60848
RBANP	0	28009	4089.5	6.8491
MATURITY	0	2355.1	329.74	7.1422
D73	0	-6957.6	1697.1	-4.0997

R-SQUARE = .93486
R-SQUARE (CORRECTED) = .91314
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 2.7236
SUM OF SQUARED RESIDUALS = 21554343

STD ERROR OF REGRESSION = 1547.6

YEAR	RXPTBAN	RBANP	MATURITY	D73
1970	13766	.36858	1	0
1971	16235	.33176	2	0
1972	17847	.38746	3	0
1973	17512	.48731	4	1
1974	29163	.57412	5	0
1975	21040	.68797	1	0
1976	22917	.55778	2	0
1977	25526	.6165	3	0
1978	30069	.6288	4	0
1979	27910	.57856	5	0
1980	19870	.60535	1	0
1981	25588	.59657	2	0
1982	25657	.61532	3	0

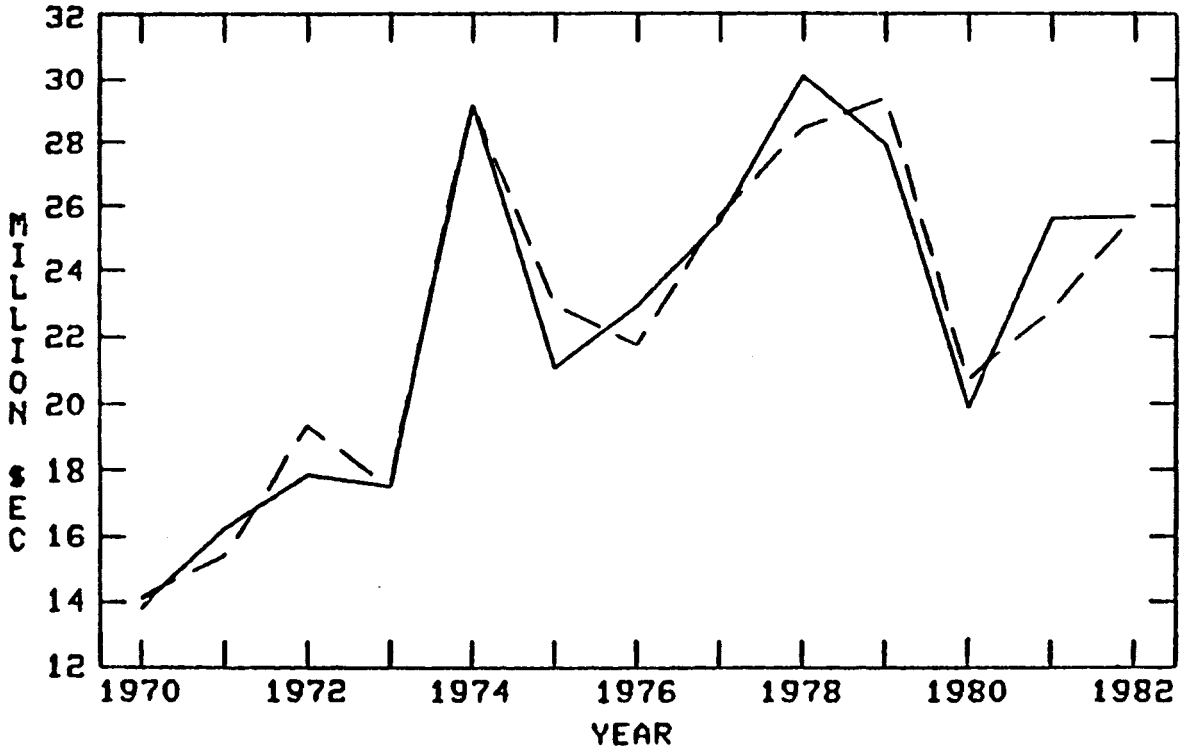

Fig. 13. Comparison of actual and fitted time series for Exports: Bananas.

TABLE XV

REGRESSION AND VARIABLE VALUES FOR
EXPORTS: COPRA AND OTHER AGRICULTURE

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RXPTCOA

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
&C	0	4438	531.1	8.3562
RXPTOAG	1	1.9052	.4041	4.7146
D8081	0	-1650.3	619.98	-2.6618

R-SQUARE = .71234
R-SQUARE (CORRECTED) = .64842
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 2.3067
SUM OF SQUARED RESIDUALS = 4206287

STD ERROR OF REGRESSION = 683.64

YEAR	RXPTCOA	RXPTOAG	D8081
1970	6601.5	479.7	0
1971	4924	645.01	0
1972	5596.8	796.48	0
1973	5122.5	752.24	0
1974	7104.2	1470.6	0
1975	8161	1501.9	0
1976	6740.6	1337.7	0
1977	7534	1722	0
1978	7472.9	2183.6	0
1979	8249.4	2345.8	0
1980	7495.4	1650.9	1
1981	5694.2	1115.5	1
1982	6345	1072.9	0

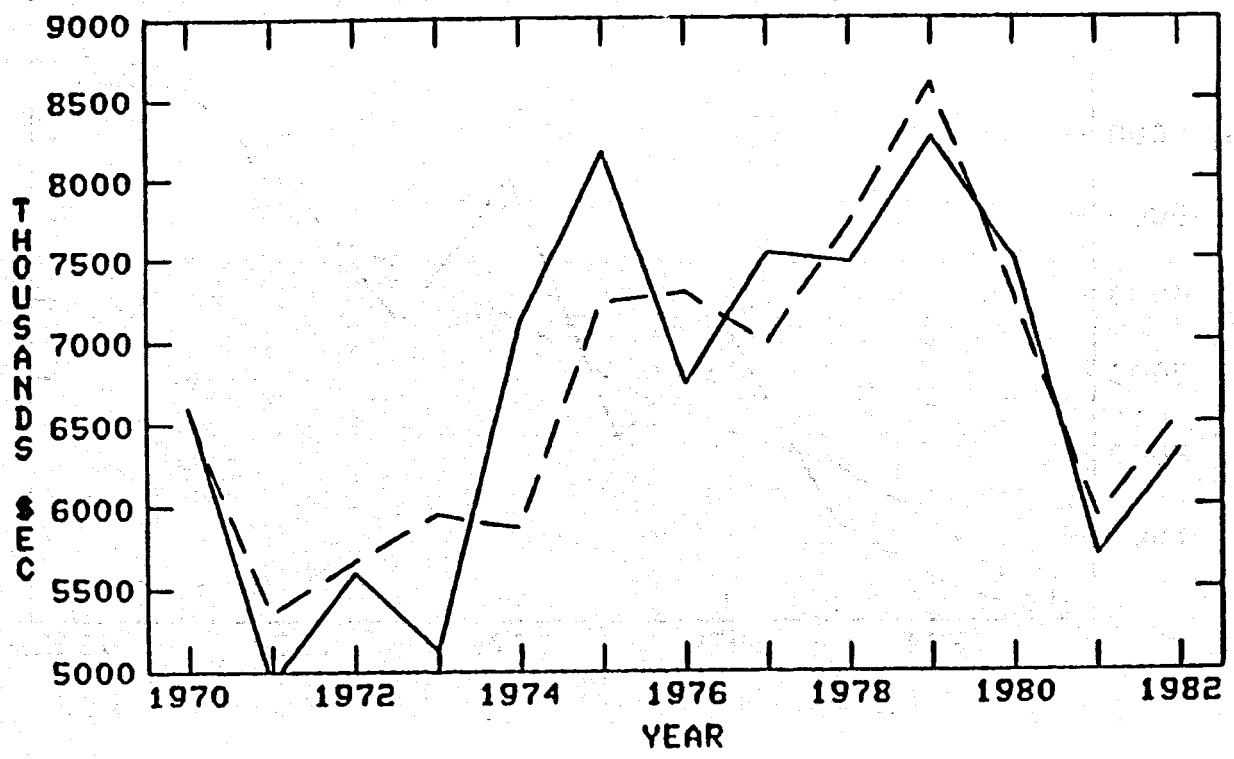

Fig. 14. Comparison of actual and fitted time series for Exports: Copra and Other Agriculture.

TABLE XVI

REGRESSION AND VARIABLE VALUES FOR
EXPORTS: GARMENTS

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RXPTGAR

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-2764.8	1148.7	-2.4068
CPICLO	1	23.765	3.9126	6.0714

R-SQUARE = .84041
R-SQUARE (CORRECTED) = .81761
NUMBER OF OBSERVATIONS = 9
DURBIN WATSON STATISTIC= 3.0589
SUM OF SQUARED RESIDUALS = 6764765

STD ERROR OF REGRESSION = 983.05

YEAR	RXPTGAR	CPICLO
1973	5.176	162.7
1974	417.81	195.5
1975	1190	215.3
1976	3597.6	238.8
1977	2235	274.5
1978	5487.9	299.5
1979	3651	326.4
1980	5360.1	406.3
1981	6619.7	413.6
1982	6718.8	431.7

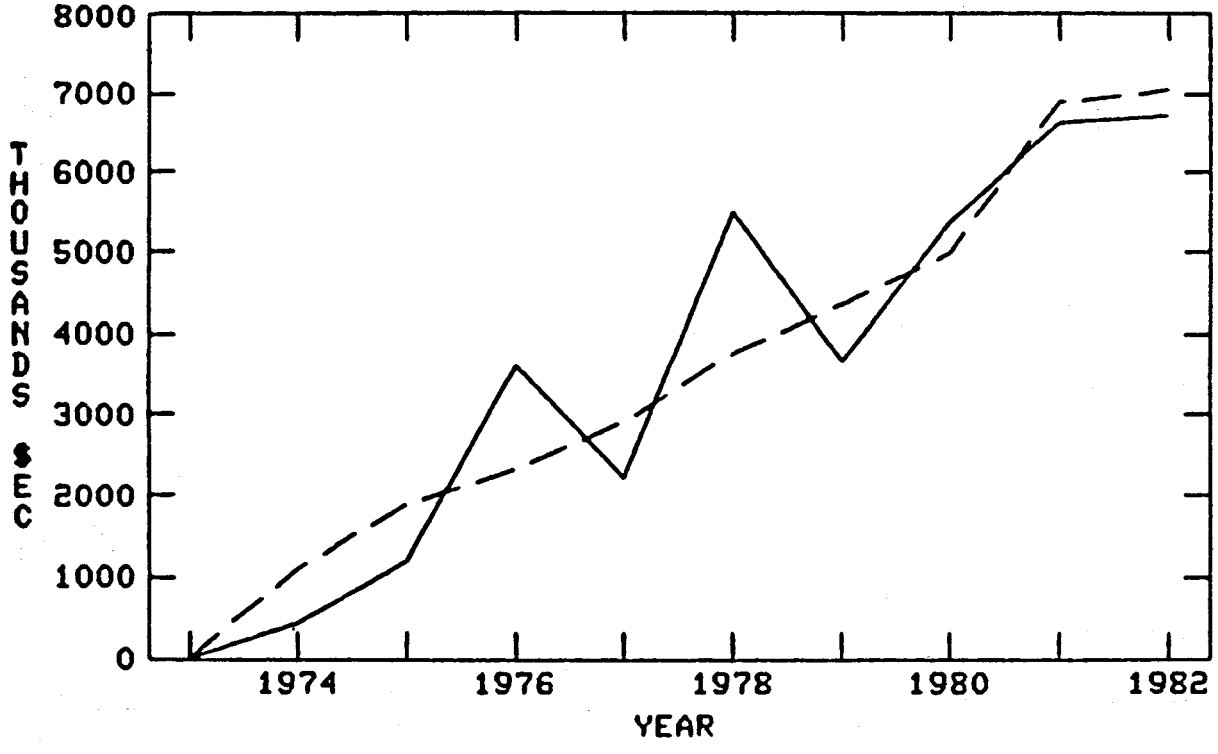

Fig. 15. Comparison of actual and fitted time series for Exports: Garments.

TABLE XVII

REGRESSION AND VARIABLE VALUES FOR
EXPORTS: BOXES

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RXPTBOX

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	21421	2391.5	8.9572
RXPTBAN	1	-.55608	.093778	-5.9297

R-SQUARE = .85423
R-SQUARE (CORRECTED) = .82994
NUMBER OF OBSERVATIONS = 8
DURBIN WATSON STATISTIC= 1.5812
SUM OF SQUARED RESIDUALS = 5166648

STD ERROR OF REGRESSION = 927.96

YEAR	RXPTBOX	RXPTBAN
1974	4700.4	29163
1975	5816.9	21040
1976	9312.7	22917
1977	9472	25526
1978	7154.8	30069
1979	3969.8	27910
1980	4907.1	19870
1981	9733.4	25588
1982	8627.6	25657

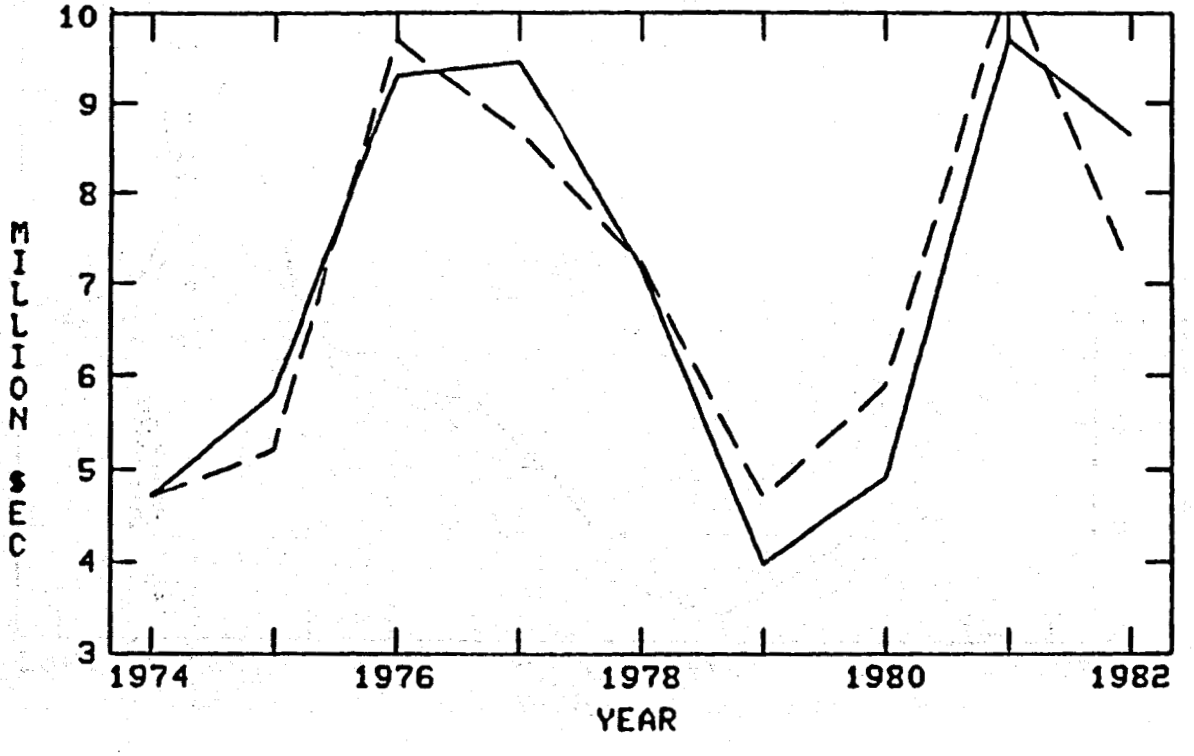

Fig. 16. Comparison of actual and fitted time series for Exports: Boxes.

TABLE XVIII

REGRESSION AND VARIABLE VALUES FOR
EXPORTS: NOT ELSEWHERE SPECIFIED

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RXPTNES

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-27903	5068	-5.5057
RGDPSIN	0	.45006	.064096	7.0217
D80	0	12058	2852.2	4.2277

R-SQUARE = .90796
R-SQUARE (CORRECTED) = .88955
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 1.5499
SUM OF SQUARED RESIDUALS = 66461297

STD ERROR OF REGRESSION = 2578

YEAR	RXPTNES	RGDPSIN	D80
****	********	*******	***
1970	135.28	68111	0
1971	356.86	73944	0
1972	5910	74753	0
1973	3302.6	60524	0
1974	1129.9	61077	0
1975	2227.9	70897	0
1976	7123.8	78630	0
1977	10830	80900	0
1978	11427	90800	0
1979	14037	90900	0
1980	26146	93300	1
1981	16566	94300	0
1982	14520	93700	0

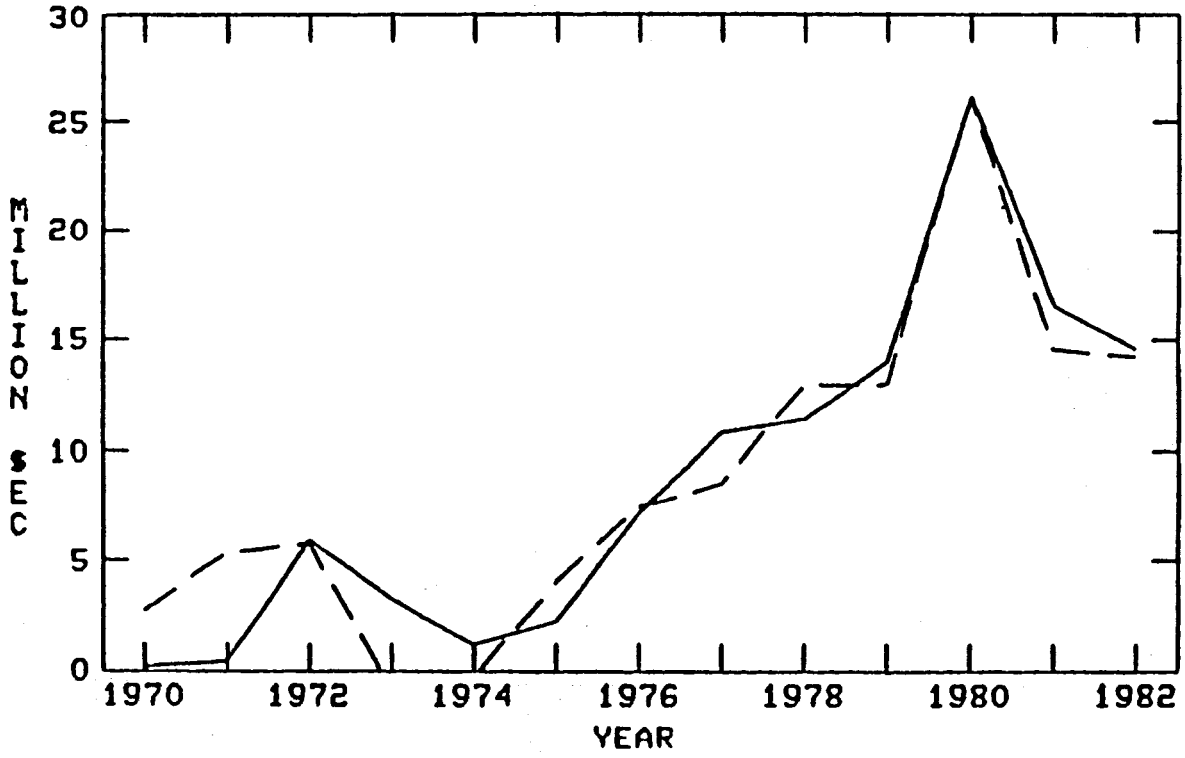

Fig. 17. Comparison of actual and fitted time series for Exports: Not Elsewhere Specified.

