1978

A macroeconometric model for the Panamanian economy 1950-1972

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7907283

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A MACROECONOMETRIC MODEL FOR THE PANAMANIAN ECONOMY 1950-1972.

IOWA STATE UNIVERSITY, PH.D., 1978

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Panamanian economy 1950-1972

by

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A Dissertation Submitted to the

Graduate Faculty in Partial Fulfillment of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Major: Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1978

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CHAPTER I. INTRODUCTION

In recent years, there has been increasing interest in the short run problems of the LDC's. There has been a change in the view that growth of GDP is more important than stabilization and other short run problems, and consequently, a large number of Keynesian income determination models have been constructed for less developed economies, among them those of Latin America. This raises the question of how does the body of theory on stabilization within the framework of income determination models, which has been developed for the more developed countries, apply to the different features of the LDC's in general.

This dissertation is a first attempt to build a medium size macroeconometric model for the Panamanian economy. The model presented here is a smaller version of a model built by Stavrou and Arboleda (1975). A number of its equations have been respecified and its dynamic properties differ from those of the initial model in some important characteristics. As a first attempt, it suffers from the problems commonly encountered in such enterprises. Being first means that there is no previously accumulated body of econometric knowledge to draw upon, so that the results are preliminary, and in various parts of the model, tentative rough approximations. For this reason, the research strategy has been to keep the specification of the equations as simple as possible, in order that the process of testing different formulations of the equations may begin. When this exploratory phase is over, we may undertake to refine the structure of the model.

The intention has been to build a forecasting model useful to predict the quantitative value of the main macroeconomic aggregate variables one or two years into the future. The model contains as much detail as the data permitted and was considered useful for users of the forecasts. In its present form, the model is useful to make ex ante forecasts of the future values of GDP and its components under sets of alternative assumptions about the values of the exogenous variables, which include both policy instruments and noncontrolable variables.

Chapter II presents a description of the Panamanian economy from 1950 to 1972. Chapter III presents some results from the literature on the question of how well does the economic theory on stabilization apply to the different conditions of the LDC's. Chapter IV presents the specification and estimation of the model. Chapter V presents some model simulations and multiplier analyses. And finally, chapter VI presents the conclusions and recommendations of the study.

CHAPTER II. THE PANAMANIAN ECONOMY

This chapter offers a brief description of the Panamanian economy. It discusses a number of characteristics which are peculiar to Panama, and essential to understand the course of its development. The central theme is the small size of the economy. It interacts with the lack of resources and the influence of geography to shape the economic development of Panama.

The topics mentioned are listed below:

1. Small size of the economy. This is discussed in terms of the small area, small population and small GDP (Gross Domestic Product).
2. Very open economy. This is discussed as being due to the small size of the economy.
3. Limited productive capacity. This is discussed as being partially due to the small size of the economy with its more limited natural resource endowment, and also in terms of the poverty of human resources due to history and past policy. Finally, the effect of international relations is also mentioned.
4. Existence of special institutional arrangements. This is explained as the result of geography and international politics.
5. Results of economic growth during the sample period. This is analyzed in terms of the structural changes

which occurred in the economy as a consequence of the process of economic growth during the 1950 to 1970 period.

6. The dual economy: the two Panamas. This is analyzed as the result of the process of economic growth discussed in five above, which did not change all structural aspects of the Panamanian economy.

The Effect of Geography

The special geographic location of Panama has exerted considerable influence upon its economic structure and development. Since the early sixteenth century, the isthmus has been the crossroads for trade and communication routes linking the Atlantic and Pacific oceans.

Panama's geography fostered the development of trade, commerce and services. Also, the lack of population, the poor quality of agricultural land, the unhealthy climate, and the poverty of mineral resources, prevented the development of agriculture and industry. Thus it can be said that Panama's natural resource is its geography.

In the fourth decade of the eighteenth century, British and Dutch piracy forced the Spaniards to abandon the Panama route. The impact of this measure on the economy of Panama was disastrous. The exodus of population was so great that the Spanish Government had to forbid emigration in order to prevent the depopulation of the isthmus.

The following century was one of decay and stagnation. It lasted until the discovery of gold in California, which created a new demand for transporation across the isthmus. The American-built Panama Railroad across the isthmus was completed in 1855. The boom lasted until 1869, when the American intercontinental railroad was completed, providing an alternative route to the U.S. west coast. There followed another ten years of economic depression, which lasted until the beginning of the French attempt to build a canal through Panama. After the French failure, the U.S. began negotiations with Colombia to obtain the concession to build a canal. After Panama separation from Colombia in 1903, the U.S. became the dominant power in the isthmus. The American built canal was completed in 1914.

The concentration of the Panamanian economy on commerce, trade, and services, and the backwardness of agriculture and manufacturing have persisted until now. Another feature of interest is the very great vulnerability of the economy to external shocks. In the past, these shocks were caused by changes in the external demand for transportation across the isthmus, and had a severe impact on the Panamanian economy, creating periods of boom and depression that lasted many years.

Small Size of the Economy

The Republic of Panama occupies the Isthmus of Panama, a narrow portion of land connecting the North and South American continents.

Panama is bounded on the north by the Caribbean Sea, on the east by Colombia, on the south by the Pacific Ocean, and on the west by Costa Rica.

In spite of its small area, roughly about 29,000 square miles, the country has several well-marked climatic regions of economic importance. Over seventy percent of the land area is mountainous but there are no large highland plateaux of temperate climate. The sparsely populated lowlands on the Caribbean coast have a tropical rainy climate which makes them unsuitable for human settlement. The majority of the population is concentrated on the lowlands on the Pacific coast, which have a climate ranging from tropical wet and dry on the western and eastern parts, to tropical dry on the central part.

The western central mountain range comes to an end near the narrowest portion of the isthmus, leaving a gap in the mountains; in this gap are situated the Panama Canal and Canal Zone and the cities of Panama and Colon.

The Canal Zone occupies an area of 553 square miles, and bisects the isthmus from coast to coast. Furthermore, it encloses the cities of Panama and Colon.

The volume of economic activity

The small size of the Panamanian economy may be easily shown by using the figures for its gross domestic product.

Table 2.1 shows gross domestic product by sector of origin for

Table 2.1. Gross domestic product by sector of origin, Panama: 1950 and 1972[a] (millions of 1960 Balboas).

Sector	1950	Percent	1972	Percent
Agriculture	74.5	28.7	172.0	16.6
Construction and Mining	11.2	4.3	74.5	7.2
Manufacturing	23.5	9.1	177.1	17.1
Electricity, water, sewage	3.2	1.2	34.2	3.3
Services	124.5	48.0	504.3	48.8
Canal Zone	22.3	8.6	71.3	6.9
Gross domestic product	259.2	100.0	1033.8	100.0

[a]Source: Direccion de Estadistica y Censo, Ingreso Nacional, various issues.

1950 and 1972. The focus of our interest in these figures lies in their small magnitude. For example, the total output of the manufacturing sector in 1950 was β/23.5 million. The magnitude of this figure helps to explain later development of the industrial sector.