TABLE XIX

COCHRANE-ORCUTT REGRESSION AND VARIABLE VALUES FOR EXPORTS: RE-EXPORTS

COCHRANE-ORCUTT ITERATIVE PROCEDURE

VARIABLES...
RREXPT
JC
RMPTELM
MEAN OF DEPENDENT VARIABLE IS 6992.5

ITERATION	RHO
1	.50917
2	.51287

FINAL VALUE OF RHO= .51287
NO. OF ITERATIONS= 2

STANDARD ERROR OF RHO= .24782
T-STATISTIC FOR RHO= 2.0695

INDEPENDENT VARIABLE	COL	ESTIMATED COEFFICENT	STANDARD ERROR	T-STATISTIC
JC	1	-2844	1530.9	-1.8578
RMPTELM	1	1.1198	.1171	9.5624

R-SQUARED = .89463
R-SQUARED(CORRECTED) = .88409
DURBIN-WATSON STATISTIC = 1.961
NUMBER OF OBSERVATIONS = 12
SUM OF SQUARED RESIDUALS = 34542797
STANDARD ERROR OF THE REGRESSION = 1858.6
R-SQUARED IN TERMS OF CHANGES = .93674

YEAR	RREXPT	RMPTELM
1970	1642.6	8505.1
1971	7058.4	12835
1972	3102.4	7971.2
1973	7242.6	7519
1974	2714.3	5327.1
1975	2894.4	7639.2
1976	4589.1	6592.7
1977	5388.3	7585
1978	4942.5	8658
1979	8021.6	10890
1980	23168	22173
1981	8376.8	8243.8
1982	6411.1	6489.7

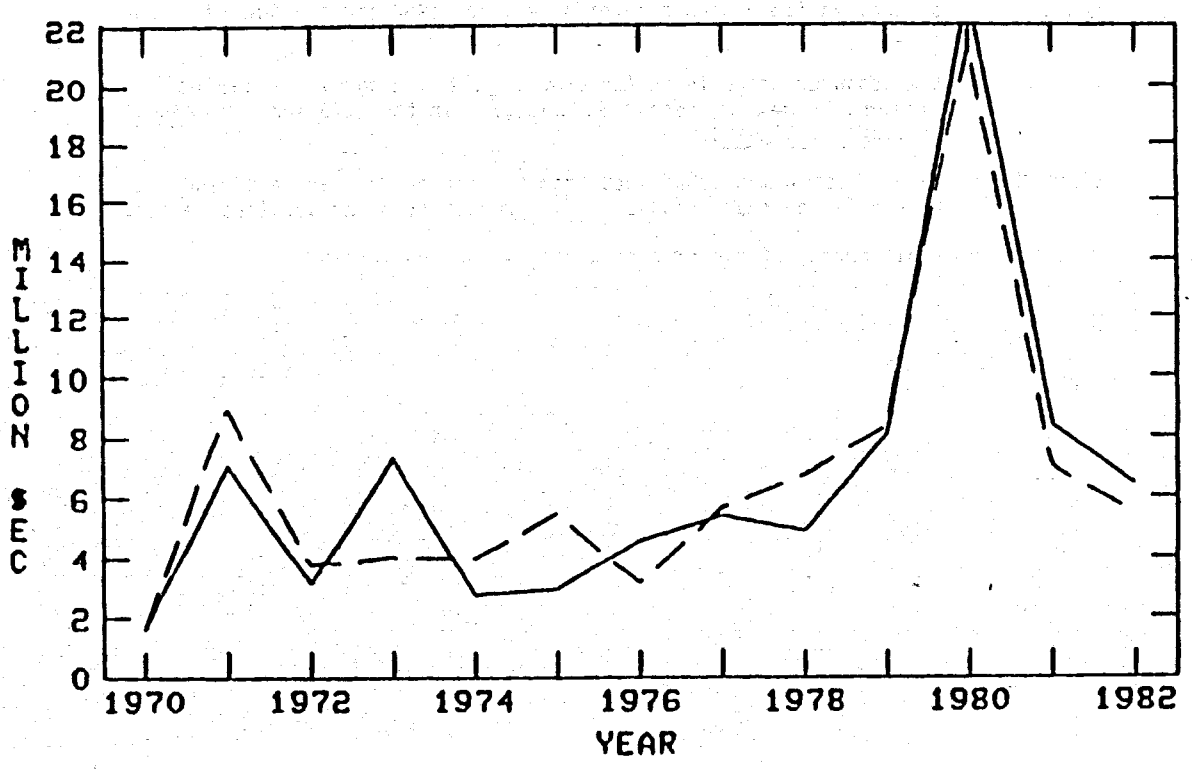

Fig. 18. Comparison of actual and fitted time series for Exports: Re-exports.

TABLE XX

DEFINITIONS FOR FOREIGN TRADE: EXPORTS VARIABLES

Exports

RXPTBAN = real exports of bananas.

RXPTCOA = real exports of copra and other agriculture.

RXPTGAR = real exports of garments.

RXPTBOX = real exports of boxes.

RXPTNES = real exports not elsewhere specified.

RREXPT = real exports of re-exports, the values of re-exports taken from the tables, "Imports, Exports and Balance of Trade ...," in the 1981 and 1982 Annual Statistical Digests.

RBANP = real banana price.

MATURITY = a discrete variable representing the growth cycle in banana production, i.e., 1,2,3,4,5,1.2,3,4,....

RXPTOAG = real exports of other agricultural goods which consist of cocoa, fruit and vegetables, and spices.

D8081 = a dummy variable with the value of 1 for 1980 and a value of 1 for 1981.

CPICLO = the consumer price index for clothing, taken from the tables entitled, "Index of Retail Prices...," in the 1976 and 1982 Annual Statistical Digests.

RGDPSIN = real gross domestic product from the mining and manufacturing sectors plus the real gross domestic product from the services sector.

RMPTELM = real imports of electrical machinery and appliances.

single-equation expression of the exports of a commodity is actually a reduced form equation in its own right. It reflects a series of equilibrium positions over time,with quantity exported being a function of both demand and supply factors not explicitly stated in the equation. Because of this, it is difficult a priori even to say whether a single equation will be primarily a demand function expressing world demand for St. Lucian exports, or a supply function expressing St. Lucian production reaction, say, to the world export price it faces.

This is a familiar problem in statistical time-series demand analysis in determining whether or not a set of price-quantity points reflect primarily a demand curve, a supply curve,or a series of shifts in both supply and demand. If we have a complete structural model with all equations identified, then it is possible to define the demand and supply functions explicitly.

However, in this case we do not have complete structural models. The export equations presented here constitute a set of reduced form equations of the underlying structural models. In the context of a macroeconometric model, they do not constitute structural equations in the sense of explaining and forecasting the monetary value of exports on the basis of the exogenous and other endogenous variables of the model.

Where possible,we included a commodity price variable(for example, in the banana export equation). The sign on banana price is positive,indicating a St. Lucian banana supply equation. Likewise, for the garment export equation, the sign on the price variable, proxied by the CPI of clothing, is significant and positive. Copra and other agriculture summed could not be adequately represented by a price variable. The equations for exports of boxes and NES do not contain a price variable but have variables that reflect both supply and demand conditions. Re-export was estimated by a Cochrane-Orcutt to reduce the serial correlation. Examination of data indicated farm equipment and electrical machinery to be the major items exported. One plausible explanation is that these items are imported, used a short period, and traded or sold on another island. The re-export equation is considered to be a demand equation.

D.4.b. Imports (MPT). (Refer to Tables XXI-XXVI and Figures 19-23.) Because import equations exhibit many of the same characteristics as consumption expenditure equations, the same considerations apply as discussed in the section on exports.

TABLE XXI

REGRESSION AND VARIABLE VALUES FOR
IMPORTS: CAPITAL GOODS

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RMPTCAP

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	6332.6	1881.4	3.366
RGDPIND	1	.42431	.14145	2.9998
D7180	0	13278	2061.7	6.4404

R-SQUARE = .8457
R-SQUARE (CORRECTED) = .81141
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 1.3197
SUM OF SQUARED RESIDUALS = 63699355

STD ERROR OF REGRESSION = 2660.4

YEAR	RMPTCAP	RGDPIND	D7180
1970	12485	6091.4	0
1971	20467	6309.9	1
1972	10872	5581.8	0
1973	9922.4	5003.5	0
1974	6968.1	7009.3	0
1975	10064	10677	0
1976	8197.9	13486	0
1977	10264	15000	0
1978	16151	17000	0
1979	17039	16800	0
1980	28467	19700	1
1981	13651	19200	0
1982	10676	20600	0

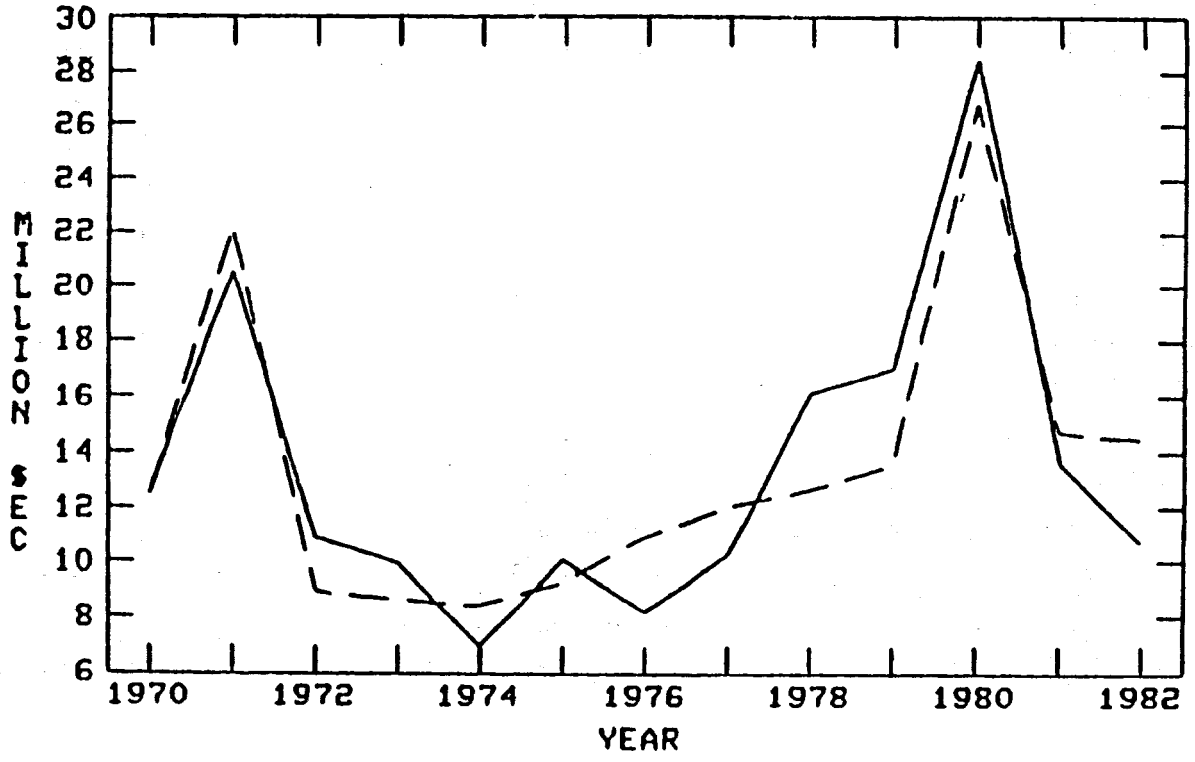

Fig. 19. Comparison of actual and fitted time series for Imports: Capital Goods.

TABLE XXII

REGRESSION AND VARIABLE VALUES FOR
IMPORTS: INTERMEDIATE GOODS

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RMPTINT

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
SC	0	13453	1843.7	7.2965
RMPTCAP	1	.65163	.091548	7.1179
RPR	1	-.024548	.0054771	-4.4819
D7779	0	5984.6	1346.8	4.4435

R-SQUARE = .90493
R-SQUARE (CORRECTED) = .86928
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 2.5479
SUM OF SQUARED RESIDUALS = 23126543

STD ERROR OF REGRESSION = 1700.2

YEAR	RMPTINT	RMPTCAP	RPR	D7779
1970	12515	12485	460678	0
1971	9759.3	20467	534665	0
1972	15777	10872	406144	0
1973	7558.7	9922.4	257748	0
1974	13014	6968.1	212338	0
1975	13413	10064	188495	0
1976	14985	8197.9	264002	0
1977	17826	10264	247204	1
1978	16293	16151	275764	0
1979	23665	17039	318893	1
1980	16222	28467	300818	0
1981	23454	13651	313290	0
1982	15869	10676	308618	0

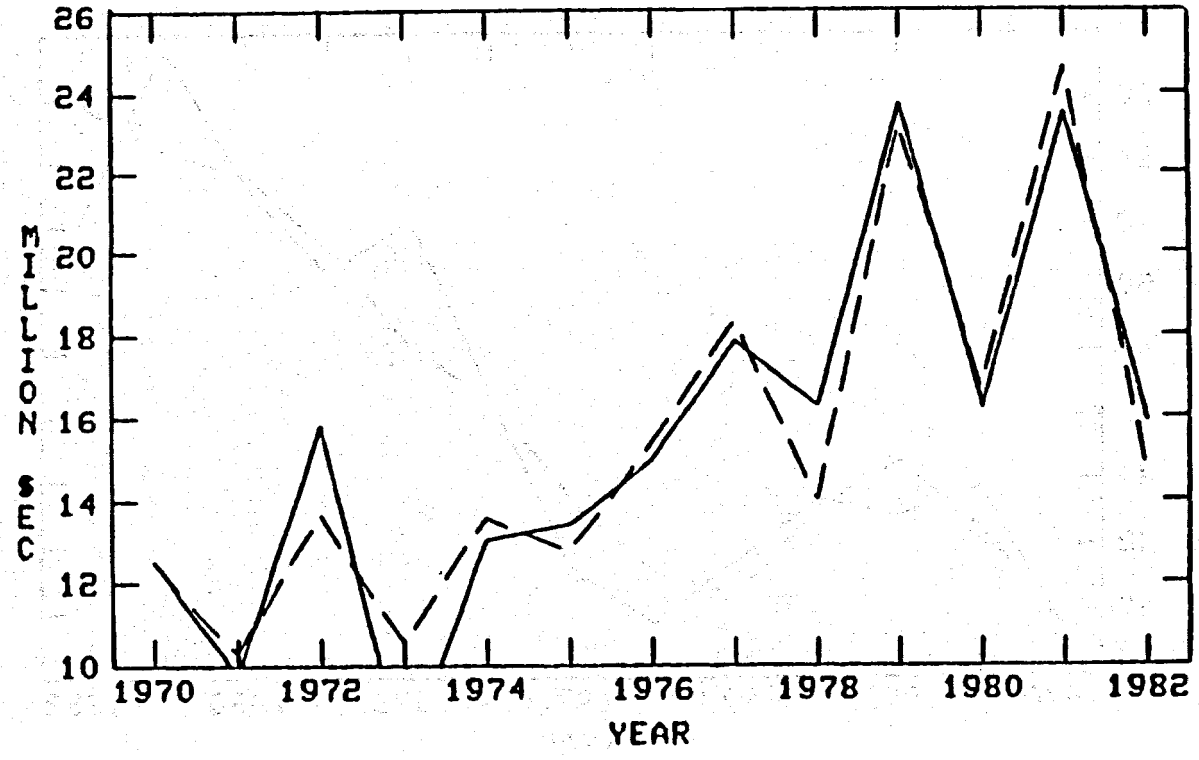

Fig. 20. Comparison of actual and fitted time series for Imports: Intermediate Goods.

TABLE XXIII

REGRESSION AND VARIABLE VALUES FOR
IMPORTS: CONSUMER GOODS

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RMPTCON

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-32978	12081	-2.7298
RPDY	1	.15081	.040854	3.6915
POP	0	.5324	.11334	4.6974

R-SQUARE = .86016
R-SQUARE (CORRECTED) = .82908
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 2.3503
SUM OF SQUARED RESIDUALS = 52699557

STD ERROR OF REGRESSION = 2419.8

YEAR	RMPTCON	RPDY	POP
1970	39612	137366	100893
1971	43784	143499	102908
1972	42898	127307	104962
1973	43461	101614	107058
1974	41515	98623	109196
1975	39655	104910	111376
1976	41191	119128	113600
1977	46549	123292	115500
1978	52174	140281	117500
1979	50440	149261	118400
1980	53226	147319	120300
1981	57653	151202	122200
1982	52325	153629	124000

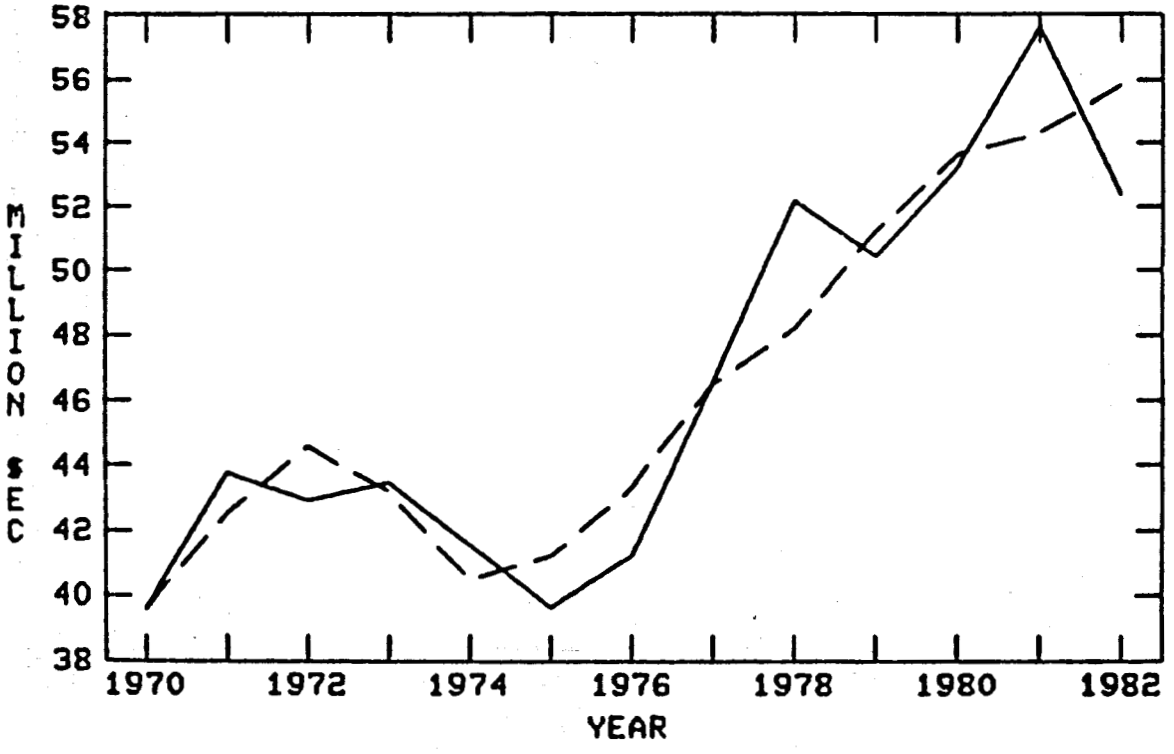

Fig. 21. Comparison of actual and fitted time series for Imports: Consumer Goods.

TABLE XXIV

REGRESSION AND VARIABLE VALUES FOR
IMPORTS: GASOLINE

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RMPTGAS

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
$C	0	-249.41	471.16	-.52935
DNAUTO	0	.83346	.081975	10.167

R-SQUARE = .90382
R-SQUARE (CORRECTED) = .89508
NUMBER OF OBSERVATIONS = 13
DURBIN WATSON STATISTIC= 2.427
SUM OF SQUARED RESIDUALS = 6959929

STD ERROR OF REGRESSION = 795.44

YEAR	RMPTGAS	DNAUTO
****	*******	*******
1970	1264	686.28
1971	1217.6	1801.8
1972	1124.9	2602.3
1973	1606.3	3184.4
1974	3133.6	3660.7
1975	3080.6	4110.1
1976	3985.9	4588.1
1977	3931	5320.6
1978	4435.2	6211
1979	5800.3	7024.9
1980	8038	8138.8
1981	5901.7	8964.5
1982	8265.3	9728.9

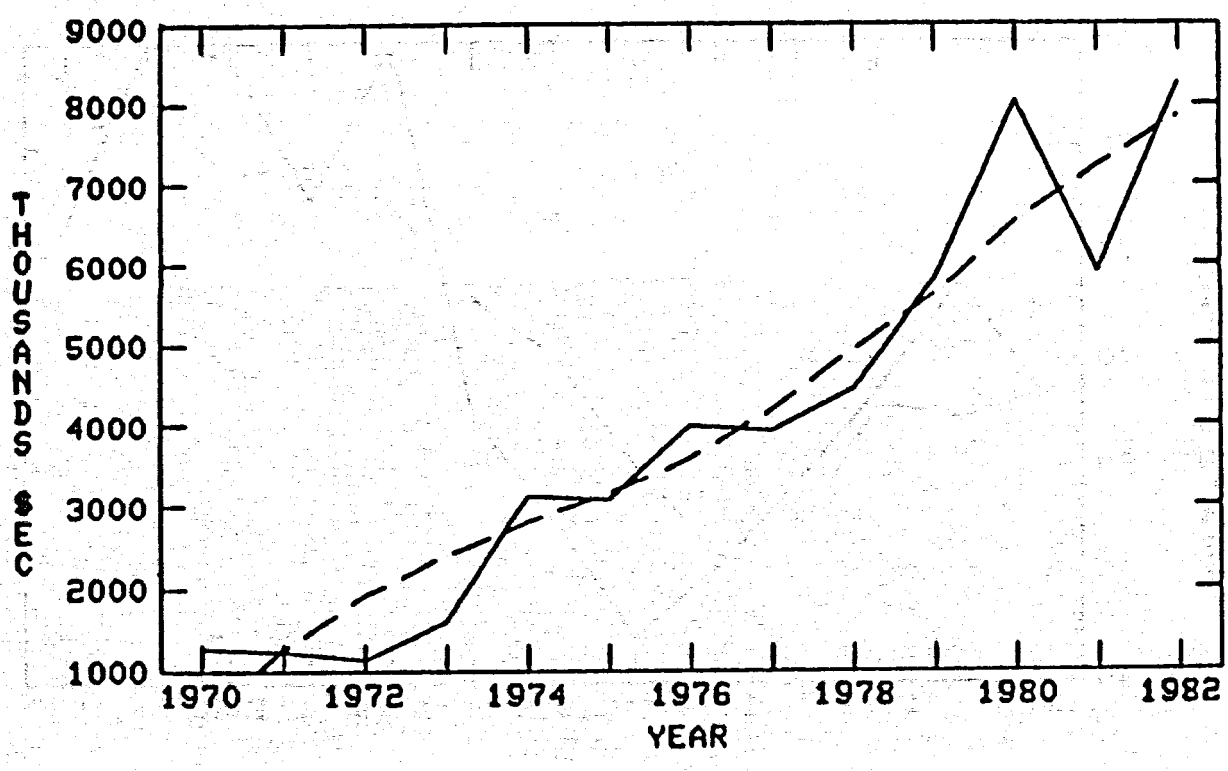

Fig. 22. Comparison of actual and fitted time series for Imports: Gasoline.

TABLE XXV

REGRESSION AND VARIABLE VALUES FOR
IMPORTS: NOT ELSEWHERE SPECIFIED

ORDINARY LEAST SQUARES ESTIMATION

DEPENDENT VARIABLE: RMPTNES

NAME	LAG	COEFF	STD ERROR	T-STATISTIC
RGDPIND	1	1.721	.73132	2.3533
RGDPSRV	0	.79695	.14064	5.6664

R-SQUARE = .70578
R-SQUARED (COMPUTED ABOUT ZERO) = .98161
R-SQUARE (CORRECTED) = .97977
NUMBER OF OBSERVATIONS = 12
DURBIN WATSON STATISTIC= 1.4991
SUM OF SQUARED RESIDUALS = 1.2762E9

STD ERROR OF REGRESSION = 11297

YEAR	RMPTNES	RGDPIND	RGDPSRV
1970	66792	6091.4	62020
1971	77163	6309.9	67634
1972	67074	5581.8	69172
1973	58492	5003.5	55520
1974	50581	7009.3	54067
1975	44182	10677	60221
1976	54992	13486	65144
1977	64687	15000	65900
1978	99855	17000	73800
1979	84894	16800	74100
1980	98803	19700	73600
1981	99992	19200	75100
1982	82791	20600	73100

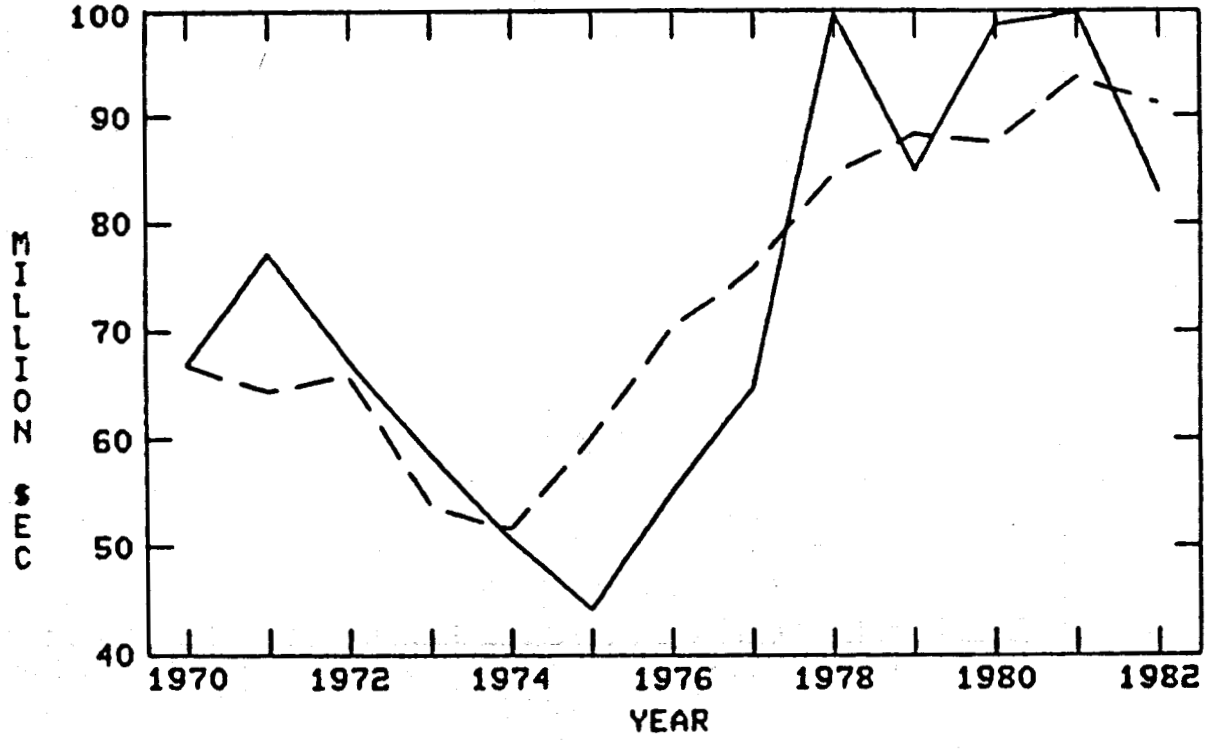

Fig. 23. Comparison of actual and fitted time series for Imports: Not Elsewhere Specified.

TABLE XXVI

DEFINITIONS FOR FOREIGN TRADE: IMPORTS VARIABLES

Imports

RMPTCAP = real imports of buses from Table 15, "Preliminary Summary Tables of External Trade," of St. Lucia plus the real imports of electrical machinery and appliances.

RMPTINT = real imports of fertilizer plus paper and paper board plus cement plus iron and steel (see Appendix B for individual import listings).

RMPTCON = real imports of food items minus feedstuff plus beverages plus tobacco plus clothing plus footwear (see Appendix B for listings of individual import variables).

RMPTGAS = real imports of motor spirits.

RMPTNES = real imports not elsewhere specified. It equals

RMPTNES = RMPIT - RMPTCLO - RMPTFTW - RMPTCAR - RMPTBUS - RMPTFRT - RMPTELM - RMPTPPB - RMPTCEM - RMPTFEX - RMPTGAS - RMPTFOOD.

(see Appendix B for individual import listings).

RGDPIND = real gross domestic product from the mining and manufacturing sectors.

RPR = real gross domestic product total divided by the real banana price received per pound.

RPDY = real total personal disposable income.

PDY = total personal disposable income. It is derived from total GDP by use of the relation

PDY = CONSUMPTION + SAVINGS.

World Bank estimates of private consumption plus domestic savings average 80.9% of GDP for the years 1975-1981. Therefore, PDY was defined as

PDY = .809* GDP.

POP = population from the 1970 census and figures reported in the Annual Statistical Digests for 1976-1982 (Ref. Nos. 2 and 3). The 1971-1975 data are estimated by using compound growth rates between the 1970 and 1976 data.

DNAUTO = depreciated number of automobiles. The automobile stock was assumed to have an average life of eight years. This implies 1-(16/100) cars remain annually, thus annual cumulative sum was depreciated by 0.16.

RGDPSRV = real GDP from the services sector.

The equations for imports of capital goods and intermediate goods exhibit similar characteristics-lagged variables. The capital goods equation is a function of economic activity in the industrial sector lagged one period while current imports of intermediate goods are determined by past levels of capital good imports. So we see an entrepreneur responding to levels of economic activity by first importing the capital goods and, after they are in place, then the intermediate goods. Parallel reasoning describes the equation for imports NES.

Imports of consumer goods and gasoline can be considered demand equations dependent upon income, population, and the depreciated stock of automobiles.

E. Model Forecasts

The model presented in the preceeding section was used to forecast values of the dependent variables, total, and per capita gross domestic product. To use the model as a forecasting tool, values for the exogenous variables must be obtained. Given the recursive structure, the model will solve for the necessary lagged endogenous variables. Values of the predetermined variables are presented in Tables XXVII and XXVIII. For this initial exercise, the values were derived by simple extrapolation.

A dynamic simulation was initialized beginning in 1981. The predicted GDP for 1982 was $8.7 million less than the observed value for 1982. Consequently, the predicted value was increased by a constant adjustment of $8.7 million to equal the actual value. This constant adjustment to GDP was then carried through all simulations.

The model forecasts are presented in Tables XXIX through XXXIV. Table XXIX presents forecasts of the component blocks, per capita GDP, and total GDP. Table XXX shows the forecasts of the component blocks broken down to the equations level. Graphical representation of component blocks is presented in Figures 24 through 29.

Private consumption expenditure is forecast to recover from the hurricane-caused drop. The recovery is led by increases in consumption of electricity (fuel and light) followed by increased consumption NES. Increased activity in the industrial sector contributes to both of these increases. Implied elasticities were calculated and are presented in Table XXXV. The short-run price elasticity of demand for fuel and light was calculated to be -0.41, implying a 1% increase in electricity prices would cause a 0.41% reduction in demand. This implies electricity demand is relatively inelastic.

TABLE XXVII

EXOGENOUS VARIABLES
(1981 - 1985)

Year	RBANP	MATURITY	RXPTOAG	D8081	CPICLO	RMPTELM
1981	.59657	2	1 115.5	1	413.6	8 243.8
1982	.61532	3	1 072.9	0	431.7	6 489.7
1983	.6346	4	1 113.4	0	441.2	7 869.7
1984	.6548	5	1 155.2	0	450.9	9 522.1
1985	.6757	4	1 198.5	0	460.8	11 522

Year	POP	DNAUTO	DST78	TARRIVE	FLRATIO	D7982
1981	122 200	8 964.5	1	96 569	1.1146	0
1982	124 000	9 728.9	1	98 181	1.1465	1
1983	125 827	10 080	1	99 820	1.2112	1
1984	127 679	10 795	1	101 486	1.2508	1
1985	129 560	11 509	1	103 180	1.2904	1

Year	UNEMP	D82	SRVLAB	RINVVEH	MFGLAB	ROUTWKR	RCUMAGIN	REGXPT
1981	13 942	0	9 884	5 960.2	4 448	1.753	7 911	61 127
1982	13 991	1	9 943	4 716.3	4 517	1.9425	8 082.7	61 689
1983	14 063	1	9 997	5 839	4 587	2.09	8 836.7	62 000
1984	14 133	1	10 040	5 986	4 658	2.24	9 373.1	62 000
1985	14 201	1	10 068	6 133	4 730	2.41	9 909.5	62 000

TABLE XXVIII

INITIAL VALUES OF LAGGED ENDOGENOUS VARIABLES

Year	RPR	XPTBAN	RPDY	GDPIND	GDPTOU	ROUTWKR	RGDPT	MPTCAP	PCGDPT
1981	313 290	25 588	151 202	19 200	11 100	1.753	186 900	13 651	1.5295
1982	308 618	25 657	153 629	20 600	11 600	1.9425	189 900	10 676	1.5315

TABLE XXIX

DYNAMIC SIMULATION 1982-1985,
ST LUCIA MACRO MODEL WITH CONSTANT ADJUSTMENT
(Thousand 1977 $EC)

Year	Consumption	Investment	Government*	Exports	Imports	Per Capita GDP	Total GDP
1982	159 869	78 807	61 689	64 729	183 900	1 531	189 900
1983	163 237	77 445	62 000	70 487	188 116	1 540	193 760
1984	164 190	79 178	62 000	74 323	192 094	1 537	196 304
1985	166 132	79 451	62 000	73 847	195 344	1 503	194 793

*Exogenous values, not calculated by the model.

TABLE XXX

OUTPUT BLOCK FORECASTS
(By Year)

Year	Services	Tourism	Agriculture	Industrial
1983	74 564	11 790	26 798	20 315
1984	74 960	12 146	28 757	20 798
1985	75 287	12 508	30 457	21 287

TABLE XXXI

CONSUMPTION BLOCK FORECASTS
(By Year)

Year	Food and Beverage	Fuel and Light	Durables	Not Elsewhere Specified
1983	47 802	4 346.2	10 057	26 468
1984	47 773	4 502.7	9 657.9	27 296
1985	48 399	4 662.4	9 648.7	28 135

TABLE XXXII

INVESTMENT BLOCK FORECASTS
(By Year)

Year	Building and Construction	Materials and Transport
1983	57 820	19 625
1984	59 024	20 155
1985	60 193	19 258

TABLE XXXIII

FOREIGN TRADE BLOCK, EXPORT FORECASTS
(By Year)

Year	Bananas	Copra and Other Agriculture	Garments	Boxes	Not Elsewhere Specified	Re-Exports
1983	28 595	6 482.1	7 490.2	7 153.7	14 798	5 968.5
1984	31 516	6 559.2	7 715.9	5 519.9	15 194	7 818.8
1985	29 746	6 638.9	7 946.3	3 895.7	15 561	10 058

TABLE XXXIV

FOREIGN TRADE BLOCK, IMPORT FORECASTS
(By Year)

Year	Capital Goods	Intermediate Goods	Consumer Goods	Gasoline	Not Elsewhere Specified
1983	15 073	12 834	57 181	8 151.9	94 876
1984	14 952	16 117	57 576	8 747.8	94 701
1985	15 157	16 164	58 888	9 342.9	95 793

TABLE XXXV

IMPLIED SHORT-RUN ELASTICITIES

Dependent Variable	Exogenous Variable									
	TARRIVE	RPDY	POP	FLRATIO	PCGDPT	UNEMP	RBANP	CPICLO	RPR	DNAUTO
PCEFBV	.47	.35								
PCEFLI			4.6	-.41						
PCEDUR					1.01					
KAPBLD						6.26				
XPTBAN							.67			
XPTCOA										
XPTGAR								2.28		
XPTBOX										
XPTNES										
MPTCAP										
MPTINT									.50	
MPTCON		.42	1.29							
MPTGAS										1.06

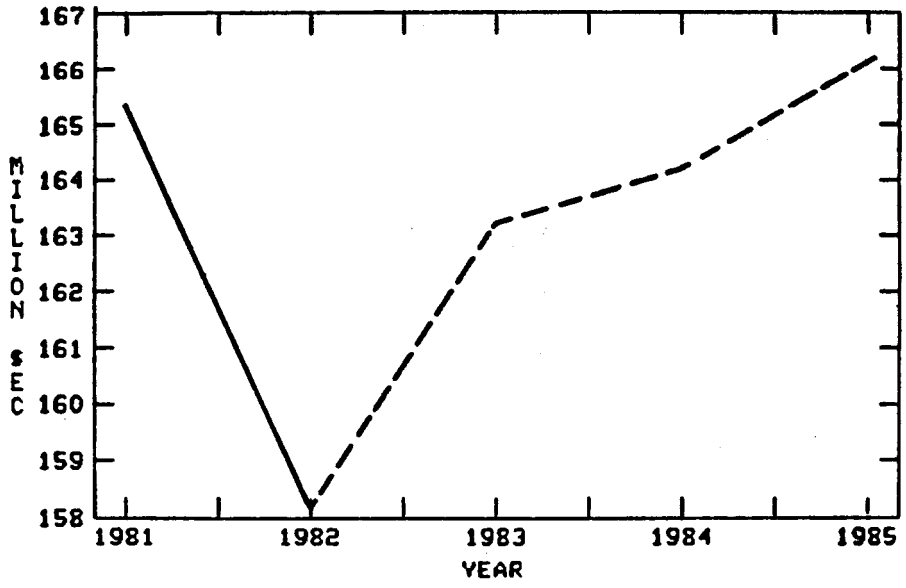

Fig. 24. Private consumption expenditure.

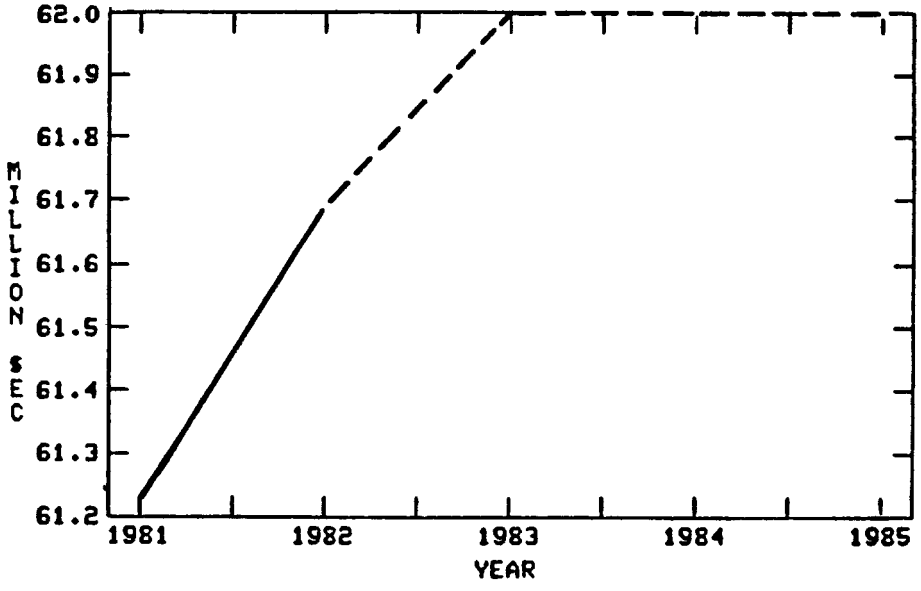

Fig. 25. Government expenditure.