Table 2.1 also shows the small relative importance of agriculture and industry and the greater importance of services together with the Canal Zone.

Of course, the same small magnitudes will be found in gross domestic product from the demand side. In Table 2.2, we note that private fixed investment was β/23.7 million in 1950, and β/230.8 million in 1972.

Another way to show Panama's smallness is to look at the population. In fact, Panama is considered a sparsely populated country as the following figures for census years 1930 to 1970 show:

Total Population (in thousands)	
1930	467.4
1940	622.6
1950	795.0
1960	1061.1
1970	1434.4

Population growth has been very rapid and increasing at an increasing rate during the sample period, being around 3.2 percent per

Table 2.2. Gross domestic product by final demand component, Panama: 1950 and 1972[a] (millions of 1960 Balboas).

Final demand component	1950	Percent	1972	Percent
Private consumption	179.5	69.2	685.8	66.3
Public consumption	34.2	13.2	124.6	12.0
Private fixed investment	23.7	9.1	230.8	22.3
Public fixed investment	3.8	1.5	78.0	7.5
Change in stocks	5.0	1.9	24.5	2.4
Exports	109.8	42.4	345.3	33.4
Imports	105.4	40.7	455.2	44.0
Gross domestic product	259.2	100.0	1033.8	100.0

[a]Source: Direccion de Estadistica y Censo, Ingreso Nacional, various issues.

year during the seventies.

Openness of the Economy

Panama's economy is very open. Table 2.3 shows that since 1950 imports of goods and services have consistently been over 35 percent of Gross Domestic Product.

Similarly, exports of goods and services have consistently been over 29 percent of Gross Domestic Product over the same period.

The large importance of foreign trade is due mainly to the small size of the economy. An economy as small as Panama's has very little diversity in its productive structure and requires to import a substantial number of goods that cannot be produced locally. Thus Panama cannot choose between imports and domestic productions for a very wide ranging variety of goods. She either imports or does without.

Limited Productive Capacity

According to Kuznets (1960), this feature is characteristic of small countries. The small territory is unlikely to have a wide diversity of natural resources and the small internal market is not likely to support the production of a wide range of goods and services.

Panama's limited productive capacity is related to the poverty of her natural and human resources and to the size of her internal market. What follows is a brief overview of the agricultural and industrial sectors and a brief description of its labor force.

Table 2.3. Exports and imports as percent of gross domestic product, Panama: 1950-1972[a].

Year	Exports as % of GDP	Imports as % of GDP
1950	42.4	40.7
1951	36.4	37.4
1952	37.9	41.3
1953	38.0	38.0
1954	35.3	38.4
1955	36.1	39.0
1956	34.3	39.1
1957	31.7	38.3
1958	29.8	37.7
1959	29.6	35.1
1960	30.6	35.9
1961	31.7	36.4
1962	35.2	39.0
1963	36.1	42.3
1964	34.6	39.9
1965	36.2	41.5
1966	36.9	42.4
1967	37.4	42.1
1968	37.6	40.6
1969	37.0	43.2
1970	36.3	44.2
1971	35.0	44.8
1972	33.4	44.0

[a]Source: Direccion de Estadistica y Censo, Ingreso Nacional, various issues.

Agricultural productive capacity

It has been said before that Panama has a limited productive capacity in agriculture. The reasons for this are several and will be discussed below.

In the first place, Panama has a tropical rainy climate. The low fertility of her soils is due to the climate and also to the volcanic origin of her mountains. It is because of this volcanic origin that Panama's soils are so deficient in phosphorus.

Also, the disease susceptibility of crops and livestock is very high because of the high temperatures and humidity that prevail all year. In some regions, such as the Atlantic coast of Panama, the high temperature and humidity require special crop and livestock management practices whose know how is not generally available in the country.

The topography of the isthmus is also an obstacle to agricultural production. Over seventy percent of Panama is mountainous and the amount of level agricultural land is limited. Table 2.4 shows land capability by type of crop. Panama has no class I land, and very little class II land. Most of the area suitable for annual crops is in class III and IV. Only 22.9 percent of all land is suitable for annual crops; 23.8 percent is suitable for permanent pastures and the remaining land is useful mostly for other permanent crops and forest.

Another cause for Panama's limited agricultural productive capacity is the primitive "slash and burn" production technology used

Table 2.4. Republic of Panama land capability by type of crop[a].

Crop Use	Area in thousand Has	Percent of total
Annual crops	1661.2	22.9
Class II land	189.3	2.6
Class III land	656.8	9.1
Class IV land	782.8	10.8
Class V land	32.3	0.4
Permanent pastures	1722.7	23.8
Permanent crops	2261.5	31.2
Forest	1354.4	18.7
Other uses	246.8	3.4
Total land area	7246.6	100.0

[a]Source: Direccion de Planificacion y Administracion de la Presidencia (1971a).

by her peasants. As an example, the plow was not widely used in Panama until very recently, when it is used with a tractor. Literally then, Panamanian agriculture went from the planting stick and the machete to the tractor. What may be asked at this point is why was agriculture allowed to remain in such a state. A possible answer may be that the country has been looking to commerce and trade and utterly neglected all other sectors. Panama's elites have a very limited agricultural and industrial tradition. For centuries they have been looking outward to commerce and trade. It has been only after World War II that some kind of an effort has been made to develop agriculture and manufacturing.

Human resources

The fundamental cause for Panama's limited productive capacity must lie in the poverty of her human resources. For example, Johr and Kneschaurek (1960), in their analysis of the Swiss economy, find that Switzerland's high level of productivity and welfare is in large part attributable to the high quality of its labor force.

The poverty of Panama's human resources is in part due to history. Spain and Colombia did not foster education in the Isthmus. After 1903, the successive Panamanian governments created an educational system designed to make primary education widely available to the general population, even in the rural areas. This was done with the intention of providing a minimum of education for all the population. However, the system did not provide equally well for secondary and university education. The secondary schools were few and concentrated in urban areas. University education was not available domestically until 1935, when the University of Panama was created. Table 2.5 shows school enrollment by level for 1950, 1960, and 1970. The emphasis on primary education is clear. The figures in Table 2.6 show the low level of general education among the Panamanian population.

For example, in 1970, the country had 15.7 percent illiterates in the population seven years and older. The average number of school years completed was 4.8, and only 28,683 persons had had some university education.

Another factor that must be taken into account is the widespread lack of technical and scientific proficiency and experience among the general population.

The country has not emphasized technical education. For example, Table 2.7 shows that in 1972 there were 6,122 students enrolled in industrial technical and vocational courses out of a total of 99,063 students enrolled in secondary education.

The situation is similar at the university level. The country has not created a domestic technical capacity. Some areas of applied technology were ignored until very recently. For example, the school of agriculture at the University of Panama was not established until 1959. Table 2.8 shows that university enrollment is heavily concentrated in nontechnological areas.

Table 2.5. School enrollment in the Republic of Panama by primary, secondary and university levels: 1950, 1960, 1970[a].

Educational Level	1950	1960	1970
Primary education			
Number of schools	950	1,298	1,784
Teachers	3,415	5,309	8,717
Students	110,059	161,800	255,287
Secondary education			
Number of schools	78	127	192
Teachers	959	1,704	3,784
Students	17,519	38,964	78,466
University education			
Number of schools	1	1	2
Teachers	88	144	368
Students	1,519	3,915	7,553

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

Table 2.14. Structure of the Panamanian industrial sector: 1970[a] (firms having five or more employees).

Subsector	Number of firms	Percentage of total	Employees	Percentage of total	Gross output (millions of Balboas)	Percentage of total
Food products	175	29.9	5,780	26.0	110.0	30.8
Beverages	21	3.6	1,593	7.2	29.5	8.3
Tobacco	2	o.3	325	1.5	10.1	2.8
Clothing and shoes	81	13.8	3,818	17.2	22.7	6.4
Leather products	8	1.4	157	0.7	1.0	0.3
Wood products	33	5.6	1,083	4.9	5.9	16.5
Furniture	54	9.2	1,164	5.2	8.9	2.5
Paper and products	14	2.4	759	3.4	14.6	4.1
Publishing	40	6.8	1,666	7.5	12.1	3.4
Chemicals	42	7.2	1,673	7.5	91.6	25.7
Nonmetallic minerals	46	7.8	2,003	9.0	22.0	6.2
Basic metals	7	1.2	432	1.9	7.5	2.1
Metal products	38	6.5	1,239	5.6	14.8	4.2

Population with some university education	6,251	12,532	28,683
No formal education	194,924	201,154	189,455
Illiterates[b]	149,202	151,806	166,233
Unknown	1,036	3,387	1,611

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, (1971a).

[b]Refers to population ten years and older

Table 2.7. Enrollment in secondary education by type of course: 1965-1972[a].

	1965	1966	1967	1968	1969	1970	1971	1972
Total	54906	58517	62533	66735	70851	78466	86795	99063
First three years[b]	27653	30013	31701	35266	37163	40852	46353	54075
Academic	6955	7639	8114	8913	9033	10068	10178	11752
Normal	1391	1313	1277	1310	1726	2194	2954	4346
Technical and vocational[c]	18907	19552	21441	21246	22929	25352	27310	28890
Agriculture	346	395	453	552	504	669	814	1035
Business	8756	8790	10199	10276	12345	13464	14546	14456
Industrial	5840	5902	6409	6134	5975	6472	6519	6122
Homemaking	3769	4288	4206	4145	3749	3850	4009	3856
Other	196	177	174	139	356	897	1422	3421

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

[b]After the first three years of secondary education, the student may choose to continue into an academic, normal, or vocational curriculum.

[c]Some technical and vocational curricula may be entered with a sixth grade education.

Table 2.8. University of Panama enrollment by college: 1967-1972[a].

College	1967	1968	1969	1970	1971	1972
Public administration and business	2618	2866	2118	2692	5679	6964
Agriculture	123	130	103	111	340	375
Architecture	370	360	293	321	451	603
Natural sciences and pharmacy	1936	2241	1224	1490	2175	2612
Law and political science	417	434	359	455	657	853
Humanities and education	2823	3029	1956	1923	2742	3137
Engineering	311	360	272	316	546	758
Medicine	132	150	155	156	153	197
Dentistry	0	9	47	89	106	171
All colleges	8730	9579	6527	7553	13849	15670

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

Another point that must be mentioned, even though it is not easily quantifiable, is what Johr and Kneschaurek (1960) call proper standards of labor and professional ethics in the average member of the labor force. In the case of Panama, it is not clear that the average member of the Panamanian labor force is deeply motivated by a stern labor ethic. For example, the 1976 modifications to the 1972 Labor Code, provide strong penalties for workers who habitually are absent from work on Mondays or Fridays. The implicit assumption is that the worker is an irresponsible carouser. In fact, examples of drunkenness, absenteeism, and negligence are fairly common among both blue and white collar workers.

Of course, to complete the labor force picture, it must be said that it is highly doubtful that Panama's entrepeneurial and managerial classes, sharing the same cultural heritage with the workers, are as motivated and skilled as their Swiss counterparts.

Limited industrial production capacity

Panama's small internal market will seriously limit the development of an industrial sector. The small domestic market would not be an obstacle if she could produce for export to the world markets. However, this has not been the case.

Total industrial production in 1950 at 1960 prices was only ฿/23.5 million. Its composition is shown in Table 2.9. Food products, beverages, clothing and shoes, publishing and nonmetallic minerals (cement) are the most important items.

Table 2.9. Value added in the industrial sector, Panama, 1950[a].

	Millions of 1960 Balboas
Foods	6.4
Beverages	6.5
Tobacco	0
Clothing and shoes	2.7
Lumber products	0.8
Furniture	0.3
Paper and products	0
Publishing	2.9
Leather and products	0.1
Chemicals	0.6
Nonmetallic minerals	1.8
Other industries	1.4
Total	23.5

[a]Source: Direccion de Estadistica y Censo, Ingreso Nacional, (1968).

It is conjectured that another cause for the very limited industrial tradition in Panama may be the influence of institutional arrangements due to geography.

The 1846 Mallarino-Bidlack treaty between the U.S. and Colombia granted free passage through the isthmus to all U.S. citizens and goods. The effect of this measure may have been to transform Panama into a free trading zone.

Furthermore, after independence, Panamanian workers in the Canal Zone were entitled to shop there. This situation lasted until the 1955 Remon-Eisenhower treaty.

Thus, the impact of international competition together with the small domestic market and the lack of resources may explain the limited industrial development of Panama. What is more, the easy availability of foreign goods must also have limited agricultural production, since the transit zone would supply itself with food from abroad.

Special Institutional Arrangements

Panama has three other institutions which are of economic importance. They are the monetary and banking systems, the Canal Zone and the Colon Free Trade Zone.

Monetary system

Panama's monetary system was created by the Monetary Convention of 1904 with the U.S. Panama has no central bank, and uses the U.S.

dollar as its circulating medium. The Balboa exists only (or mainly) as fractional currency.

In addition to this, the Panamanian banking system has been dominated by the largest U.S. banks. The only Panamanian bank of any significance is the Government owned Banco Nacional. All other Panamanian banks are rather unimportant. As an example, First National City Bank of New York has been operating in Panama since 1904 and Chase Manhattan since 1915. Both banks are well-established in Panama. Other large banks came in the sixties, like Bank of America in 1964. After 1970, Panama has become a regional financial center and a number of large international banks operate from there.

The monetary and banking systems reinforce the openness of the economy. The absence of exchange and convertibility risks makes the country very attractive to foreign investors. Together with the small size of the economy, this has had the consequence that investment projects in Panama could be easily financed from abroad. Similarly, investment funds could easily be taken out of Panama.

Panama Canal Zone

The U.S. installations in Panama, to operate and defend the Panama Canal, constitute the Panama Canal Zone.