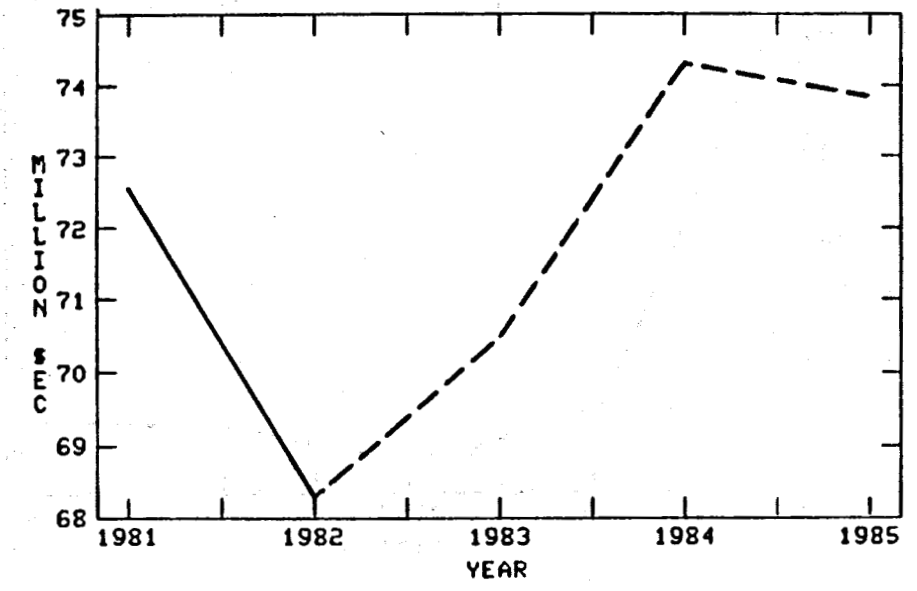

Fig. 26. Exports.

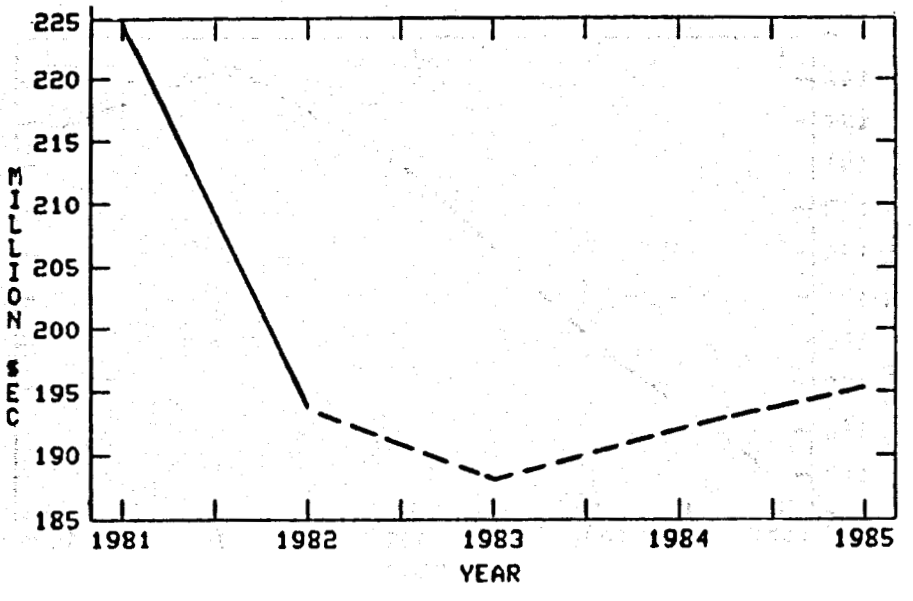

Fig. 27. Imports.

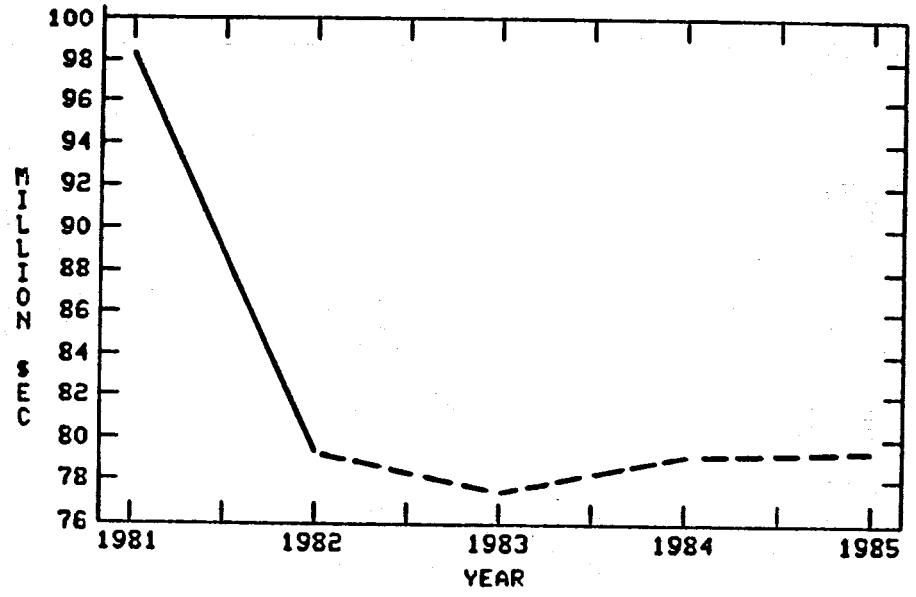

Fig. 28. Investment.

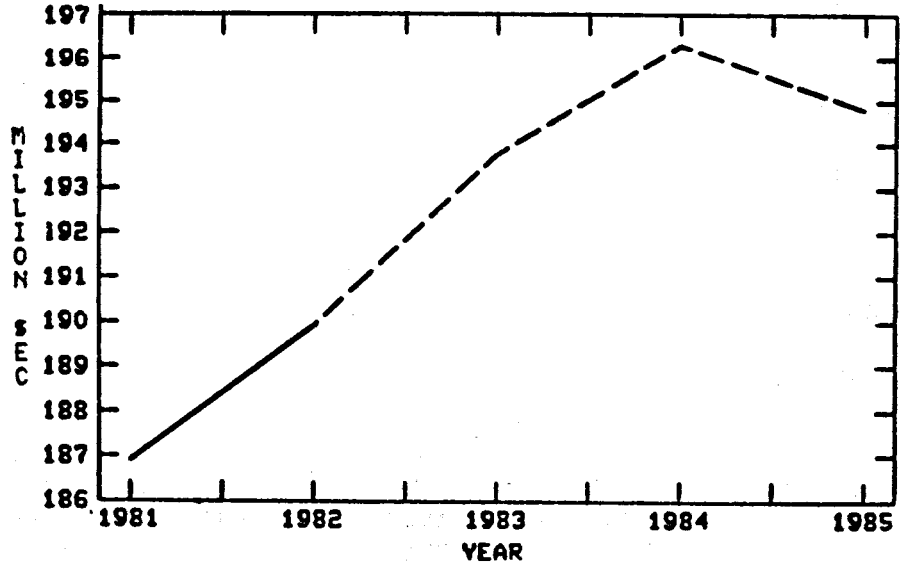

Fig. 29. St. Lucia gross domestic product.

Consumption of food and beverages shows a modest increase and short-run income elasticity of 0.35. The response of consumption of food and beverages to tourist arrivals indicates that for a 10% increase in arrivals, consumption of food and beverages would increase 4.7%,and imports of consumer goods would increase 4.2%.

Government expenditures, Figure XXV, are exogenous to the model,and input values reflect the most recent levels.

The foreign trade sector is important to St. Lucia's economy. The exports show a remarkable recovery from the hurricane due to the replanting of bananas and the increased yields. Due to the cyclical nature of banana production however, yields in the later forecast period decline,causing a reduction in banana export values. The implied price elasticity of supply for bananas is 0.67. Exports of copra and other agricultural products exhibit a slight increase. Problems are anticipated with copra exports in the near term due to an excess supply from Asian markets. Garment exports, on the other hand,look strong,while exports of boxes begin to falter as they are related to lagged banana export production. Rapid growth is indicated in the re-export sector,but we have little solid information as to how this sector performs.

Imports show a decline from the 1980 hurricane and bottom out in 1983. Increase in imports begin and are led by imports of gasoline. Only one large increase occurs in imports of intermediate goods in response to imported capital goods the previous year. The remaining periods exhibit steady growth.

The pattern for investment in St. Lucia is mixed. We forecast a growth in investment in building and construction, primarily as response to increasing unemployment. Investment in materials and transport remains relatively unchanged.

All total, we see the GDP of St. Lucia growing over the next two years and then beginning to decline due primarily to reduced banana exports affecting banana export values and exports of boxes. Increased imports also contribute to the decline in GDP, particularly imports of gasoline and increased consumption expenditures for fuel/light and the related imports of diesel fuel.

On a per capita level, GDP declines in the post-84 period. The growth in population exceeds the growth rate of the economy which results in declining per capita incomes.

On a positive note,the forecast growth in garment exports, up 6.1%, will provide needed employment and foreign exchange to offset the anticipated decline in banana export earnings.

II. NONLINEAR OPTIMIZING MODEL

A. Introduction

To complement the short-term outlook provided by the macroeconometric model for St. Lucia, we used a nonlinear programming model to forecast growth in consumption and GNP (Gross National Product) and to estimate energy costs and optimal investment levels for the period through 2012. The St. Lucia Model is a small dynamic model of the energy production sector and the rest of the economy (as a single sector) for St. Lucia. The model is a standard optimal growth model and is adapted from Alan Manne's ETA-MACRO Model of the US and thus draws heavily on the development of that model.[1]

The basic questions addressed by the St. Lucia Model are:how fast should energy be developed to keep pace with growth of the rest of the economy? What relative emphasis should be placed on capital investment in the energy vs. non-energy sectors of the economy? What general types of energy investments are most appropriate? What effect will world oil prices have on the St. Lucia economy? Of course there are other questions that can be addressed,but this short list gives a flavor for the orientation of the model. The model is less well suited for evaluating specific energy projects or for detailed development issues.

In the next section more detail will be presented on use and applications of the St. Lucia Model. The subsequent section presents detailed documentation of the model. This is followed by sections concerning parameter estimation, results, and conclusions.

B. Applications and Use

The St. Lucia Model can be thought of as consisting of two pieces (Fig. 30). One piece represents the nonenergy portion of the economy. In a very simplistic fashion, this portion of the model tells how many aggregate goods and services can be produced from specific amounts of capital, labor, electricity, and other energy inputs. Using this representation of the production process, the model chooses an optimal capital stock and energy-use mix to achieve maximal economic growth (the labor stock is exogenous to the model).

[1]This discussion also draws heavily on the various documentations of the ETA-MACRO Model, particularly (7). We have appreciated the clarity with which the ETA-MACRO Model is documented.

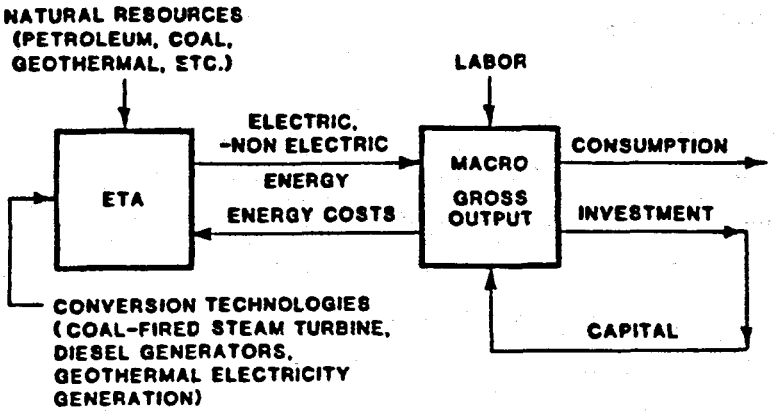

Fig. 30. An overview of ETA-MACRO.

The other portion of the model concerns the supply of the two basic production inputs, electricity and other energy. In particular, this portion of the model focuses on the supply of electricity. There are several ways to generate electricity and a variety of levels of electricity output at any point in time. This portion of the model computes the least-cost way of generating any given amount of electricity as well as supplying any given amount of nonelectric energy. Combining these two halves, the model seeks to maximize the net present value of final demand (consumption) over an infinite-time horizon by adjusting energy use, investment and thus the capital stock. The model is dynamic, consisting of a five-year period beginning with the period centered around 1982. Consumption is gross output, less depreciation, investment, and energy costs. There is a fundamental tradeoff between investment and consumption. More consumption can be enjoyed now by reducing investment, which in turn reduces consumption opportunities at future points in time. Other economic objectives can be used besides maximizing the present-value of consumption, although, since the model is an equilibrium model, no unemployment exists in the model and thus employment objectives are infeasible.

With that overview of the model, we turn to uses of the St. Lucia Model. Given an initial labor force and an assumed growth rate through time, an initial capital stock, a discount rate, characteristics of the economy-wide production function, and energy costs, the model is completely specified. Optimal investment level and energy use levels can then be determined. Any of the above

parameters can be adjusted to look at their effect on model performance. In the energy use sector, optimal mixes and the time phases of geothermal and diesel generating technologies are computed. In particular, we measure the effect of a partial or complete elimination of geothermal.

C. Description of Model

As described earlier, the St. Lucia Model consists of two basic parts: an energy sector and a nonenergy, rest-of-economy (i.e., macroeconomic sector). We will describe these two sectors separately and thus discuss how they are integrated into the St. Lucia Model.

C.1. The Energy Sector. The entire function of the energy sector is to compute the least-cost way of satisfying demands for electric energy over the ($DMELEC_t$) and demand for nonelectric energy over time ($DMNELE_t$). These demands are from the macro sector. Electricity demand is satisfied by productive capacity of various types (j) for generating electricity: PC_{jt}. This capacity cannot be arbitrarily adjusted up and down but may only be changed through investment, DP_{jt}. Nonelectric energy demand is satisfied through oil imports which are represented by the variable, $NEPETR_t$, which, however, may be adjusted upwards or downwards at any time. Costs then consist of annualized capital costs for generating capacity as well as fuel costs for diesel generation and other energy use. This discussion is expressed in mathematical notation below.

1. Indices

$t = 1,....,T$	Time periods, running discretely in 5-year intervals ($t = 00,05,10,15,....,75$).
$j = 1,....,J$	Electricity generating technologies (j = DIES, GEOT).

2. Endogenous Variables

PC_{jt}	Productive electricity generating capacity (10^9 kWh/year).
$NEPETR_t$	Use of petroleum for nonelectric purposes (10^9 kWh/year).
DP_{jt}	Electricity generating capacity increments (10^9 kWh/year).

$QPETR_t$ Quantity of petroleum imported (10^{12} Btu/year)

$ENCOST_t$ Energy Costs (10^9 EC$/year).

3. Exogenous From Macro Sector

$DMELEC_t$ Demand for electricity (10^{12} kWh/year).

$DMNELE_t$ Demand for nonelectric energy (10^{12} Btu/year).

4. Coefficients and Parameters

h_{jt} heat rate for generating capacity (10^3 Btu/kWh).

C_{jt} cost of generating capacity (net of fuel use) (EC$/$10^3$ kWh).

po_t price of oil imports (EC$/$10^6$ Btu).

5. Constraints

a. Capacity Constraints: Relates investments (DP_{jt}) to on-line capacity (PC_{jt}). Note that after thirty years, capacity is retired. For $t - 30 < 0$, DP_{t-30} represents a constant equivalent to capacity due to be retired in time period t:

$$\text{Capacity available}_{jt}: \quad PC_{jt} = PC_{j,t-5} + 5[DP_{jt} - DP_{j,t-30}], \tag{2}$$

i.e., "Total capacity in year t = capacity, from previous 5 years + capacity increments - retirements."

b. Satisfaction of Demand

$$RQELEC_t: \quad \sum_{j=1}^{J} PC_{jt} \geq DMELEC_t, \tag{3}$$

"Electric generating capacity $\geq$ Demand for electricity."

$$RQNELE_t: \quad NEPETR_t \geq DMNELE_t, \tag{4}$$

"Use of petroleum for nonelectric purposes $\geq$ demand for nonelectric energy."

c. Total Demand for Oil

$$RQPETR_t: \quad QPETR1_t \geq \sum_{j=1}^{J} h_{jt} PC_{jt} + NEPETR_t , \tag{5}$$

"Petroleum imports $\geq$ petroleum needed to generate electricity + petroleum used for nonelectric purposes."

d. Total Energy Costs

$$COSTEN_t: \quad 1000ENCOST_t = \sum_{j=1}^{J} C_{jt} CP_{jt} + po_t QPETR1_t , \tag{6}$$

"Energy Cost = Cost of electricity generation exclusive of fuel cost + fuel cost."

In the above constraint, the 1000 appears to ensure consistency between the units of $ENCOST_t$ (10^9 EC$) and the units of the right-hand side of the equation (10^6 EC$). The purpose of this constraint is purely for convenience: to transmit energy cost information to the macroeconomic model through a single variable.

C.2. The Macroeconomic Sector. The macroeconomic sector consists of a single aggregate-production function representing output from the entire non-energy portion of the St. Lucia economy. Inputs to the aggregate-production function are capital stock (K_t), labor (L_t), electricity (E_t), and nonelectric energy (N_t). The production function is a so-called nested constant elasticity of substitution (CES) production function of the form

$$Y^{\rho} = a(K^{\alpha} L^{1-\alpha})^{\rho} + b(E^{\beta} N^{1-\beta})^{\rho}, \tag{7}$$

where Y_t is output. The labor force is exogenously specified. The capital stock is initialized but from that point determined by investment. Energy use comes from the energy sector of the model. Note that capital and labor appear together in a Cobb-Douglas framework as do the two types of energy. The

production function is termed CES because the elasticity of substitution between the K-L aggregate and the E-N aggregate is given by $\rho = \frac{1}{1-\sigma}$, where σ equals the elasticity of substitution between energy and nonenergy inputs. In actuality, in any time period, production is broken into two pieces: production from new capital (put in place since the base year, 1977) and production from old (existing prior to the first time period) capital. This reflects the fact that once invested, capital cannot easily be shifted to new tasks. Thus, output in any year is given by

$$Y_t = \lambda^t \bar{Y} + [a(KN_t^{\alpha} LN_t^{1-\alpha})^{\rho} + b(EN_t^{\beta} NN_t^{1-\beta})^{\rho}]^{1/\rho}, \tag{8}$$

where λ is a decay factor reflecting retirement of old capacity, $\bar{Y}$ is output prior to the first period and KN_t, LN_t, EN_t, and NN_t represent the new quantities of the basic factors. Thus $KN_t = K_t - \lambda^t \bar{K}$, $LN_t = L_t - \lambda^t \bar{L}$, etc. In summary, production in any period consists of "decayed" production from the base period plus production from "new" resources.

One might note that no technical progress has been embodied in the macroeconomic production function. In fact, technical change has been embodied in labor inputs. Labor inputs are in productivity units not physical labor force. Thus, if the actual labor force is growing by 3% per year and productivity growth is 2% per year, then L_t would grow at 5% per year.