The Canal Zone has been of considerable economic importance to Panama since 1904, but since 1950, its direct impact on Panama's economy has been decreasing. For example, in 1950, Panamanian exports to the Zone were over seventy percent of all exports. In

1970, they were down to 39.8 percent. However, the indirect effect on Panama remains large. The section on economic performance since 1950 will develop more fully the role of the Canal Zone on the economy.

<u>Colon Free Trade Zone</u>

The Colon Free Trade Zone was created in 1951 in an effort to provide an economic base for the city of Colon, on the Atlantic side of the Panama Canal.

Over the years, service exports from the free zone have become an important component of Panama's total exports.

Economic Performance 1950-1972

Between 1950 and 1972, Panama experienced considerable economic growth. Table 2.10 shows that Gross Domestic Product (GDP) nearly quadrupled during the period. However, growth was not uniform throughout these years. In fact, 1951 and 1958 were years when GDP barely grew or diminished. However, after 1958 the economy began a period of rapid and steady growth that lasted until 1972.

This process of rapid growth produced structural changes in the economy as the following figures show:

Year	Agriculture as % of GDP	Manufacturing as % of GDP	Services and C. Z. as % of GDP
1950	28.7	9.1	56.6
1960	23.0	13.1	56.1
1965	21.4	15.9	54.4
1970	18.0	17.2	55.6

Briefly stated, we notice that agriculture decreased its relative share in GDP while manufacturing's became nearly as large as agriculture's in its contribution to GDP, and all services maintained their overall importance.

The changes were produced by different rates of growth in the various sectors. Table 2.10 shows that while GDP nearly quadrupled between 1950 and 1972, agriculture nearly doubled its output and manufacturing increased over sevenfold. Services increased about as much as GDP.

The very rapid growth in manufacturing was a consequence of the import substitution policy undertaken by the Panamanian government. Law 12 of 1950 and Law 25 of 1957 introduced a series of measures to promote industrial import substitutions as follows:

Firstly, firms were given fiscal incentives in the form of total or partial tax exemptions on income taxes, on import duties on capital and intermediate goods, on export duties, and on property taxes.

Secondly, firms were given protection from foreign competition

Table 2.10. Indexes of real gross domestic product by sector of origin and by expenditure component, Panama, 1950, 1960, 1970-1972 (1950=100).

Gross domestic product component	1950	1960	1970	1971	1972
Agriculture	100.0	128.5	216.2	224.3	230.9
Construction and mining	100.0	214.3	502.7	595.5	665.2
Manufacturing	100.0	231.9	653.6	709.4	753.6
Electricity, water, sewage	100.0	262.5	812.5	950.0	1068.8
Services	100.0	162.9	343.1	376.2	405.1
Canal Zone	100.0	136.3	315.2	328.7	319.7
Gross domestic product	100.0	160.4	345.1	375.2	398.8
Private consumption	100.0	179.9	346.4	378.0	382.1
Public consumption	100.0	137.1	299.4	332.2	364.3
Private fixed investment	100.0	208.4	687.3	831.2	973.8
Public fixed investment	100.0	315.8	1552.6	1518.4	2052.6
Change in stocks	100.0	128.0	406.0	426.0	490.0
Exports	100.0	115.9	295.5	309.8	314.5
Imports	100.0	141.5	376.1	413.5	431.9

in the form of very restrictive higher tariffs, and import quotas. These benefits were given for a period of 25 years under Law 12, but were reduced to a period of 15 years under Law 25.

An interesting question is why the import substitution process began to take momentum after 1957. A complete answer is not known, but a partial answer may point out two possible causes:

One cause has to do with the import quota system. It began to be widely used after 1957; the system was further reinforced in 1961 and 1965.[1]

The other reason may be the Remon-Eisenhower treaty of 1955. In this treaty the U.S. agreed to gradually terminate or restrict manufacturing operations in the Canal Zone; to eliminate Canal Zone commissary benefits for Panamanian Zone workers living in Panama; and to bring wages of Panamanian employees in the Zone to the U.S. minimum wage rate. According to Carter (1970) the treaty is the single most important event affecting the flow of funds from the Canal Zone to Panama during the period. It must be stated here that the import substitution policy was also applied to the agricultural sector. The policy has been to encourage the production of agricultural produces that can be produced in Panama. Examples are lard, tomato products, dairy products, onions, potatoes.

Another question that may be asked is what were the sources of

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[1]Direccion de Planificacaion y Administracion de la Presidencia, 1971b, pp. 123-4.

growth during this period. Clearly one source was growth in manufacturing due to the import substitution process. The other may have been growth in exports. Exports were growing very slowly during the fifties, but changed to very rapid growth during the sixties. Table 2.11 shows that, with 1950 as the base year, the index for real exports was 115.9 in 1960 and 295.5 in 1970. This substantial growth in exports during the sixties was the result of the very fast expansion of banana production by the United Fruit Company, which transferred some of her operations in Central America to Panama; to increased earnings from the Canal Zone as a result of the gradual implementation of the U.S. minimum wage rate; to the fast growth of trade in the Colon Free Trade Zone; to tourism and finally to growth in other exports. Table 2.11 also shows the composition of Panamanian exports for selected years during the period of reference. It is interesting to notice that with the possible exception of bananas, and a few relatively minor items such as shrimp and sugar, nearly all Panamanian exports are made possible by the geographic position. The Colon Free Trade Zone is a distribution center for the rest of Latin America, which exploits Panama's central position and good communications. Tourism is essentially passengers in transit who change planes in Panama and visiting business men. And finally, the refined oil products, which together with sugar and shrimp are the main components in other exports, are exported to the Canal Zone, to ships bunkering in the Canal,

Table 2.11. Composition of Panamanian exports, selected years[a] (millions of 1960 Balboas).

	1950	1955	1960	1962	1965	1970
Total Exports	109.8	113.7	127.3	175.9	223.4	324.5
Index 1950 = 100	100.0	103.6	115.9	160.2	203.5	295.5
Bananas	12.5	19.4	18.2	19.0	30.0	42.6
Index 1950 = 100	100.0	155.2	145.6	152.0	240.0	340.8
Percent of total	11.4	17.1	14.3	10.8	13.4	13.1
Canal Zone	77.4	69.4	65.4	86.6	97.4	129.3
Index 1950 = 100	100.0	89.7	84.5	111.9	125.8	167.0
Percent of total	70.5	61.3	51.4	49.2	43.6	39.8
Tourism	4.5	6.0	11.8	17.5	18.1	32.9
Index 1950 = 100	100.0	133.3	262.2	388.9	402.2	731.1
Percent of total	4.1	5.3	9.3	9.9	8.1	10.1
Colon Free Trade Zone	0	1.7	6.3	8.5	11.6	28.2
Index 1950 = 100	-	100.0	370.6	500.0	682.3	1658.8
Percent of total	-	1.5	4.9	4.8	5.2	8.7
Other exports	15.4	16.7	25.6	44.3	66.3	91.5
Index 1950 = 100	100.0	108.4	166.2	287.7	430.5	594.2
Percent of total	14.0	14.7	20.1	25.2	29.7	28.2
Refined oil products	0	0	0	14.2	28.9	36.8
Index 1962 = 100	-	--	-	100.0	203.5	259.2
Percent of total	-	-	-	8.1	12.9	11.3

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

and to planes refueling in Panama.

From the demand side of GDP, the other important development besides export growth, was the extraordinary growth in investment. We find in Table 2.12 that private fixed investment grew over ninefold during the period. Simultaneously, public investment in infrastructure grew at a very rapid pace, increasing over twentyfold by 1972.

It is hypothesized here that private investment was induced by the opportunities created by the import substitution process. Table 2.12 shows that private investment in capital goods reached much higher and permanent levels after 1961 and 1966, which agrees closely in time with the changes in the import quota policy of 1961 and 1965. Investment in other construction, which is essentially nonresidential construction, shows substantial growth after 1966, which again coincides with the latter part of the import quota policy period.

The importance of the export sector in explaining economic growth during the sixties raises an important issue: as Sjaastad[2] has pointed out, export growth was largely fortuitous, and had nothing to do with Panamanian economic policy. The import substitution policy had nothing to do with it, for export of manufactures are very unimportant within total exports during the entire period.

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[2]See Sjaastad, 1972, p. 1.

Table 2.12. Private fixed investment in Panama 1955-1972[a] (in millions of 1960 Balboas).

Year	Total	Capital goods	Other construction	Housing
1955	31.7	13.6	7.4	10.7
1956	37.6	18.7	7.5	11.4
1957	44.2	23.8	7.6	12.8
1958	45.5	25.3	9.4	10.8
1959	49.4	25.2	11.4	15.2
1960	49.4	21.5	14.6	13.3
1961	57.4	38.8	10.4	8.2
1962	60.0	36.7	11.3	12.0
1963	69.0	36.9	10.8	21.3
1964	60.6	34.0	12.4	14.2
1965	75.4	44.3	13.0	18.1
1966	115.8	65.5	25.9	24.4
1967	116.1	67.8	21.7	26.6
1968	130.3	74.6	23.9	31.8
1969	143.7	72.8	34.7	36.2
1970	162.9	90.2	31.2	41.5
1971	197.0	94.8	50.5	51.7
1972	230.8	114.9	44.6	71.3

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

The Dual Economy: The Two Panamas

The years of economic growth did not substantially change the face of Panama. Table 2.13 shows Panamanian labor force by sector of employment for census years 1950, 1960, and 1970. The most striking change occurred in the agricultural sector. Labor force in agriculture declined from 54.7 percent of total in 1950 to 36.6 percent in 1970. An additional loss occurred in the Canal Zone share of total employment. These losses were compensated by increases in the relative shares of total employment in other sectors. The following figures are changes in the percent of total employment in each sector, for the period 1950-1970:

Agriculture	-18.1
Mining	0
Manufacturing	3.6
Construction	2.6
Electricity, etc.	0.5
Commerce	4.6
Transport, etc.	1.0
Services	8.4
Canal Zone	- 2.3

About 68.7 percent of the change was absorbed into the various service sectors. Manufacturing and construction absorbed only about 30.4 percent of it. We may generalize and say that, essentially, rural

Table 2.13. Employment by sector, Panama, 1950, 1960, 1970[a].

Sector	1950	Percent of total	1960	Percent of total	1970	Percent of total
Agriculture	131,839	54.7	153,056	51.1	158,200	36.6
Mining	359	0.1	360	0.1	500	0.1
Manufacturing	18,018	7.5	22,079	7.4	47,800	11.1
Construction	6,657	2.8	9,312	8.1	23,500	5.4
Electricity, water, sewage	1,180	0.5	1,500	0.5	4,200	1.0
Commerce	19,855	8.2	27,482	9.2	55,800	12.8
Transport, storage and communications	6,700	2.8	8,571	2.9	16,300	3.8
Services	37,646	15.7	58,560	19.6	104,200	24.1
Canal Zone	18,003	7.4	16,261	5.4	22,400	5.1
Nonspecified	847	0.4	2,203	0.7	0	0.0
Total	241,104	100.0	299,386	100.0	432,900	100.0

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, various issues.

workers from the agricultural sector were absorbed into mostly low productivity jobs in the urban services sectors. The manufacturing sector did absorb only a limited proportion of the labor force. During this period there was a great increase in urbanization and the metropolitan area around the cities of Panama and Colon, and the corridor linking them, contain nearly half the population of the country.

As a consequence of the dual economy, the income distribution in Panama is highly unequal. There are wide disparities between and within urban and rural Panama. These disparities have been accentuated by the process of economic growth.

The low productivity of agriculture is one of the roots of the unequal income distribution. The relatively high proportion of population who live in the subsistence agricultural sector have extremely low per capita incomes.

Since growth in manufacturing was one of the causes of economic growth during the sample period, we may inquire what is the structure of the industrial sector. Table 2.14 gives us the answer. Panama's small industrial sector produces essentially light industry and construction goods for the domestic market. The proportion of industrial exports is minimal. Furthermore, the sector is heavily dependent on imported intermediate goods.

Table 2.6. Educational level of the Panamanian population according to census years 1950, 1960, 1970[a].

Population	1950	1960	1970
Total Population	805,285	1,075,541	1,428,082
Rural	515,588	629,328	748,712
Urban	289,697	446,213	679,370
Average population age	19.3	18.3	18.4
Population seven years and older	588,429	782,227	1,054,349
Average education (in years)	3.2	3.9	4.8
Population with some primary and secondary education	386,218	565,154	834,600
Elementary education	324,303	454,887	643,830
1. grade	35,530	49,617	68,213
2. grade	50,568	61,998	85,258
3. grade	71,720	87,423	108,680
4. grade	54,614	71,435	91,532
5. grade	40,159	56,858	79,978
6. grade	71,712	127,556	210,169
Secondary education	61,915	110,267	190,770
7. grade	10,930	18,403	31,711
8. grade	16,036	25,477	43,291
9. grade	11,546	21,704	38,227
10. grade	11,650	14,325	18,530
11. grade	6,811	11,875	18,354
12. grade	4,942	18,483	40,657

Machinery	4	0.7	77	0.3	0.6	0.2
Electrical equipment	3	0.5	81	0.4	1.1	0.3
Transportation equipment	5	0.8	115	0.5	1.2	0.3
Other	13	2.2	216	1.0	2.8	0.8
Total	586	100.0	22,181	100.0	356.5	100.0

[a]Source: Direccion de Estadistica y Censo, Panama en Cifras, (1972).

CHAPTER III. SOME THEORETICAL CONSIDERATIONS

This chapter deals with some theoretical questions concerning the building of short term Keynesian macroeconomic models for the less developed countries (LDC's). This requires an examination of the models which have been built in the past for macroeconomic analysis of developing economies. Thus we present a brief survey of the literature on the subject. The survey includes a listing of the most relevant characteristics of the LDC's from the point of view of model building, as well as a description of the most commonly used equation specifications for such models. The last part of the chapter comments on the choice of estimation technique.