C.3. The Integrated Model. The energy and macroeconomic sectors are integrated through a single objective function which drives the model as well as a capital accumulation equation to convert investment to capital stock. The objective function is to maximize the net present value of the utility of consumption:

$$\max \sum_{t=0}^{70} (1+\delta)^{-t} \ln C_t = \sum_{t=75}^{\infty} (1+\delta)^{-t} \ln[C_{75}(1+g)^{t-75}]. \tag{9}$$

In the above equation C_t is consumption and δ is the discount rate. The utility function is logarithmic and serves the purpose of reflecting diminishing marginal utility. Thus, if consumption doubles, utility (lnC) does not quite

double. Any other objective function could of course be used,and its exact functional form is not critical to the qualitative use of the model. The second term in equation (9) is the infinite horizon simulator, serving to assume that the model does not just exhaust all resources during the last time period. From year 75 onwards, consumption is assumed to grow at some exogenously specified growth rate, g.

$$C_t = Y_t - I_t - ENCOST_t. \tag{10}$$

In fact when equation (10) is substituted into equation (9), the variable C_t disappears completely which is why it is not actually found in the St. Lucia Model.

Note that the second part of equation (9) refers to terminal conditions on consumption. Consumption in the terminal period is defined as above except that the terminal investment must be tied to capital through the growth rate, g, and depreciation, λ[2]:

$$I_{75} = (g + 1 - \lambda)K_{75}.$$

Investment constraints are the only others that are needed, tying investment to capital stock:

$$KN_t = \lambda^5 KN_{t-5} + 2I_{t-5} + 3I_t.$$

Thus,the model can be restated as

$$\max \left\{ \sum_{t=0}^{70} (1+\delta)^{-t} \ln(Y_t - I_t - ENCOST_t) + \sum_{t=75}^{\infty} (1+\delta)^{-t} \ln(Y_{75} - I_{75} - ENCOST_{75}), \right.$$

[2]Inspection of Eqn. 9 indicates that g does not enter the objective function except as a constant. Thus, the need for the terminal investment equation exists.

where $\{Y_t = \lambda^t \bar{Y} + [a(K_t - \lambda^t \bar{K})^{\alpha\rho}(L_t - \lambda^t \bar{L})^{(1-\alpha)\rho} + b(E_t - \lambda^t \bar{E})^{\beta\rho}(N_t - \lambda^t \bar{N})^{\beta(1-\rho)}]^{1/\rho}$

for t = 0,5,10,....,75)},

constrained by

TERMINR: $I_{75} = (g + 1 - \lambda)K_{75}$, the terminal investment rate.

$CAPCUM_t$: $K_t = \lambda^5 K_{t-5} + 2I_{t-5} + 3I_t$, t = 5,....,75, the capital stock.

CP_{jt} : $PC_{jt} = PC_{j,t-5} + 5[DP_{jt} - DP_{j,t-30}]$, j = 1,2,3; t = 0,5,....,75.

$RQELEC_t$: $\sum_{j=1}^{J} PC_{jt} \geq E_t$, t = 0,5,....,75.

$RQNELE_t$: $NEPETR_t \geq N_t$, t = 0,5,....,75.

$RQPETR_t$: $QPETR1_t \sum_{j=1}^{J} h_{jt}PC_{jt} + NEPETR_t$, t = 0,5,....,75.

$COSTEN_t$: $1000ENCOST_t = \sum_{j=1}^{J} C_{jt}PC_{jt} + po_t QPETR1_t$, t = 0,5,....,75.

In the above maximization, the variables are I_t, $ENCOST_t$, K_t, PC_{jt}, DP_{jt}, E_t, N_t, $NEPETR_t$, and $QPETR1_t$. In the computer code, K_t is $KAPSTK_t$, E is $DMELEC_t$, and N_t is $DMNELE_t$.

D. Parameter Estimation

This section is concerned with input data to the model. In the macroeconomic portion, one must specify an elasticity of substitution, σ, between the capital-labor aggregate and the energy aggregate. The coefficients α and β must also be specified. Base-year values of $\bar{Y}$, $\bar{K}$, $\bar{L}$, $\bar{N}$, $\bar{E}$ and $P_{\bar{N}}$ are specified by

the user and are used to calculate the coefficients a and b based on equating the value of marginal product to factor price, P_N It is also necessary to specify a discount rate (δ), the depreciation rate (λ) and a post-horizon growth rate (g). The labor force (in productivity units) for all time periods must also be input.

In the energy subsection of the model, one must specify heat rates, h_{jt}, converting electricity generation to fuel use; price of generation net of fuel, C_{jt}; cost of oil imports, po_t; upper bounds on generating capacity (e.g., geothermal); and retirement rates for capacity in place before the base year, $DP_{j,t-30}$ for $0 \leq t \leq 25$--this is treated as a constant in the constraint CP_{jt}.

Table XXXVI contains values of the various input data for the base run described in the next section.

E. Results and Conclusions

The model was run with three different sets of future oil prices and, for each set of oil prices, two different energy technology scenarios – one that continues exclusive use of diesel generators with replacement as necessary and one which allows the gradual installation of geothermal capacity (referred to as "without geothermal" and "with geothermal," respectively). The predicted values of the major variables discussed previously are in the Table XXXVII for 1982 through 2012.

All runs of the model predict healthy growth of the St. Lucian economy in the next three decades. GNP is predicted to grow at an average rate of 3.3%/year and annual consumption at 4.7% to 5.1%/year, depending on the price of oil and whether geothermal capacity is installed.

Since the focus of our efforts is to evaluate the relative benefit of geothermal energy development to the St. Lucian economy, the remainder of the discussion will compare forecasts with and without geothermal under the two extreme assumptions about the price of oil – the real oil price remains constant and the oil price increases by 2%/year (referred to as the "higher oil price" case). The relative benefit of geothermal will be measured as the per cent increase in a benefit (e.g., annual consumption) afforded by installation of geothermal in a given year under a given assumption about the price of oil. For example, the relative benefit of geothermal in annual consumption in 2012, if the oil price increases by 2%/year, is

TABLE XXXVI
INPUT VALUES
(Constant 1977 EC$)

Base Year = 1977

$\bar{Y}$	=	.152	(10^9 EC$)
$\bar{K}$	=	.380	(10^9 EC$) [Assumed to equal 2.5 times GNP — a reasonable K/GNP ratio for a developing country (8)].
$\bar{L}$	=	1.00	
$\bar{N}$	=	.4	(10^{12} Btu)
$\bar{E}$	=	.05	(10^9 kWh)
$P_{\bar{N}}$	=	0.00975	(EC$/1000 Btu)
$L_0, L_1, \ldots, L_{75}$	=	(1.16, 1.446, 1.717, 2.039, 2.364, 2.740, 3.101, 3.508, 3.873, 4.276, 4.721, 5.213, 5.755, 6.354, 7.016, 7.7) (Assumed a 3%/year increase in labor force and productivity).	
δ	=	.05	
σ	=	.125	
α	=	.29 (Estimated from St. Lucian economic data).	
β	=	.55	
λ	=	.96	
g	=	.02	
h_{jt}	=	12 (10^3 Btu/kWh) for j = DIESEL; 0 for j = GEOTHERMAL	
C_{jt}	=	26.08 (EC$/1000 kWh) for j = DIESEL; 29.65 for j = GEOTHERMAL	
po_t	=	12.08	($EC/10^6$ Btu) for the constant oil price case. This price is increased by 1% or 2%/year for the cases which assume that the real oil price increases.
$DP_{j,t-30}$	=	.006	for j = DIESEL
$DP_{j,t-25}$	=	.031	
$DP_{j,t-20}$	=	.013	

Upper bounds on (10^9 kWh/year) on $PCGEOT_t$ for t = 0,5,....,75 = (0,.05,.07,.105,.125,.160,.210,.220,.221,....,.221).

$$9\% \text{ increase} = \frac{AC_{2012} \text{ w/ Geothermal} - AC_{2012} \text{ w/o Geothermal}}{AC_{2012} \text{ w/o Geothermal}},$$

where AC = annual consumption.

In addition to the relative benefit of geothermal, the effect of increasing oil prices on the economy is quantified in the results and will be discussed also. The relative effect of increasing oil prices is measured by calculating the increase or decrease in a variable between the constant oil case and the higher oil price case for a given year and a given energy technology.

As one would expect, the relative benefits to the economy of geothermal generating capacity increases as the price of oil increases. However, the size of the relative benefit of geothermal installation varies for the different variables considered, as will be apparent in the discussions below. The sensitivity to oil price increases (the elasticity with respect to the price of oil) varies also for the different variables forecasted. In general, one can see in the results the deterioration in economic welfare that results from increases in the price of oil. This deterioration is ameliorated by varying degrees if geothermal is installed.

One general result applies for all variables that will be discussed - namely, a "benefit" (such as consumption, GNP, etc.) is generally largest and a "cost" (e.g., cost of energy, petroleum requirements) is lowest in the case that allows development of geothermal energy and in which oil prices remain constant. In other words, a future in which the price of oil remains constant and geothermal capacity is developed is the best for development. In contrast, the case in which the price of oil increases by 2%/year and geothermal is not installed is the worst for economic development of all six cases considered.

The discussion focuses on two years: 1992, when 10 MW of geothermal capacity has been installed and 2012, when 30 MW are installed. Since it has been assumed that the St. Lucian economy bears the full, levelized life-cycle cost of any new energy capacity rather than receiving foreign aid money, the results may be somewhat conservative.

E.1. Annual Consumption. Forecasted annual consumption is shown in Fig. 31. In 1992, the relative increase in annual consumption allowed by the installation of geothermal energy ranges from a 2% increase in the constant oil case to a 3% increase in the higher oil price case. By 2012, the benefit of

TABLE XXXVII

PREDICTED VALUES OF MACROECONOMIC VARIABLES
(in billions of 1977 EC$'s unless otherwise stated)

Variable	Year	Price of Oil Remains Constant		Price of Oil Increases by 1%/year		Price of Oil Increases by 2%/year	
		Without Geothermal	With Geothermal	Without Geothermal	With Geothermal	Without Geothermal	With Geothermal
Annual Consumption	1982	0.084	0.084	0.084	0.084	0.084	0.084
	1987	0.183	0.185	0.182	0.184	0.181	0.184
	1992	0.201	0.205	0.199	0.204	0.197	0.203
	1997	0.233	0.238	0.229	0.236	0.225	0.234
	2002	0.271	0.279	0.266	0.276	0.259	0.273
	2007	0.314	0.324	0.306	0.320	0.296	0.316
	2012	0.361	0.373	0.349	0.368	0.334	0.364
Cumulative Consumption	1982	0.422	0.422	0.422	0.422	0.422	0.422
	1987	1.137	1.145	1.133	1.143	1.129	1.141
	1992	1.745	1.774	1.744	1.769	1.734	1.763
	1997	2.313	2.347	2.295	2.337	2.276	2.327
	2002	2.824	2.872	2.796	2.857	2.765	2.842
	2007	3.288	3.349	3.248	3.330	3.202	3.309
	2012	3.706	3.781	3.652	3.756	3.588	3.729
GNP (Y)	1982	0.180	0.180	0.180	0.180	0.180	0.180
	1987	0.227	0.228	0.227	0.228	0.227	0.228
	1992	0.263	0.265	0.263	0.264	0.263	0.264
	1997	0.310	0.313	0.310	0.313	0.309	0.312
	2002	0.361	0.365	0.360	0.364	0.358	0.363
	2007	0.420	0.425	0.417	0.423	0.414	0.422
	2012	0.480	0.485	0.475	0.483	0.470	0.480
Investment (I)	1982	0.0790	0.0790	0.0790	0.0790	0.0790	0.0790
	1987	0.0250	0.0261	0.0252	0.0261	0.0254	0.0261
	1992	0.0401	0.0417	0.0397	0.0415	0.0394	0.0412
	1997	0.0520	0.0539	0.0511	0.0536	0.0503	0.0533
	2002	0.0600	0.0619	0.0585	0.0613	0.0571	0.0605
	2007	0.0713	0.0731	0.0690	0.0717	0.0666	0.0699
	2012	0.0788	0.0819	0.0757	0.0805	0.0721	0.0784
Capital Stock (KAPSTK)	1982	0.4750	0.4750	0.4750	0.4750	0.4750	0.4750
	1987	0.6204	0.6237	0.6208	0.6237	0.6215	0.6238
	1992	0.6761	0.6860	0.6756	0.6853	0.6757	0.6847
	1997	0.7873	0.8043	0.7837	0.8027	0.7807	0.8009
	2002	0.9260	0.9483	0.9170	0.9456	0.9084	0.9411
	2007	1.0888	1.1172	1.0719	1.1086	1.0545	1.0981
	2012	1.2669	1.3026	1.2393	1.2887	1.2094	1.2700

TABLE XXXVII (cont.)

PREDICTED VALUES OF MACROECONOMIC VARIABLES
(in billions of 1977 EC$'s unless otherwise stated)

Variable	Year	Price of Oil Remains Constant		Price of Oil Increases by 1%/year		Price of Oil Increases by 2%/year	
		Without Geothermal	With Geothermal	Without Geothermal	With Geothermal	Without Geothermal	With Geothermal
Productive Diesel Generating Capacity (10^9 kWh/yr)	1982	0.0638	0.0638	0.0638	0.0638	0.0638	0.0638
	1987	0.0665	0.0328	0.0664	0.0328	0.0663	0.0328
	1992	0.0748	0.0198	0.0745	0.0198	0.0742	0.0198
	1997	0.0864	0.0198	0.0857	0.0198	0.0849	0.0198
	2002	0.0990	0.0198	0.0977	0.0198	0.0963	0.0198
	2007	0.1140	0.0198	0.1119	0.0198	0.1097	0.0198
	2012	0.1291	0.0000	0.1260	0.0000	0.1223	0.0000
Productive Geothermal Generating Capacity (PCGEOT) (10^9 kWh/yr)	1982	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1987	0.0000	0.0454	0.0000	0.0463	0.0000	0.0472
	1992	0.0000	0.0700	0.0000	0.0700	0.0000	0.0700
	1997	0.0000	0.0897	0.0000	0.0948	0.0000	0.1003
	2002	0.0000	0.1084	0.0000	0.1171	0.0000	0.1250
	2007	0.0000	0.1299	0.0000	0.1433	0.0000	0.1578
	2012	0.0000	0.1713	0.0000	0.1904	0.0000	0.2100
Diesel Generating Capacity Increments (DPDIES) (10^9 kWh/yr)	1982	0.0139	0.0139	0.0139	0.0139	0.0139	0.0139
	1987	0.0067	0.0000	0.0067	0.0000	0.0067	0.0000
	1992	0.0042	0.0000	0.0042	0.0000	0.0042	0.0000
	1997	0.0023	0.0000	0.0022	0.0000	0.0021	0.0000
	2002	0.0025	0.0000	0.0024	0.0000	0.0023	0.0000
	2007	0.0030	0.0000	0.0028	0.0000	0.0026	0.0000
	2012	0.0169	0.0100	0.0167	0.0100	0.0165	0.0100
Geothermal Generating Capacity Increments (DPGEOT) (10^9 kWh/hr)	1982	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1987	0.0000	0.0090	0.0000	0.0093	0.0000	0.0094
	1992	0.0000	0.0047	0.0000	0.0047	0.0000	0.0046
	1997	0.0000	0.0039	0.0000	0.0050	0.0000	0.0060
	2002	0.0000	0.0037	0.0000	0.0045	0.0000	0.0049
	2007	0.0000	0.0043	0.0000	0.0052	0.0000	0.0066
	2012	0.0000	0.0082	0.0000	0.0094	0.0000	0.0104
Demand for Electric Energy (DMELEC) (10^{12} kWh/yr)	1982	0.0638	0.0638	0.0638	0.0638	0.0638	0.0638
	1987	0.0665	0.0782	0.0664	0.0791	0.0663	0.0800
	1992	0.0748	0.0898	0.0745	0.0898	0.0742	0.0898
	1997	0.0864	0.1095	0.0857	0.1146	0.0849	0.1200
	2002	0.0990	0.1282	0.0978	0.1369	0.0963	0.1448
	2007	0.1140	0.1498	0.1119	0.1631	0.1095	0.1776
	2012	0.1291	0.1713	0.1260	0.1904	0.1223	0.2100

TABLE XXXVII (cont.)

PREDICTED VALUES OF MACROECONOMIC VARIABLES
(in billions of 1977 EC$'s unless otherwise stated)

Variable	Year	Price of Oil Remains Constant		Price of Oil Increases by 1%/year		Price of Oil Increases by 2%/year	
		Without Geothermal	With Geothermal	Without Geothermal	With Geothermal	Without Geothermal	With Geothermal
Demand for Nonelectric Energy (DMNELE) (10^{12} Btu/yr)	1982	0.6400	0.6400	0.6400	0.6400	0.6400	0.6400
	1987	0.6512	0.5604	0.6474	0.5515	0.6438	0.5431
	1992	0.7697	0.6534	0.7584	0.6422	0.7477	0.6312
	1997	0.9215	0.7489	0.8980	0.6998	0.8761	0.6532
	2002	1.0826	0.8655	1.0424	0.7821	1.0057	0.7147
	2007	1.2681	1.0017	1.2060	0.8753	1.1500	0.7674
	2012	1.4528	1.1340	1.3648	0.9625	1.2861	0.8201
Energy Cost (ENCOST)	1982	0.0171	0.0171	0.0171	0.0171	0.0171	0.0171
	1987	0.0192	0.0167	0.0201	0.0173	0.0209	0.0179
	1992	0.0221	0.0181	0.0240	0.0190	0.0261	0.0200
	1997	0.0259	0.0211	0.0292	0.0228	0.0330	0.0247
	2002	0.0300	0.0243	0.0352	0.0269	0.0413	0.0297
	2007	0.0348	0.0281	0.0424	0.0316	0.0517	0.0357
	2012	0.0396	0.0302	0.0501	0.0341	0.0634	0.0382
Petroleum Imports (QPETR) (10^{12} Btu/yr)	1982	1.2780	1.2780	1.2780	1.2780	1.2780	1.2780
	1987	1.4493	0.9540	1.4445	0.9451	1.4398	0.9367
	1992	1.6678	0.8910	1.6528	0.8798	1.6384	0.8689
	1997	1.9582	0.9865	1.9262	0.9364	1.8951	0.8908
	2002	2.2710	1.1031	2.2154	1.0197	2.1611	0.9523
	2007	2.6362	1.2393	2.5490	1.1129	2.4635	1.0050
	2012	3.0021	1.1390	2.8768	0.9624	2.7532	0.8201
Petroleum Used for Nonelectric Purposes (NEPETR) (10^{12} Btu/yr)	1982	0.6400	0.6400	0.6400	0.6400	0.6400	0.6400
	1987	0.6513	0.5604	0.6474	0.5515	0.6438	0.5431
	1992	0.7697	0.6534	0.7584	0.6422	0.7477	0.6312
	1997	0.9216	0.7489	0.8979	0.6988	0.8760	0.6532
	2002	1.0827	0.8653	1.0424	0.7821	1.0057	0.7147
	2007	1.2680	1.0017	1.2060	0.8753	1.1500	0.7674
	2012	1.4528	1.1390	1.3648	0.9624	1.2861	0.8200

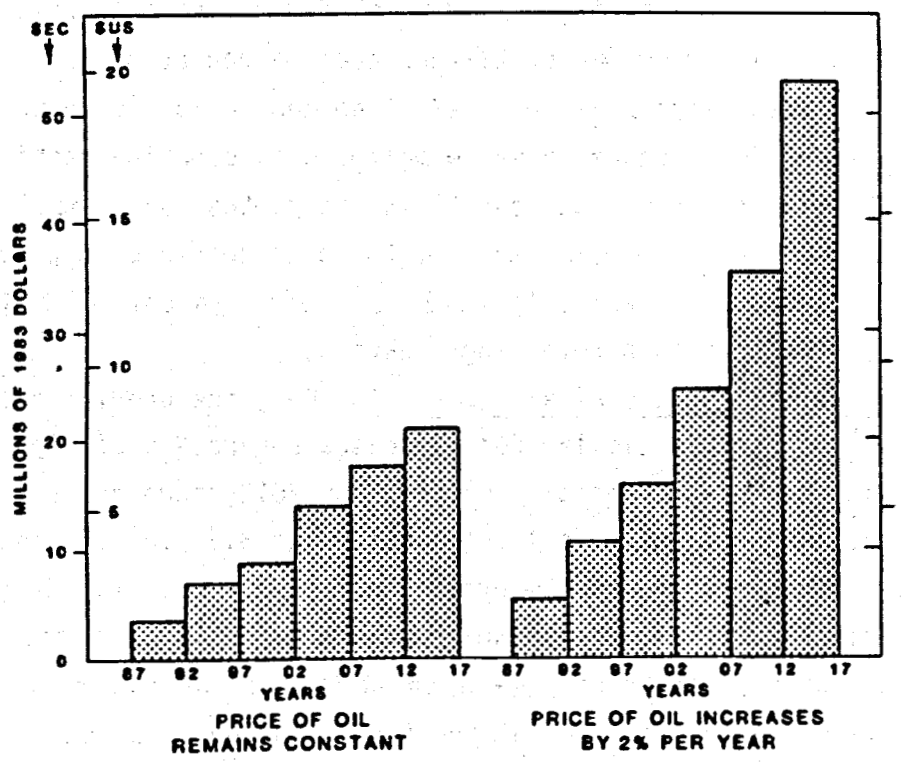

Fig. 31. Increase in annual consumption due to installation of geothermal power.

geothermal capacity has widened to 3% and 9%, respectively. A comparison of the constant oil case with the 2%/year increase case shows that geothermal energy cushions the negative effect of oil price increases. With geothermal, predicted annual consumption is 2.5% lower than it would have been had oil prices remained constant; without geothermal, annual consumption is 7.5% lower.