Income Determination Models for Developing Economies: General Considerations

In a recent survey of the field, regarding the use of economy-wide models for Less Developed Countries (LDC's), Behrman and Hanson (1975) find that the dominant frameworks in use for macroeconomic policy analysis and policy recommendations have been the Harrod-Domar aggregate growth models, static and dynamic linear programming models, and Chenery two-gap models. This state of affairs has been the consequence of the widely held view that growth is more important than stabilization in LDC's, and that lack of capital and foreign exchange would be the most important constraints on growth. The questions of stabilization and other short run factors were not considered important. However, since the mid sixties or so, there has been an increasing interest in stabilization and other short term problems of LDC's, and a large number of Keynesian income determination models have been built for the less developed economies, among them, those of Latin America. A valid question then, is how does the body of theory on stabilization within the framework of income determination models, which has been developed for the more developed countries (MDC's), apply to the different features of the LDC's in general? Beltran-del-Rio and Klein (1974) address themselves to this question, with special reference to Latin America. They find that the models for the LDC's have begun to differ from those of the MDC's. The models are not totally different, but there are differences in the description of resource endowment, technology and institutions which characterize each individual economy. Thus, the models are more useful for alternative policy simulation or forecasts. Beltran-del-Rio and Klein made a listing of the main features in which the LDC's differ from the more advanced economies. It will be interesting to analyze that listing in the context of Panama. On the list are features which are important to the functioning of the economy and should, as much as possible, be introduced into the model. Unfortunately, these are also the areas on which serious data deficiencies exist so that it is almost impossible to portray them adequately.

Supply deficiency

This is the characteristic feature of LDC's, and it most certainly applies to Panama. The limited productive capacity of the Panamanian economy has already been mentioned. In the agricultural sector, the subsistence farmers are the best example. However, the sector as a whole suffers from serious technological backwardness. For example, there is a widespread lack of adapted varieties; and there is very little organized knowledge about fertilizer requirements, pest control, irrigation, and management practices.

The industrial sector is quite undeveloped, protected behind very restrictive tariffs and import quotas, dependent on imported raw materials and capital goods, and producing for the very small local market, which effectively prevents its further development.

The services sectors suffer from lack of skilled technicians and, in many cases, adequate capital equipment. In fact, the services sectors have absorbed a considerable number of unskilled migrants from the rural areas. These workers have gone into mostly low productivity jobs in the urban areas such as personal services, small retailing and the like.

Capital accumulation

The accumulation of capital and its financing are a critical bottleneck in most LDC's. Generally, the LDC's face the dual problem of generating sufficient internal savings and of earning enough foreign exchange to finance the flow of investment. Another problem that has to be solved is the division of the task between the public and the private sectors.

In the case of Panama, during most of the sample period, public investment has gone into the creation of infrastructure, with direct productive investment being left to the private sector. Traditionally, the government has financed its investment budget by foreign borrowing; the private sector has had a more limited access to external borrowing, so we may conclude that it has depended more on internal savings.

However, from 1970 on, the situation has changed considerably; since then, the government has greatly increased the scope of its enterprises, either displacing, or being in direct competition with the private sector. Most of the public investment during this period has been financed by foreign borrowing. In the other hand, the creation and growth of the international financial center in Panama since 1970, has allowed the private sector to borrow from the international banks, which is equivalent to external borrowing.

Foreign investment and external debt

Usually, the LDC's are dependent on foreign investment and on external debt to bring in technology, and in many cases, the required foreign exchange to finance imports of capital goods and intermediate materials.

As a consequence of her monetary system and her close relation to the U.S., foreign investment has traditionally been important in Panama. Examples are banana production, electricity and telephone utilities in Panama City and Colon until 1972, international communications, the oil refinery, and her banking system.

The Panamanian public sector has traditionally borrowed abroad to finance its investment budget, and sometimes, its operations budget. After 1970, with the growth of Panama as a regional financial center, the private sector has also been able to borrow externally easily.

Exports of primary goods

As a rule, most LDC are exporters of primary goods. However, Panama is an exception to this characteristic. Traditionally, the bulk of Panamanian exports has been services. This is due to geography on the one hand, and to her limited productive capacity on the other. However, during the early part of the sample periods the bulk of her exports of goods were bananas. After 1962, with the opening of the country's only oil refinery, refined oil products became important. In recent years, sugar has also become somewhat important. Thus we have that Panama's exports are mainly services, but her exports of goods are mostly primary goods.

Income distribution

As a rule, the income distribution in LDC's is quite unequal. The income distribution in Panama is one of the worst in Latin America. Merrill et al. (1975) summarize the results of two studies measuring the income distribution in Panama during 1969 and 1970.

For example, the lowest half of the income recipients received about 15 percent of the income, and the top ten percent received about 45 percent of the income.

This situation is due essentially to the dual economy, where a substantial number of the labor force will work in low income occupations. Examples are subsistence farmers and other agricultural workers in the rural areas, and workers in domestic services and other services in the urban areas.

Population and labor force

Another common trait of many LDC's is rapid population growth. Panama has experienced rapid population growth during the entire sample period and after. During the fifties, population growth was about 2.8 percent per year; but in the sixties, the growth rate accelerated to about 3.2 percent per year.

Labor force growth has been similar to that of population. However, growth of the skilled and technical part of the labor has been a different matter. As discussed before, Panama has failed to develop a technical capacity in its labor force.

Internal labor migration

Panama has experienced large internal migration during the sample period. For example, the percentage of urban population was 43.3 in 1960 and 48.5 in 1972. Panama City, and to smaller extent, other towns, have developed a belt of shanty towns around them, where the rural migrants concentrate. These people, who are mostly unskilled and half illiterate, constitute the bulk of the workers in low income occupations in urban services. The source of migration is rural poverty. It is difficult to appreciate how wretched the subsistence farmers of Panama are. Their per capita income has been estimated to be about B/100 per year. These estimates are undated and unnamed, but they may be considered realistic. For example, Merrill et al. (1975) give an estimate of B/170 per capita income for rural Veraguas, one of the poorest provinces in Panama. Thus, the widespread rural poverty is the main force driving these people toward the towns and cities.

Prices, wages, and money supply

Inflation is a chronic problem in a number of LDC's. However, Panama has not suffered from it as some other Latin American countries have. The nature of her monetary system does not allow the government to manipulate very many monetary variables. However, it must be mentioned that the interest rate was fixed by law until 1970, and that in 1975, government fixed lower interest rates on loans to agriculture and industry, which were to be financed by raising interest rates on loans to other sectors such as trade, private consumption, and others.

Production bottlenecks in agricultural and industrial sectors have not been a source of inflationary pressure, because when they occurred, the government has opened imports. Most of the time, the imported goods were cheaper and of better quality.

Organized labor has been weak and politically impotent so that wage demands by unions have not been important in creating inflation. The wage-price spiral has not existed in Panama.

Inflation in Panama has come through import prices. Table 2.3 shows that imports have been about 40 percent of gross domestic product during the entire sample period, so that rising import prices were the main cause of Panamanian inflation. A secondary source of price increases, but not of sustained inflation, has been indirect taxation by the government. Indirect taxes have been used to promote the import substitution policy by taxing imports, or to generate additional government revenue by taxing whatever was expedient.