E.2. Cumulative Consumption. The relative benefit of geothermal energy in predicted cumulative consumption is a 2% increase in 1992 for all assumptions about oil prices, and, in 2012 a 2% increase for the constant oil case and a 4% increase for the 2%/year oil price increase.

The effect of increasing oil price on cumulative consumption is less than its effect on annual consumption because of the discount factor applied to cumulative consumption. As is often done in welfare economics, a social discount rate of 5% has been applied to cumulative consumption to put a higher priority

on the near term and to emphasize the distant future less because it is less certain. Oil price increases of 2%/year cause a reduction in cumulative consumption of 1.4% with geothermal and 3.2% if no geothermal is installed.

E.3. GNP. Because we chose to maximize consumption rather than GNP in the model, GNP does not show much sensitivity to geothermal capacity or to oil price increases. There is generally a 1% to 2% decrease in predicted GNP if geothermal is not installed and a 1% to 2% decrease in GNP if oil prices increase by 2%/year rather than remaining constant.

E.4. Investment and Capital Stock. In 1992, the predicted level of investment in the economy is similar for all cases regardless of higher oil prices and/or the existence of geothermal capacity. By 2012, however, the existence of geothermal capacity at a given oil price allows an 8.5% to 9.5% increase in the level of investment, mainly because energy costs and the fuel bill are lower with geothermal and therefore more money is available for investment. Contrasting the higher oil price case with the constant oil price case shows that higher oil prices decrease predicted investment by 4% to 5%.

As discussed earlier, the capital stock is a function of the initial capital stock, the amount of investment, and depreciation (or retirement) of old capital. The initial capital stock in the St. Lucian economy was assumed to equal 2.5 times the GNP for the base year, 1977. According to Meier (7), this assumption seemed reasonable for a developing economy. Since neither the initial capital stock nor the depreciation rate vary with oil prices or the existence of geothermal capacity, the level of investment is the sole cause of differences among predicted capital stock in the six runs of the model. As with investment, in 1992 capital stock levels are equal for all oil prices and energy technologies. By 2012, the effect of differing investment levels begins to manifest itself in capital stock levels. At a given oil price, capital stock levels are 3% to 5% higher if geothermal is installed. But as oil prices increase, capital stock is decreased by 4.5% if no geothermal is installed and by 2.5% if geothermal is installed.

E.5. Electric Generating Capacity. The optimal levels of the two types of generating capacity as computed by ETA-MACRO are included in Table XXXVII. Although they are similar, they are not exactly the same as the engineering recommendations (Edeskuty and Altseimer, 1984) because we did not require the addition of geothermal capacity in 5 MW increments. Upper limits on geothermal capacity were simply specified to correspond to the installation plan

recommended by the engineers. For the constant oil case and the 1%/year oil price increase case, the optimal level of geothermal capacity is somewhat lower than the upper limit because the model assumes slightly more reliance on non-electric energy until oil prices increase further (i.e., electricity demand is lower while oil prices are lower).

E.6. Energy Demand and Energy Cost. Given the limited amount of substitution that can take place between electric and nonelectric energy, the demand for electric energy is higher and the demand for nonelectric energy is lower if geothermal capacity is installed because the relative price of electric energy decreases. This relationship is shown graphically in Fig. 32. The reader should be cautioned that the curves are not, in an economic sense, demand curves because the ceteris paribus assumption does not apply - the capital stock and the structure of the economy in general will be different if the price of oil has increased by 2%/year for the past 30 years rather than remaining constant. In addition, the y-axis shows the price of oil rather than the price of electricity or nonelectric energy.

As discussed earlier in the text, energy costs represent the total energy bill to the St. Lucian economy for both electric and nonelectric energy. The cost of energy technologies were provided by Edeskuty and Altseimer (1984). The cost of diesel electricity generation reported by Edeskuty and Altseimer (1984) includes the fuel cost and assumes that the real price of oil remains constant. We separate the fuel cost from the capital and other operating costs of diesel generation and examine the effects of increases in fuel costs (oil price).

In general, energy costs more or less double between 1992 and 2012. This is not necessarily cause for alarm because the amount of energy used as the economy expands increased dramatically as well (as shown by the projections of demand for electric and nonelectric energy). Energy cost projections are significantly lower if geothermal capacity is installed: in 1992, costs are 18% to 23% lower, depending on the price of oil; and in 2012, they are 25% to 40% lower. Compared with the constant oil-price case, an increase in the price of oil by 2%/year increases energy costs by 60% without geothermal and by 27% if geothermal is installed.

The per cent of GNP that is spent to pay the energy bill is a more important indicator of the relative size of the energy costs. If oil prices remain constant and no geothermal is installed, energy costs are steady at about 8.5% of GNP from 1992 through 2012; if geothermal is installed, costs decrease

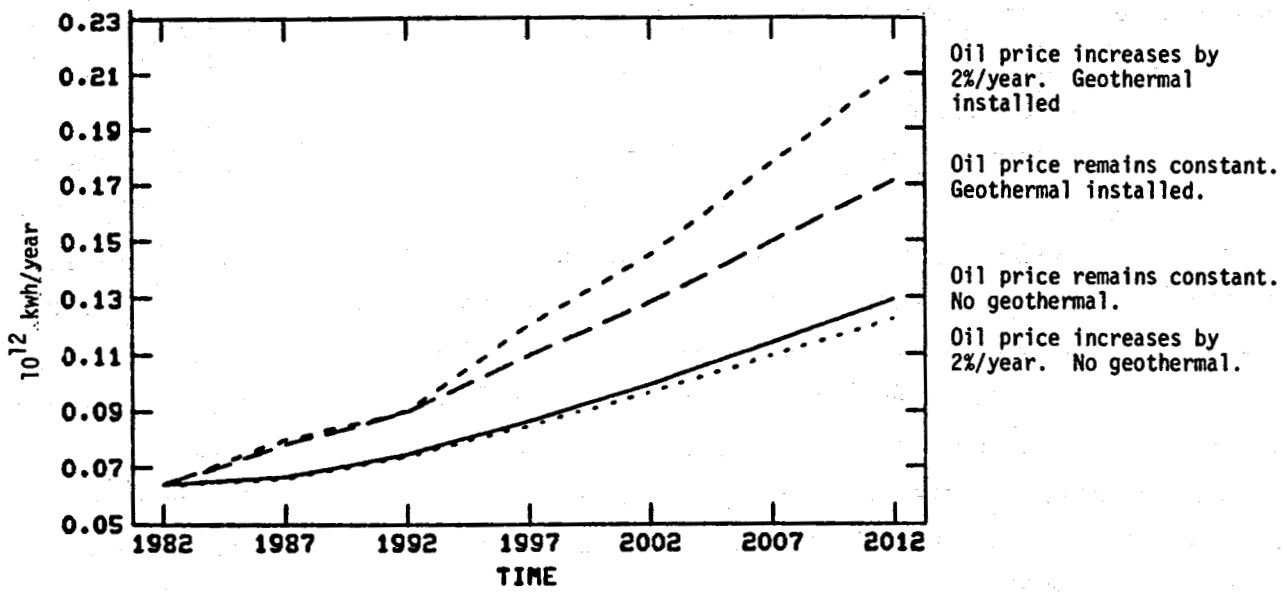

Fig. 32a. Predicted demand for electric energy.

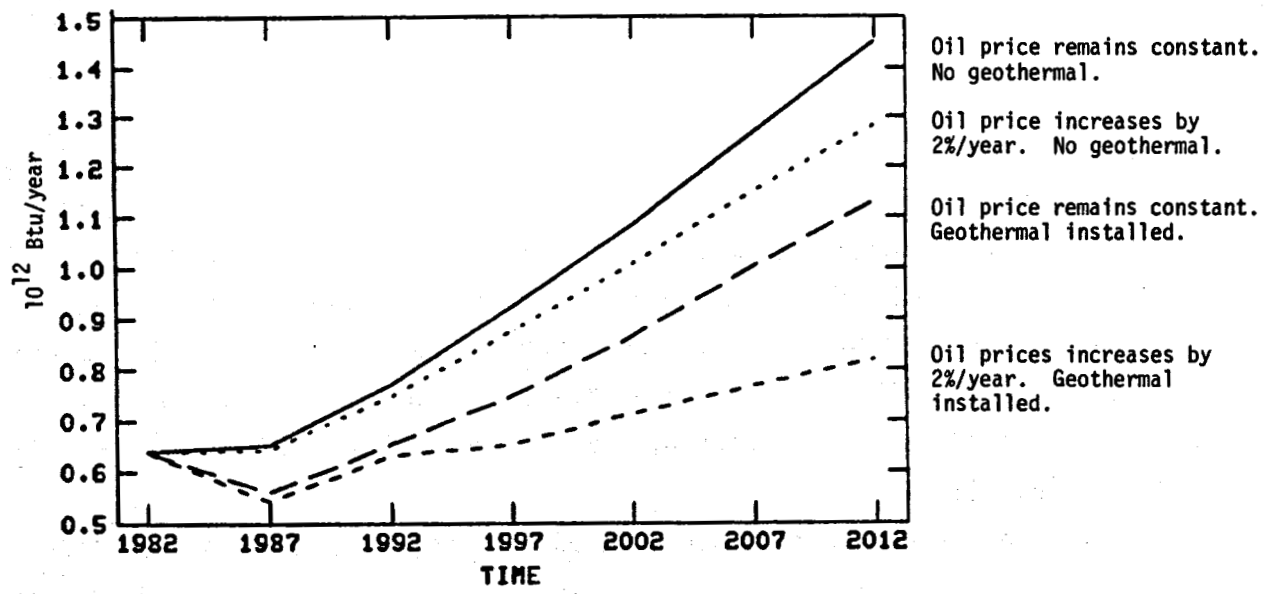

Fig. 32b. Predicted demand for nonelectric energy.

to about 6.5% of GNP for the same period. If oil prices increase by 2%/year and geothermal is not installed, energy costs represent a larger share of GNP — 10% in 1992 and 13.5% in 2012; if geothermal is installed, energy costs only amount to 7.5% of GNP in 1992 and 8% in 2012 — less than the constant-oil-price - without-geothermal case.

E.7. Petroleum Demand. The quantity of petroleum imported for all purposes also shows a pattern similar to that of the demand for nonelectric and electric energy. The demand projections are shown in Fig. 33. In all cases, the installation of geothermal halves the amount of petroleum required. An increase in the price of oil has a lesser effect on petroleum imports because the demand for energy is relatively inelastic — energy is necessary to economic growth. As shown by the energy cost projections, an increase in oil prices simply increases the percentage of GNP that must be spent on the fuel bill if geothermal is not installed.

Petroleum requirements for nonelectric energy decrease as the price of oil increases and, for a given oil price scenario, also decrease when geothermal capacity is an option.

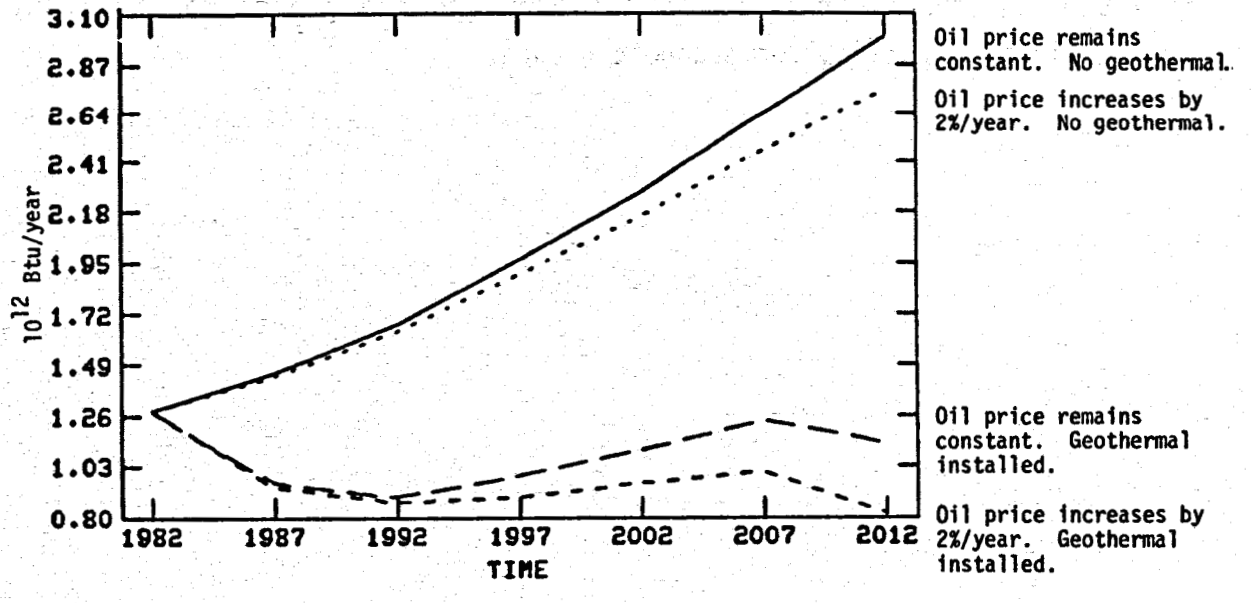

Fig. 33. Predicted petroleum imports.

F. Summary

The St. Lucia Model provides a long-term forecast of economic variables through the use of a nonlinear programming model that allows an interaction between energy costs and economic growth.

In our application of the model, we sought to examine the relative benefit of geothermal energy to the economy under a variety of assumptions about the future price of oil. We chose to maximize cumulative consumption because it represents a maximization of the welfare of the St. Lucian population. If geothermal energy is installed, cumulative consumption is increased by 2% to 4% by 2012 and annual consumption is increased by 3% to 9%, depending on the price of oil. The GNP is forecasted to increase at an average rate of about 3%/year and, for a given year, is about 1% to 2% lower if geothermal is not installed and/or if oil prices increase rapidly. Nonenergy related investment levels are distinctly higher if geothermal is installed.

Installation of geothermal capacity markedly decreases energy costs, increases the relative demand for electricity,and decreases the demand for petroleum.

In conclusion, the St. Lucia Model predicts a significant benefit to the economy from the installation of geothermal generating capacity. Energy costs as a percentage of GNP are decreased, leaving more funds to be spent on other goods. This allows an increase in consumption and investment. The case in which the real oil price remains constant and the geothermal is installed provides the best outlook for economic growth.

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APPENDIX A

LISTING OF ST. LUCIA ECONOMETRIC POLICY MODEL

```
EDITING REDSKIN
  1 PROGRAM
  2 CLEARDATA
  3 YEAR=INTS(1981 1985)
  4 $
  5 FTXX3=KEPTLIST(FTXX3);FTMX3=KEPTLIST(FTMX3)
  6 FCOX3=KEPTLIST(FCOX3);FINX3=KEPTLIST(FINX3)
  7 FOUX3=KEPTLIST(FOUX3)
  8 GOV=KEPTLIST(GOV)
  9 LAGENDO=KEPTLIST(LAGENDO)
 10 $
 11 PRINT 'T=3,5'
 12 FOR T=3,5
 13 $OUTPUT
 14 $
 15 GDPSRV(T)= 20655 +4.6044%SRVLAB(T)+1.3493%RINVVEH(T)
 16 GDPTOU(T)= -9541+.21369%TARRIVE(T)
 17 GDPIND(T)=-10874 +6.7994%MFGLAB(T)
 18 GDPAGR (T)=       +6059.3%(ROUTWKR(T-1))+1.8592%(RCUMAGIN(T-1))
 19 GDPSIN(T)=GDPSRV(T)+GDPIND(T)
 20 OUTPUT(T)=GDPSRV(T)+GDPTOU(T)+GDPIND(T)+GDPAGR(T)
 21 $
 22 $CONSUMPTION
 23 $
 24 PCEFBV(T)= 7457.6 +.23748%TARRIVE(T)+.10831%(RPDY(T-1))
 25 PCEFLI(T)=-8737.9+.11036%POP(T)+661.42%D7982(T)-1208.4%FLRATIO(T)
 26 PCEDUR(T)=        +6566.9%PCGDPT(T-1)
 27 PCENES(T)=-8359.9+1.7144%GDPIND(T)
 28 CONSUMPT(T)=PCEFBV(T)+PCEFLI(T)+PCEDUR(T)+PCENES(T)
 29 $
 30 $INVESTMENT
 31 $
 32 KAPBLD(T)=-169367+17.2%UNEMP(T)-14697%D82(T)
 33 KAPMAT(T)=65199-1.8573%(GDPIND(T-1))-7313.5%D82(T)
 34 INVESTME(T)=KAPBLD(T)+KAPMAT(T)
 35 $
 36 $FOREIGN TRADE
 37 $
 38 $     EXPORTS
 39 XPTBAN(T)= 1400  +28009%RBANP(T)+2355.1%MATURITY(T)
 40 XPTCOA(T)= 4438  +1.9052%(RXPTOAG(T-1))-1650.3%D8081(T)
 41 XPTGAR(T)=-2764.8+23.755%(CPICLO(T-1))
 42 XPTBOX(T)=21421-.55608%(XPTBAN(T-1))
 43 XPTNES(T)=-27903 +.45006%GDPSIN(T)+12058%D8081(T)
 44 RREXPT(T)=-2844  +1.1198%RMPTELM(T)
 45 EXPORTS (T)=XPTBAN(T)+XPTCOA(T)+XPTGAR(T)+XPTBOX(T)+XPTNES(T)+RREXPT(T)
 46 $
 47 $    IMPORTS
 48 MPTCAP(T)= 6332.6+.42431%(GDPIND(T-1))
 49 MPTINT(T)= 13453+.65163%(MPTCAP(T-1))-.024548% (RPR(T-1))
 50 MPTCON(T)=-32978 +.15081%(RPDY(T-1))+.5324%POP(T)
 51 MPTGAS(T)=-249.41+.83346%DNAUTO(T)
 52 MPTNES(T)=       1.721%(GDPIND(T-1))+.79695%GDPSRV(T)
 53 IMPORTS (T)=MPTCAP(T)+MPTINT(T)+MPTCON(T)+MPTGAS(T)+MPTNES(T)
 54 $
 55 $
 56 BALTRADE(T)=EXPORTS(T)-IMPORTS(T)
 57 $
 58 $ INCOME IDENTITIES
 59 $
 60 CO(T)=CONSUMPT(T) + GDPSRV(T)
```

(APPENDIX A cont.)

```
 61   I(T)=INVESTME(T)
 62   G(T)=RGEXPT(T)
 63   X(T)=EXPORTS(T)
 64   M(T)=IMPORTS(T)
 65 GDP1=CO(T)+I(T)+G(T)+(X(T)-M(T))
 66 RPDY(T)=(GDP1)%.809
 67 PCGDPT(T)=(GDP1)/POP(T)
 68 RPR(T)=(GDP1)/RBANP(T)
 69 ROUTWKR(T)=GDPAGR(T)/AGRLAB(T)
 70 ENDLOOP T
 71 PRINT 'NATIONAL INCOME=CONSPN+INVEST+GOVT+EXPORTS-IMPORTS'
 72 PRINT 'DYNAMIC SOLUTION'
 73 GDPSL=CO+I+G+(X-M)
 74 TT='1977 $EC'
 75 TABULATE YEAR CO I G X M GDPSL:TITLE TT
 76 TIME;DATE
```

APPENDIX B

ANNUAL DATA USED IN ECONOMETRIC MODEL CONSTRUCTION

TABLE B-Ia

IMPORTS
IN 1000'S OF 1977 EC $'S

YEAR	RMPTCLO	RMPTFTW	RMPTCAR	RMPTBUS	RMPTFRT	RMPTELM	RMPTPPB
****	*******	*******	*******	*******	*******	*******	********
1970	4720.8	2253.8	3101.5	3979.7	2350.3	8505.1	2005.1
1971	5365.7	2150	5384.4	7632.6	1864.9	12835	1299.4
1972	4544.9	2548.3	5229.7	2900.4	3941.6	7971.2	4693
1973	5177.7	2339.5	3110.8	2403.4	1509.7	7519	955.83
1974	4288.1	1742.7	2442.3	1641	2133	5327.1	6643.8
1975	2844.3	1551.1	1848.6	2424.4	3649.2	7639.2	5875.7
1976	2739.5	1855.4	2716.7	1605.2	2914.6	6592.7	7740.1
1977	3661	2237	4573	2679	2713	7585	10423
1978	3223.4	2234.2	4381	7493.2	2093.5	8658	8707.7
1979	3447.6	2488	4109	6149	2705.2	10890	3610.5
1980	3294	2750.1	4746.8	6294.7	1853.9	22173	5319.5
1981	3877.6	2470.7	3455.6	5407.3	3906.7	8243.8	9027.7
1982	4132.9	2614.5	3311.7	4186.4	2472.2	6489.7	7202.7

TABLE B-Ib

IMPORTS
IN 1000'S OF CURRENT EC $'S

YEAR	MPTCLO	MPTFTW	MPTCAR	MPTBUS	MPTFRT	MPTELM	MPTPPB
****	******	******	******	******	******	******	******
1970	1860	888	1222	1568	926	3351	790
1971	2296	920	2304	3266	798	5492	556
1972	2117	1187	2436	1351	1836	3713	2186
1973	3001	1356	1803	1393	875	4358	554
1974	3120	1268	1777	1194	1552	3876	4834
1975	2371	1293	1541	2021	3042	6368	4898
1976	2519	1706	2498	1476	2680	6062	7117
1977	3661	2237	4573	2679	2713	7585	10423
1978	3506	2430	4765	8150	2277	9417	9471
1979	4509	3254	5374	8042	3538	14242	4722
1980	4705	3928	6780	8991	2648	31670	7598
1981	6000	3823	5347	8367	6045	12756	13969
1982	6799	4301	5448	6887	4067	10676	11849

Definitions for TABLE B-Ia and TABLE B-Ib

Unless otherwise specified, all import data are the EC dollar values reported in the table, "Imports of Selected Commodities, Quantity and Value,...," from the 1981 and 1982 Annual Statistical Digests.

MPTCLO = imports of clothing.
MPTFTW = imports of footwear.
MPTCAR = imports of cars - from Table 15, "Preliminary Summary Tables of External Trade," of St. Lucia.
MPTBUS = imports of buses from Table 15, "Preliminary Summary Tables of External Trade," of St. Lucia.
MPTFRT = imports of fertilizer.
MPTELM = imports of electrical machinery and appliances.
MPTPPB = imports of paper and paperboard.

TABLE B-IIa

IMPORTS
IN 1000'S OF 1977 EC $'S

YEAR	RMPTCEM	RMPTFEX	RMPTGAS	RMPTDIES	RMPTFOOD	RMPTT	RMPTNES
****	*******	*******	*******	********	********	******	*******
1970	1789.3	6370.6	1264	1385.8	32637	138541	66792
1971	2664.2	3930.8	1217.6	1736.4	36268	161248	77163
1972	2183.3	4959.2	1124.9	2245.6	35805	147467	67074
1973	2232.6	2860.6	1606.3	1908.2	35944	127968	58492
1974	1268.6	2968.7	3133.6	3786.4	35484	125227	50581
1975	1350.8	2537.2	3080.6	4114.7	35259	120471	44182
1976	1702	2628.6	3985.9	5323.5	36596	136716	54992
1977	1640	3050	3931	6201	40651	160232	64687
1978	2269.1	3222.5	4435.2	6084.6	46717	205459	99855
1979	1617.9	15732	5800.3	11465	44505	208876	84894
1980	2583.4	6464.9	8038	12225	47181	233952	98803
1981	2872.7	7647.3	5901.7	10382	51305	224872	99992
1982	1886.2	4307.4	8265.3	10257	45578	193751	82791

TABLE B-IIb

IMPORTS
IN 1000'S OF CURRENT EC $'S

YEAR	MPTCEM	MPTFEX	MPTGAS	MPTDIES	MPTFOOD	MPTT	MPTNES
****	******	******	******	*******	*******	******	******
1970	705	2510	498	546	12859	54585	26862
1971	1140	1682	521	743	15519	68998	33761
1972	1017	2310	524	1046	16678	68690	32289
1973	1294	1658	931	1106	20833	74170	35008
1974	923	2160	2280	2755	25818	91115	39558
1975	1126	2115	2568	3430	29392	100425	40260
1976	1565	2417	3665	4895	33650	125710	55460
1977	1640	3050	3931	6201	40651	160232	70888
1978	2468	3505	4824	6618	50812	223469	115226
1979	2116	20575	7586	14994	58206	273181	126023
1980	3690	9234	11481	17461	67391	334162	158585
1981	4445	11833	9132	16065	79387	347956	170787
1982	3103	7086	13597	16873	74979	318736	153071

Definitions for TABLE B-IIa and TABLE B-IIb

Unless otherwise specified, all import data are the EC dollar values reported in the table, "Imports of Selected Commodities, Quantity and Value,...," from the 1981 and 1982 Annual Statistical Digests.

MPTCEM = imports of cement.

MPTFEX = imports of iron and steel.

MPTGAS = imports of motor spirits.

MPTDIES = imports of gas oil, diesel oil, and other fuel oil.

MPTFOOD = imports of food items.
It equals S.I.T.C. Section 0 (food total) minus Division 0.08 (feedstuff) plus Division 1.11 (beverages) plus Division 1.12 (tobacco). 1970-1975 data are from, "Tables of Principal Imports by S.I.T.C. Codes," in the Annual Report of Overseas Trade of St. Lucia." 1976, 1977, 1979-1982 are from the tables, "Value of Imports, Domestic Exports and Re-Exports by Sections and Divisions S.I.T.C. (R)," in the Annual Statistical Digests. 1978 data are from "Summary Trade Tables of St. Lucia."

MPTT = total imports from the table, "Imports, Exports and Balance of Trade...," in the 1981 and 1982 Annual Statistical Digests.

MPTNES = the value of imports not included in the above categories, i.e., it equals
MPTNES = MPTT - MPTCLO - MPTFTW - MPTCAR - MPTBUS - MPTFRT - MPTELM - MPTPPB - MPTCEM - MPTFEX - MPTGAS - MPTFOOD.

TABLE B-IIIa

DISPOSABLE INCOME
IN 1000'S OF 1977 EC $'S

YEAR	RPDY
....	.....
1970	137366
1971	143499
1972	127307
1973	101614
1974	98623
1975	104910
1976	119128
1977	123292
1978	140281
1979	149261
1980	147319
1981	151202
1982	153629

TABLE B-IIIb

DISPOSABLE INCOME
IN 1000'S OF CURRENT EC $'S

YEAR	XPDY
****	******
1970	54122
1971	61403
1972	59300
1973	58895
1974	71760
1975	87453
1976	109539
1977	123292
1978	152577
1979	195212
1980	210421
1981	233963
1982	252732

Defintions for TABLE B-IIIa and TABLE B-IIIb

PDY = total personal disposable income.
It is derived from total GDP by use of the relation

PDY = CONSUMPTION + Savings.

World Bank estimates of private consumption plus domestic savings average 80.9% of GDP for the years 1975-1981. Therefore, PDY was defined as

PDY = .809*GDP.

TABLE B-IV

POPULATION AND LABOR FORCE DATA

YEAR	POP	LABFOR	POPEMP	AGRLAB	MFGLAB	CONLAB	SRVLAB	GOVLAB
****	******	******	******	******	******	******	******	******
1970	100893	28700	26379	10446	2171	3129	7282	2500
1971	102908	30518	26907	10302	2343	3190	7408	2563
1972	104962	32452	27481	10162	2529	3251	7451	2627
1973	107058	34508	28096	10023	2729	3314	7359	2692
1974	109196	36694	28761	9885	2945	3378	7279	2760
1975	111376	39019	29476	9750	3179	3443	7693	2892
1976	113600	41491	30987	10353	3431	3510	8268	2900
1977	115500	44120	32592	10993	3703	3578	8762	2972
1978	117500	46916	34303	11674	3996	3647	9295	3046
1979	118400	49888	36124	12396	4313	3718	9738	3122
1980	120300	50646	36756	12585	4380	3729	9816	3200
1981	122200	51416	37474	12778	4448	3812	9884	3280
1982	124000	52198	38207	12973	4517	3897	9943	3362

Definitions for Table B-IV

All population and labor data are numbers of people. Unless otherwise stated below, data sources for all variables are:

1970: 1970 census reported in Ref. No. 1, p. 7.
1971-1978: estimated using a compound growth rate calculated between the 1970 and 1979 data points.
1979&1982: reported in Ref. No. 4, Table 7.1.
1980-1981: estimated using a compound growth rate calculated between the 1979 and 1982 data.

POP = population from the 1970 census and figures reported in the Annual Statistical Digests for 1976-1982 (Ref. Nos. 2 and 3). The 1971-1975 data are estimated by using compound growth rates between the 1970 and 1976 data.

LABOR = labor force.
The 1970 estimate is from Ref. No. 4, p. 13.

POPEMP = population employed.

AGRLAB = agricultural labor.
The 1975 estimate is taken from a graph on p. 13, Ref. 4, where a decrease in AGRLAB between 1970 and 1976 is discussed. The 1971-1974 data are estimated between the 1970 census figures and the 1975 estimate.

MFGLAB = number of people employed in mining and manufacturing.

CONLAB = number of people employed in the construction industry.
The major phase of hotel construction took place between 1970 and 1974. Major activity on Hess Oil started in 1978. Due to a lack of data references in the mid-1970's, hotel and Hess Oil activity is not clearly reflected in the data.

SRVLAB = number of people employed in the services industry.
This includes electricity and commerce, transport, and services (as reported in Ref. Nos. 1 and 5) but does not include people employed in tourism or by the government.

(Definitions for TABLE B-IV cont.)

TURLAB = number of people directly employed in tourism (i.e., in hotels and restaurants).
The data are estimated using a constant factor of 0.82 employees per bed (Ref. No. 5, pp. 4-56). Sources of data for numbers of beds are:
For 1970, 1973, 1974, and 1976, Ref. No. 4, pp. 31-34;
For 1978, Ref. No. 6, pp. 4-56;
For 1982, Ref. No. 5, p. 25.

GOVLAB = the number of people employed by the government.
Data are estimated from projections for 1970, 1980 and 1985 in Ref. No. 6, pp. 4-57.

NESLAB = labor not elsewhere stated.

References

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TABLE B-Va

HOUSEHOLD CONSUMPTION EXPENDITURES
IN 1000'S OF 1977 EC $'S

YEAR	RPCEFB	RPCEFL	RPCESR	RPCEDUR	RPCECS	RPCECAR	RPCENES
****	******	******	******	*******	******	*******	*******
1970	32647	1312.6	57868	9579.9	6974.6	2605.3	
1971	36278	1665.7	60294	12039	7515.8	4522.9	
1972	35815	2051.7	72349	11486	7093.2	4393	
1973	35953	2204.7	59696	10130	7517.3	2613	
1974	35492	2361.8	57312	8082.3	6030.8	2051.5	
1975	35268	2392.2	60221	5948.2	4395.4	1552.8	12202
1976	36606	2863.1	65144	6876.9	4594.9	2282	12856
1977	40662	3002.6	65900	9739.3	5898	3841.3	14984
1978	46730	3018.2	73800	9137.6	5457.6	3680	22100
1979	44517	3592.7	74100	9387.2	5935.7	3451.6	19400
1980	47194	2942.5	73600	10031	6044.1	3987.3	26702
1981	51316	3387.9	75100	9251	6348.3	2902.7	26262
1982	45589	4258.8	73100	9529.2	6747.4	2781.8	25680

TABLE B-Vb

HOUSEHOLD CONSUMPTION EXPENDITURES
IN 1000'S OF CURRENT EC $'S

YEAR	PCEFB	PCEFL	PCESR	PCEDUR	PCECS	PCECAR	PCENES
****	*****	*******	******	*******	*****	******	******
1970	12363	517.17	22800	3774.5	2748	1026.5	
1971	15523	712.75	25800	5151.4	3216	1935.4	
1972	16682	955.69	33700	5350.2	3304	2046.2	
1973	20838	1277.9	34600	5871.5	4357	1514.5	
1974	25824	1718.4	41700	5880.7	4388	1492.7	
1975	29399	1994.1	50200	4958.4	3664	1294.4	10172
1976	33659	2632.6	59900	6323.3	4225	2098.3	11821
1977	40662	3002.6	65900	9739.3	5898	3841.3	14984
1978	50326	3282.8	80269	9938.6	5936	4002.6	24038
1979	58222	4698.8	96912	12277	7763	4514.2	25373
1980	67409	4202.9	105126	14328	8633	5695.2	38138
1981	79403	5242.3	116206	14314	9823	4491.5	40638
1982	74998	7006	120255	15676	11100	4576.3	42246

Definitions for TABLE B-Va and TABLE B-Vb

PCEFB = personal consumption expenditures of food and beverages:
PCEFB = imports of (beverages, food and tobacco - feedstuff) and value of output of domestically-consumed agricultural goods.

The value of imports of food items is from the following S.I.T.C. categories: Section 0 (food total) minus Division 0.08 (feeding stuff for animals); Division 1.11 (beverages); and Division 1.12 (tobacco). The data sources were "Annual Report of Overseas Trade of St. Lucia, 1970-1975," and Annual Statistical Digests.

The value of domestically consumed agricultural output is from The Commonwealth Caribbean, Table SA2.11 for 1970-1973. The data for 1974-1976 are estimated. Mr. Augustine of the St. Lucia Department of Statistics provided the 1977-1982 data.

(Definitions for TABLE B-Va and TABLE B-Vb cont.)

PCEFL = personal consumption expenditures on electricity:
PCEFL = price of electricity/Kwh * domestic use of electricity in Kwh.

The price of electricity is derived from the price per 80 units reported in the table, "Average Retail Prices in Castries of Selected Commodities," from the 1976 and 1982 Annual Statistical Digests. The price per 80 units is assumed to be the price for 80 Kwh; the price of electricity then equals the reported price for 80 units divided by 80.

The data on domestic use of electricity are from the tables, "Electricity Generation and Distribution - Northern Area and Southern Area," in the Annual Statistical Digests.

PCESR = personal consumption expenditure on services.
It equals GDP in the service sector. See the note on GDP for data sources.

PCEDUR = personal consumption expenditures on clothing, shoes and automobiles.

PCECS = personal consumption expenditures on clothing and shoes.
The data are the sum of the imports of footwear and clothing from the table, "Imports of Selected Commodities," in the Annual Statistical Digests.

PCECAR = personal consumption expenditure on automobiles.
It equals 0.84 * value of imports of cars from the, "Preliminary Summary Tables of External Trade," St. Lucia Department of Statistics, 1980 and 1982. The number 0.84 was chosen as a scaling factor to reflect the number of autos used as taxis rather than as personal vehicles. The data available on number of cars registered as taxis were in Table 27, "Number of Motor Vehicles Registered and Licensed," in the 1976 Annual Statistical Digest.

PCENES = the value of imported consumer goods that are not covered in the categories defined above.
Data were available to us for the years 1975-1982 in the tables entitled, "Value of Imports, Domestic Exports and Re-Exports by Sections and Divisions [S.I.T.C. (R)]...," from the Annual Statistical Digests. The value of imports from Section 4 plus the following Divisions were summed to derive PCENES: Division 54, 55, 62, 76, 82, 83, 86, 88, and 89.

TABLE B-VIIa

EXPORTS
IN 1000'S OF 1977 EC $'S

YEAR	RXPTBAN	RXPTCOP	RXPTOAG	RXPTBOX	RXPTGAR	RREXPT	RXPTNES	RXPT'
1970	13766	6121.8	479.7			1642.6	135.28	22146
1971	16235	4279	645.01			7058.4	356.86	28574
1972	17847	4800.3	796.48			3102.4	5910	32456
1973	17512	4370.3	752.24		5.176	7242.6	3302.6	33185
1974	29163	5633.6	1470.6	4700.4	417.81	2714.3	1129.9	45230
1975	21040	6659.1	1501.9	5816.9	1190	2894.4	2227.9	41330
1976	22917	5402.9	1337.7	9312.7	3597.6	4589.1	7123.8	54281
1977	25526	5812	1722	9472	2235	5388.3	10830	60985
1978	30069	5239.3	2183.6	7154.8	5487.9	4942.5	11427	66555
1979	27910	5903.5	2345.8	3969.8	3651	8021.6	14037	65839
1980	19870	5844.6	1650.9	4907.1	5360.1	23168	26146	86947
1981	25588	4578.8	1115.5	9733.4	6619.7	8376.8	16566	72578
1982	25657	5272.1	1072.9	8627.6	6718.8	6411.1	14520	68280

TABLE B-VIIb

EXPORTS
IN 1000'S OF CURRENT EC $'S

YEAR	XPTBAN	XPTCOP	XPTOAG	XPTBOX	XPTGAR	REXPT	XPTNES	XPTT
1970	5424	1266	189			647.2	1199.3	8725.5
1971	6947	1362	276			3020.3	621.7	12227
1972	8313	2236	371			1445.1	2752.9	15118
1973	10150	3203	436		3	4197.8	1244.2	19234
1974	21219	3452	1070	3420	304	1974.9	1469.1	32909
1975	17539	5551	1252	4849	992	2412.8	1857.2	34453
1976	21072	4968	1230	8563	3308	4219.7	6550.3	49911
1977	25526	5812	1722	9472	2235	5388.3	10830	60985
1978	32705	5753	2375	7782	5969	5375.8	12429	72389
1979	36503	7721	3068	5192	4775	10491	18358	86108
1980	28381	8348	2358	7009	7656	33092	37346	124190
1981	39593	7085	1726	15061	10243	12962	25633	112303
1982	42208	8673	1765	14193	11053	10547	23887	112326

Definitions for TABLE B-VIIa and B-VIIb

Unless otherwise stated, all data are the EC dollar values reported in the table, "Exports of Selected Commodities, Quantity and Value...," in the 1981 and 1982 Annual Statistical Digests.