Overcapacity

The existence of areas of overcapacity in the middle of the general supply deficiency is a paradox of the LDC's.

In Panama, the industrial sector suffers from overcapacity, which is caused by the very small size of the market realtive to the productive capacity of the imported capital goods; to protectionism which permits the establishment of inefficient industries; and to the desire by business managers to control the new market.

Government and political change

The power of the government to intervene in economic matters is usually greater in LDC's than in MDC's. In the case of Panama, the government has considerable scope for intervention, and the trend has been for this power to increase over time.

Also, as the rule of law has never been particularly strong, there is ample possibility for arbitrary government action, even under constitutional governments. The role of government in promoting development or economic growth is very much hindered by incompetence, inefficiency and corruption of public officers of all ranks.

Because of all the above reasons, private investment usually takes a waiting attitude during periods of political change.

Income Determination Models for Developing Economies: Equation Specification

In another paper, Beltran-del-Rio (1974) examines the specific equations that enter into the models for LDC's and MDC's. For the MDC's, he examines the models of Project Link and for the LDC's he examines 15 models of Latin American economies taken from the literature. He is interested in finding

1. Equations with a common specification for MDC's and LDC's.
2. Equations which are common only for LDC's.
3. Single country equations.

Waelbroeck (1975) offers a survey of short run model building in the MDC's excluding the U.S. He examines 38 models from Europe, Canada, Japan, Australia, and New Zealand. We will, where it is useful, contrast his findings to those of Beltran-del-Rio.

A brief discussion of their findings follows.

Private consumption

Beltran-del-Rio finds that the Keynesian and neo-Keynesian consumption function is common to both MDC's and LDC's. It is used either in total or in per capita terms. Its variants are

$$C = f(YD) \text{ or } C = f(YD, C\text{-}1)$$

where C is real consumption in total or in per capita form, YD is real disposable income and C-1 is C lagged one period. The rate of inflation is another variable included in the models of countries which have experienced hyperinflation like Brazil and Chile. The simple Keynesian function has been highly successful in Latin American models, being applied in 12 of the models sampled.

These results are confirmed by Waelbroeck. All the models he surveyed, but two, include the Keynesian multiplier. He also finds the rate of change of prices as a factor increasing consumption in some of the models.

Investment

Here Beltran-del-Rio finds that the accelerator principle is generally used in both MDC's and the LDC's. In the Latin American models surveyed, it is used as both the naive or simple accelerator and the flexible accelerator:

$$I = f(\Delta GDP) \text{ or } I = f(GDP, K\text{-}1)$$

where I is real fixed investment, net or gross, GDP is real gross domestic product and K-1 is real capital stock lagged one period. Other variables added to the equation in some of the models are imports of capital goods, profits, credit availability, the impact of inflation and dummy variables to account for political events.

It is interesting to note that the original Keynesian investment function, the marginal efficiency of capital (rather investment) which depends on the interest and profit rates, has not been found useful for the LDC's.

Waelbroeck finds in his survey that there are sharp differences in specification among models, the main choice being between flexible accelerators or specifications which depend on profits, capacity shortages, and the availability of funds. He points out that the accelerator may be less useful in countries with narrow capital markets, and with rigidities introduced by planning, imperfect labor markets, and income policies. This would account for the mixed formulations reported by Beltran-del-Rio, where other variables are added to complement the accelerator in the investment functions.

Imports

Here both Beltran and Waelbroeck find that in both MDC's and LDC's imports are generally specified using a Keynesian demand approach:

$$M = f(Y, Pd/Pf)$$

where M is real imports, either total or a component of it; Y is real domestic aggregate demand or one of its components; and Pd and Pf are domestic and foreign prices. In the Latin American models this Keynesian formulation is modified to reflect the noncompetitive nature of their imports, especially capital goods; the great importance of import taxes in government revenues; the foreign exchange constraint, inflation and devaluation, and the impact of import substitutions policies. Thus, the only general term is the Keynesian income term, the other terms being peculiar to the LDC's of Latin America.

<u>Exports</u>

Beltran and Waelbroeck find essentially the same results. The Keynesian demand determined approach to exports

$$E = f\ (Yf,\ Pe/Pf)$$

where E is real exports or one of its components, Yf is some measure of real foreign output and Pe/Pf is the relative price of export to foreign prices, is used in some of the Latin American models, but an alternative formulation based on a supply restriction of exports is also used:

$$E = f(Q,\ C,\ \Delta St)$$

where Q is domestic output of the export good, C is domestic demand for same, and ΔS is change in its stock. This formulation is a stochastic approximation to the identity for change in stocks:

$$\Delta St = Q + M - C - E$$

where M is real imports of the good in question. The demand approach is better suited for efficient and well-organized export sectors, whereas the supply approach is better suited for backward export activities.

Prices

Beltran-del-Rio finds that the favored approach to specify prices in the Latin American models is to combine the quantity theory of money with a wage cost-push theory.

The quantity theory yields

$$P = MV/Y$$

where P is a suitable price, M is the stock of money, V is the income velocity and Y is real output. This is combined with a wage cost-push term for labor unit cost

$$P = w/a(Y/L)$$

where w is the average current wage, Y/L is labor productivity and a is the labor share on output. The final empirical addition to the equation is the addition of Pm, the import price index, to introduce external inflation. Some additional variables are changes in the exchange rate, indirect taxes, and price controls.

For the MDC's, Waelbroeck finds that the Phillips curve is the standard specification, but that it is not performing very well, and that considerable research is being done in the area.

Statistical Estimation

In his survey, Beltran-del-Rio does not comment on the statistical techniques employed to estimate the models examined. However, the Mexican model presented by Beltran-del-Rio and Klein (1974) is estaimted by OLS. Naranjo (1973) also estimates his model by OLS. These two examples show that OLS is used, at least, in some cases.

Waelbroeck, however, does comment on the statistical method used to estimate the models he surveyed. He found that OLS was used almost invariably as the estimation method. There seem to be two main reasons for this situation.

In the first place, there is a widely held view that simultaneous equation biases are not large in practice. The second reason has to do with the very recent origin of the model building activity. Simultaneous estimation methods are much more costly than OLS, and there is no great payoff from their use during the exploratory phase of model building, while the structure of the model is still tentative.

CHAPTER IV. THE MODEL

General Comments

Several general comments are given below which describe the data, the statistical procedure and the notation employed in the description of the model.

Data

The Directorate of Statistics and Census of the Office of the Comptroller General of the Republic (Contraloria General de la Republica, Direccion de Estadistica y Censo) is responsible for the elaboration of all statistical data for the Republic of Panama. Even though the original data may originate in other government agencies, it is published by Contraloria. This has the advantage of centralizing all data in only one source.

The National Accounts of Panama, at 1960 prices, start from 1950; unfortunately some important series begin from 1950 to 1960. For this reason, among others, the sample period is not the same for all equations. Most series are published in both prices of each year and 1960 prices; however, in some cases, either the current price series or the constant one is not published or even calculated; such series have been obtained by special request.