XPTBAN = exports of bananas.

XPTCOP = exports of all coconut products (See Table B-VIII, "Exports of Coconut Products," for data sources.)

XPTOAG = exports of other agricultural goods which consist of cocoa, fruit and vegetables, and spices.

XPTBOX = exports of boxes.

XPTGAR = exports of garments.

RGXPT = the value of re-exports from the tables, "Imports, Exports and Balance of Trade...," in the 1981 and 1982 Annual Statistical Digests.

XPTNES = exports not elsewhere specified.
XPTNES = XPTT - XPTBAN - XPTCOP - XPTOAG - XPTBOX - XPTGAR - REXPT

XPTT = the value of total exports from the tables, "Imports, Exports and Balance of Trade...," in the 1981 and 1982 Annual Statistical Digests.

TABLE B-IXa

INVESTMENT
IN 1000'S OF 1977 EC $'S

YEAR	RRESCON	RRECOMCO	RCOMMCON	RINDCON	RINSTCON	RINVAGR	RINVELM	RINVVEH
1970						1925.4	8505.1	4475.9
1971						584.72	12835	8494.1
1972						500.43	7971.2	3737.1
1973						933.92	7519	2901.1
1974						603.35	5327.1	2031.8
1975	14427	619	1511.5	1974.6	407.87	961.61	7639.2	2720.2
1976	10178	497.01	1497.6	125.07	3475.8	382.13	6592.7	2039.9
1977	17285	1210	3254	49	138	591.76	7585	3410.7
1978	24204	536.01	6838.5	4461.9	843.1	176.88	8658	8194.1
1979	16037	456.47	6347.8	1933.7	162.1	542.83	10890	6806.4
1980	21230	1505.9	3770.1	6683.3	863.94	748.22	22173	7054.2
1981	20948	476.3	4962	639.8	2087.4	838.74	8243.8	5960.2
1982	24001	714.86	4061.8	3427.2	3546.9	190.77	6489.7	4716.3

TABLE B-IXb

INVESTMENT DATA
IN 1000'S OF CURRENT EC $'S

YEAR	RESCON	RECOMCO	COMMCON	INDCON	INSTCON	INVAGR	INVELM	INVVEH
1970						758.6	3351	1763.5
1971						250.2	5492	3634.6
1972						233.1	3713	1740.8
1973						541.3	4358	1681.5
1974						439	3876	1478.3
1975	12026	516	1260	1646	340	801.6	6368	2267.6
1976	9359	457	1377	115	3196	351.37	6062	1875.7
1977	17285	1210	3254	49	138	591.76	7585	3410.7
1978	26326	583	7438	4853	917	192.39	9417	8912.4
1979	20974	597	8302	2529	212	709.94	14242	8901.8
1980	30324	2151	5385	9546	1234	1068.7	31670	10076
1981	32414	737	7678	990	3230	1297.8	12756	9222.5
1982	39484	1176	6682	5638	5835	313.83	10676	7758.7

Definitions for TABLE B-IXa and TABLE B-IXb

The cost of construction data are from the tables, "Building Plans Approved...," in the 1976, 1981, and 1982 Annual Statistical Digests. Mr. Augustine of the St. Lucia Department of Statistics provided the 1978 data. Data for 1970-1974 are not available.

RESCON = the cost of new residential buildings and extensions.
RECOMCO = the cost of new residential/commercial buildings and extensions.
COMMCON = the cost of new commercial buildings and extensions.
INDCON = the cost of new industrial buildings and extensions.
INSTCON = the cost of new institutional buildings and extensions.
INVAGR = agricultural investment.
It equals the value of imports of agricultural machinery and implements and tractors. The 1970-1975 data are from Table VI, "Principal Imports," from the St. Lucia Summary of Annual Trade. The 1976-1982 data are the sum of imports - re-exports reported by S.I.T.C. code in Annual Overseas Trade of St. Lucia. For 1976-1980, the following S.I.T.C. codes were used: 612.2, 695.1, 712.1, 712.21, 712.29, 712.31, 712.51, 712.59, 712.91, and 712.99. In 1981, the S.I.T.C. codes changed slightly. The following equivalent codes were used for 1981 and 1982: 612.2, 695.11, 695.12, 695.13, 695.14, 695.15, 695.16, 195.17, 695.19, 712.11, 721.21, 721.22, 721.24, 721.34, 721.97.1, 721.97.2, 721.97.9, and 722.

INVELM = investment in electrical machinery and appliances from the table, "Imports of Selected Commodities," in the 1976 and 1982 Annual Statistical Digests.

INVVEH = investment in vehicles. It is imports of vehicles minus private autos (PCECAR). Data for imports of motor vehicles are from the table, "Imports of Selected Commodities," in the 1976 and 1982 Annual Statistical Digests. Imports of cars are from Table 15, "Preliminary Summary Tables of External Trade," 1980 and 1982.

TABLE B-X

TOURISM DATA

YEAR	TARRIVE	YATCAL	YATDAY	INTRAN	TOURRES
****	*******	******	******	******	*******
1970	45902				1043.8
1971	51888	1341	22816	42859	1179.9
1972	61284	1250	20515	37267	1393.6
1973	67678	1368	12312	46845	1539
1974	73820	1633	14715	43145	1678.6
1975	66278	1394	12546	55448	1507.1
1976	75885	1886	15072	69084	1725.6
1977	89488	2777	11809	58616	2034.9
1978	105473	3200	28220	75628	2398.4
1979	102417	2793	23921	60238	2328.9
1980	99450	2472		59034	2261.5
1981	96569	1250		18934	2196
1982	98181	1087		33812	2232.6

Definitions for TABLE B-X

TARRIVE = the number of total tourist arrivals from the tables "Passenger Arrivals and Departures by Air and Sea...," in the 1972, 1976, and 1982 Annual Statistical Digests. Data were not reported for 1979 and 1980 and had to be estimated.

TOURRES = the full-time equivalent of tourist-residents. It represents the increase in the annual population due to the presence of tourists. TOURRES was derived by multiplying TARRIVE by the average length of stay in years, i.e.:

$$\text{TOURRES} = \text{TARRIVE} * \frac{8.3 \text{ days/tourist}}{365 \text{ days/year}}$$

The source for the average length of stay per tourist was the World Bank.

The following data are from data reported in the tables, "Number of Cruise Ships and Yacht Calls...," in the 1972, 1976, 1981, and 1982 Annual Statistical Digests.

YATCAL = the number of yacht calls.
YATDAY = the number of yacht days.
INTRAN = the number of intransit passengers from cruise ships.

TABLE B-XI

GDP DEFLATOR
1977 = 1.00

YEAR	GDPDEF
****	******
1970	.394
1971	.4279
1972	.4658
1973	.5796
1974	.7276
1975	.8336
1976	.9195
1977	1
1978	1.0877
1979	1.3079
1980	1.4283
1981	1.5474
1982	1.6451

Definitions for TABLE B-XI

GDPDEF = the GDP deflator relative to 1977.
The deflator for 1970-1976, years for which GDP in constant dollars was not reported, equals the price index for all items normalized to 1977. Price index data are from Table 46, "Index of Retail Prices," in the 1976 Annual Statistical Digest. For 1977-1982, the GDP deflator equals total GDP in nominal dollars divided by total GDP in constant 1977 dollars. The GDP data are from National Accounts, 1977-1982.

TABLE B-XII

CONSUMER PRICE INDEX
1964 = 100

YEAR	CPIALL	CPIFO	CPIBEV	CPIHSE	CPIFL	CPIHMIS	CPICLO	CPISER
1970	137.1	133	154	151.8	114.2	121.2	124.5	174
1971	148.9	145.5	157.1	160.4	119.5	131.9	148.6	185.6
1972	162.1	162.2	163.9	179.4	122.4	145	152.3	187.6
1973	201.7	217.3	175	184.1	140.2	157	162.7	249.3
1974	253.2	270.1	198.4	268.2	219.2	213.9	195.5	269.6
1975	290.1	312.2	241.7	321.2	223.4	246	215.3	286
1976	320	345.2	254.6	335.8	264.4	304.1	238.8	308.9
1977	348	374	282.4	340.3	304.8	376.3	274.5	316.6
1978	278	403.5	306.7	406.7	307.2	405.9	299.5	332.1
1979	436.2	464.1	405.1	413.3	491.5	470.6	326.4	342.4
1980	528.4	568.5	433.9	494.3	648	507.5	406.3	433.3
1981	578.4	625.5	471.8	550.5	644.7	659	413.6	438.2
1982	581.6	616.8	496	550.5	666.8	725.5	431.7	442.6

Definitions for TABLE B-XII

All consumer price index data are from the tables entitled, "Index of Retail Prices...," in the 1976 and 1982 Annual Statistical Digests.

CPIALL = the consumer price index for all items.
CPIFO = the consumer price index for food.
CPIBEV = the consumer price index for alcoholic drinks and beverages.
CPIHSE = the consumer price index for housing.
CPIFL = the consumer price index for fuel and lights.
CPIHMIS = the consumer price index for household and miscellaneous items.
CPICLO = the consumer price index for clothing.
CPISER = the consumer price index for services.

TABLE B-XIIIa

TRADEBALANCE
IN 1000'S OF 1977 EC $'S

YEAR	RMPTT	RXPTT	RTRADEBA
****	******	*****	********
1970	138541	22146	-116395
1971	161248	28574	-132674
1972	147467	32456	-115011
1973	127968	33185	-94783
1974	125227	45230	-79997
1975	120471	41330	-79141
1976	136716	54281	-82435
1977	160232	60985	-99247
1978	205459	66555	-138904
1979	208876	65839	-143038
1980	233952	86947	-147005
1981	224872	72578	-152294
1982	193751	68280	-125471

TABLE B-XIIIb

TRADEBALANCE
IN 1000'S OF CURRENT EC $'S

YEAR	XPTT	MPTT	TRADEBA
****	********	********	********
1970	8725.5	54585	-45860
1971	12227	68998	-56771
1972	15118	68690	-53572
1973	19234	74170	-54936
1974	32909	91115	-58206
1975	34453	100425	-65972
1976	49911	125710	-75799
1977	60985	160232	-99247
1978	72389	223469	-151080
1979	86108	273181	-187073
1980	124190	334162	-209972
1981	112303	347956	-235653
1982	112326	318736	-206410

Definitions for TABLE B-XIIIa and TABLE B-XIIIb

XPTT = the value of total exports.
MPTT = the value of total imports.
TRADEBA = XPTT - MPTT

For data sources, see Tables B-VIIb and B-IIb.

TABLE B-XIVa

GOVERNMENT INCOME AND EXPENDITURES
IN 1000'S OF 1977 EC $'S

YEAR	RGREV	RGEXPT	RBRDA
1970	42273	35449	484.15
1971	46221	37242	502.2
1972	46814	39445	798.97
1973	41128	37096	527.92
1974	37381	38064	326.87
1975	35555	33364	390.59
1976	31364	33442	187.42
1977	37479	38168	303.24
1978	46958	37652	264.11
1979	49448	32746	104.1
1980	53538	48063	171.76
1981	62253	61127	220.13
1982	68864	61689	196.99

TABLE B-XIVb

GOVERNMENT INCOME AND EXPENDITURES
IN 1000'S OF CURRENT EC $'S

YEAR	GREV	GEXPT	BRDA
1970	16656	13967	190.76
1971	19778	15936	214.89
1972	21806	18373	372.16
1973	23838	21501	305.98
1974	27199	27695	237.83
1975	29638	27812	325.6
1976	28840	30750	172.33
1977	37479	38168	303.24
1978	51075	40952	287.26
1979	64671	42827	136.15
1980	76470	68650	245.33
1981	96327	94584	340.62
1982	113286	101483	324.06

TABLE B-XVa

GOVERNMENT EXPENDITURES BY CATEGORY
IN 1000'S OF CURRENT EC $'S

YEAR	GADJP	GSERV	GTC	GALF
1970	6325.3	5571.1	2070.4	
1971	7089.6	6741.3	2105	
1972	8193.4	7686.2	2493.8	
1973	8640.8	8616.4	3090.9	1152.8
1974	13417	9517.1	3608.7	1152.5
1975	11475	10354	4014.8	1968.8
1976	12984	12301	3965.9	1499.5
1977	14286	16374	5435.2	2073.1
1978	16132	16143	7197.6	1480
1979	24112	12640	5742.8	331.68
1980	34077	22088	10058	2426.6
1981	36354	37127	15022	6081.6
1982	36218	43632	13959	7673.7

TABLE B-XVb

GOVERNMENT EXPENDITURES BY CATEGORY
IN 1000'S OF 1977 EC $'S

YEAR	RGADJP	RGSERV	RGTC	RGALF
1970	16054	14140	5254.8	
1971	16568	15754	4919.4	
1972	17590	16501	5353.8	
1973	14908	14866	5332.9	1988.9
1974	18440	13080	4959.8	1583.9
1975	13765	12421	4816.2	2361.8
1976	14121	13377	4313.1	1630.8
1977	14286	16374	5435.2	2073.1
1978	14832	14842	6617.5	1360.7
1979	18436	9665	4391	253.6
1980	23858	15464	7041.8	1698.9
1981	23494	23994	9708.2	3930.4
1982	22016	26523	8485	4664.6

Definitions for TABLE B-XIVa and TABLE B-XIVb and TABLE B-XVa and TABLE B-XVb.

The data sources for government expenditure and revenue are, "Estimates of St. Lucia," an annual publication of the Government Printing House.

For consistency with our other data, the figures were transformed to calendar year rather than fiscal year totals. It was assumed that the 1976/1977 data represented 18 months - the change in fiscal year occurred in 1976.

The original data were corrected using the following formulae:

1976 Data	=	2/3 of 1976/1977 data.
1977 Data	=	1/3 of 1976/1977 data plus 1/2 of 1977/1978 data.
1978-1981 Data	=	average of 2 appropriate fiscal year data, e.g., 1978 = 1/2 of 1977/1978 plus 1/2 of 1978/1979 data.
1982 Data	=	1981/1982 data. This assumption was made because 1982/1983 were not available.
GREV	=	"Total True Revenue;" it does not include foreign aid.
GEXPT	=	Total Local Expenditure; it does not include BRDA or contribution to capital estimate.
BRDA	=	British Development Aid Fund.
GADJP	=	total expenditures by: Judiciary; Legislature; Governor General; Prime Minister; Minister of Finance, Development, and Planning; Contributions to regional organizations; public debt; pensions; and Ministry of Trade, Industry and Tourism.
GSERV	=	total expenditure by: Ministry of Education and Culture; Ministry of Health and Local Government; and Ministry of Youth, Community Development, Social Affairs, and Sports.
GTC	=	total expenditure by Ministry of Communication, Works, Transport and Housing.
GALF	=	total expenditure by Ministry of Agriculture, Lands, Fisheries, and Co-operations.

TABLE B-XVIa

GROSS DOMESTIC PRODUCT BY SECTOR
IN 1000'S OF 1977 EC $'S

YEAR	RGDPT	RGDPAGR	RGDPIND	RGDPSRV	RGDPGOV	RGDPCON	RGDPTOU
****	******	*******	*******	*******	*******	*******	*******
1970	169797	37310	6091.4	62020	30457	32487	1432
1971	177378	41131	6309.9	67634	30615	29680	2008
1972	157364	27050	5581.8	69172	31344	21039	3177
1973	125604	22947	5003.5	55520	25190	12767	4176
1974	121908	20066	7009.3	54067	22952	12507	5306
1975	129679	19314	10677	60221	22793	13436	3239
1976	147254	21425	13486	65144	23165	17183	6851.5
1977	152400	22700	15000	65900	27300	10800	10700
1978	173400	28000	17000	73800	28500	14500	11600
1979	184500	26900	16800	74100	30400	23200	12500
1980	182100	21200	19700	73600	31100	23200	13300
1981	186900	22400	19200	75100	35600	23500	11100
1982	189900	25200	20600	73100	39100	20300	11600

TABLE B-XVIb

GROSS DOMESTIC PRODUCT BY SECTOR
IN 1000'S OF CURRENT EC $'S

YEAR	XGDPT	XGDPAGR	XGDPIND	XGDPSRV	XGDPGOV	XGDPCON	XGDPTOU
....	.....	.....	.....	.....	.....	.....	.....
1970	66900	14700	2400	24436	12000	12800	564
1971	75900	17600	2700	28941	13100	12700	859
1972	73300	12600	2600	32220	14600	9800	1480
1973	72800	13300	2900	32180	14600	7400	2420
1974	88700	14600	5100	39339	16700	9100	3861
1975	108100	16100	8900	50200	19000	11200	2700
1976	135400	19700	12400	59900	21300	15800	6300
1977	152400	22700	15000	65900	27300	10800	10700
1978	188600	33300	18600	75500	29300	17100	14800
1979	241300	37600	27700	90300	34200	32300	19200
1980	260100	35700	31300	102600	37700	34800	18000
1981	289200	40000	32000	113200	49500	38100	16400
1982	312400	44100	34000	117000	66400	32900	18000

Definitions for TABLE B-XVIa and TABLE B-XVIb

The sources for gross domestic product data are:

1970-1973 = Table SA2.11 in the Commonwealth of the Caribbean, World Bank.
1974 = constructed by computing the percentage increase from 1973 to 1975.
1975-1976 = Table 55 in the 1981 Annual Statistical Digest.
1977-1982 = Table 3, "Gross Domestic Product at Factor Cost by Kind of Activity: At Current Prices," and Table 7, "Gross Domestic Product at Factor Cost by Kind of Activity: At 1977 Prices," in St. Lucia's National Accounts 1977-1982.

GDPT = total gross domestic product (GDP) at factor cost.
GDPAGR = GDP from the agricultural sector.
GDPIND = GDP from the mining and manufacturing sectors.
GDPSRV = GDP from the service sector. For 1970-1973, this includes the following: transportation, distribution, finance, services and professional, rent of dwellings, and miscellaneous services. The 1974 datum is estimated. For 1975-1982, GDPSRV is the sum of GDP from electricity and water, wholesale and retail trade, transport and communications, banking, insurance, real estate, miscellaneous or "other" services, and imputed bank services (a negative value).
GDPGOV = GDP from the government sector.
GDPCON = GDP from the construction sector.
GDPTOU = GDP from the tourism sector. This was equated to GDP from hotels and restaurants.