Another feature of the data is that it constantly undergoes minor revisions. The latest revision available to us has been used in each case.

Over the years, the amount of detail given the National Accounts has been diminishing. This has resulted in a number of series being eliminated due to user lack of interest. Series not asked for, were dropped at the next austerity drive.

The most unfortunate reduction of detail has occurred in the income side of the National Accounts. There, the entire income distribution side has been lost. This will be discussed in more detail when we present the econometric model. Other weak areas, where series were dropped permanently or temporarily, are labor statistics for employment and unemployment, and price statistics. Another source of lost detail has been a number of major redefinitions of statistical series without making a consistent series for a sufficiently long number of years. This has happened most notably in the monetary and banking sector, but it has also happened in the labor statistics area.

Statistical procedure

Most equations have been estimated by Ordinary Least Square (OLS) and the constant term has always been left in, even when not statistically significant. Similarly, the Durbin-Watson (D-W) statistic has been given for every equation, even if it does not apply.

The consumption equations have been estimated using the Ridge Regression method of Hoerl and Kennard (1970a, 1970b) in an attempt to avoid multicollinearity problems. Ridge Regression presents an interesting departure from OLS, in that it uses biased estimation in an attempt to solve other problems arising when nonorthogonal data are encountered by the OLS estimator.

The General Linear Hypothesis model defined as

$$Y = \beta X + \mu$$

where Y is an n x 1 vector of observations, β is a p x 1 vector of unknown parameters, X is a full rank n x p matrix of fixed, known variables, μ is an n x 1 vector of random disturbances assumed to satisfy $E\mu = 0$ and $E\mu\mu^1 = \sigma^2 I$, serves as the basis for the multiple regression model frequently used in economic research.

When estimated by OLS, the estimator for β is given by

$$\hat{\beta} = (X^1X)^{-1}X^1Y$$

which has the statistical properties of being a best (in the sense of minimum variance), linear, unbiased estimator. However, when there is multicollinearity in the X variables, OLS may suffer several ill effects such as unstable coefficients, wrong signs, and nonconclusive significance tests.

In an attempt to avoid multicollinearity problems in OLS, Hoerl and Kennard (1970a, 1970b) suggest using a Ridge Regression (RR) estimator defined as

$$\tilde{\beta} = (X^1X + kL)^{-1}X^1Y$$

where k denotes a small positive number (the Ridge Parameter) and

L is a diagonal matrix having the sums of squares of the X variables as diagonal elements. If the data are standardized so that X^1X is a correlation matrix, then L becomes the identity matrix.

The RR estimator is biased:

$$E(\tilde{\beta}) = \beta - k(X^1X + kL)^{-1}L\beta$$

Its variance is given by

$$\text{Var - Cov }(\tilde{\beta}) = (X^1X + kL)^{-1}X^1X(X^1X + kL)^{-1}\sigma^2$$

an important result is that as k increases, the variance will decrease, but the bias will increase.

The main theoretical justification for RR is that, if we choose the MSE (Mean Square Error) as the criterion for optimality, then there always exists a k>0, such that

$$MSE(\tilde{\beta}) < MSE(\hat{\beta})$$

That is, if the MSE is interpreted as the squared Euclidean distance between the estimator and the parameter, then the RR estimator will be closer to the parameter than the OLS estimator, given that the proper k is found. However, there is no single way to determine k. The usual procedure is to let k vary in some suitable interval, make a plot (the Ridge Trace) of the $\tilde{\beta}_i$ against k, and then choose k visually at some point where the $\tilde{\beta}_i$ seem to "stabilize".

Vinod (1978) presents a survey of the results obtained so far by using RR. He found that Monte Carlo experiments with multicollinear data always show the superiority of RR over OLS, but there is no agreement on an "optimum" RR method.

Notation

All variables have been named as they would appear in a FORTRAN program. Variables in real terms have an R as the last letter in their name; similarly, variables in current prices have a C as the last letter in their name. Variables that usually are only given in current prices, such as taxes and the several income components, do not always follow this convention. Lagged variables have a number, denoting the lag length, as the last character in their name.

Each equation is given with the value of the estimated coefficient followed by the corresponding variable name, and its estimated standard error written below, within parentheses.

R^2 denotes R-squared corrected for degrees of freedom.

S.E. denotes the standard deviation of the equation.

D.W. denotes the Durbin-Watson statistic.

R.P. denotes the Ridge Parameter of Ridge Regression.

The Consumption Sector

The structure of the consumption sector has been determined by the availability of data in the National Accounts. The accounts provide an estimate of aggregate real private consumption (CPR), which is obtained as a residual. Gross domestic product (GDPR) is estimated directly from production data; there are also independent estimates made of imports, exports, investment and government. Thus we have

$$CPR = GDPR - \text{exports} - \text{investment} - \text{government} + \text{imports}$$

However, the National Accounts also provide an estimate of twelve categories of private apparent consumption, defined as consumption in the national territory by resident and nonresident households.

These twelve categories of consumption are related to CPR as follows:

$$CPR = \Sigma CR_i - \text{Adjustments} \qquad i = 1, 2, \ldots, 12$$

where the adjustments include the consumption of nonresidents, some government purchases, changes in inventories, the consumption of resident households abroad and the statistical discrepancy defined above.

In the model, we obtain independent estimates of CPR, each of the twelve CR's and define the adjustments as a discrepancy between the two sets of equations:

$$\text{Discrepancy} = \Sigma CR_i - CPR \qquad i = 1, 2, \ldots, 12$$

Furthermore, all the equations have been specified in terms of the

Permanent Income Hypothesis developed by Friedman (1957).

If permanent income is defined as some weighted average of all past incomes, and the weights are a decreasing geometric series as we go back in time, we can write

$$Y \text{ permanent} = \sum_i \lambda^i Y_{t-1} \qquad i = 0, 1, \ldots, \infty$$

where $0 < \lambda < 1$

then, let C_t be a linear function of Y permanent:

$$C_t = a + b\sum_i \lambda^i Y_{t-1} \qquad i = 0, 1, \ldots, \infty$$

applying the Koyck transformation:

$$\lambda C_{t-1} = \lambda a + \lambda b\sum_i \lambda^i Y_{t-1} \qquad i = 1, 2, \ldots, \infty$$

subtracting from C_t,

$$C_t - \lambda C_{t-1} = a(1 - \lambda) + bY_t$$

and finally

$$C_t = a(1 + \lambda) + bY_t + \lambda C_{t-1}$$

which is the basic form used for estimation in all equations.

The private aggregate consumption function

The aggregate consumption function, as said before, has been specified following the Permanent Income Hypothesis. However, some experimentation was done on alternative forms of the arguments of the function. This was done in an attempt to capture the effect of variables which were thought to be important during the sample period. One such case is the incorporation of the terms of trade effect into the real disposable income used in the consumption functions. Table 4.1 shows the importance of the terms of trade effect during the sample period. Another such case was an attempt to incorporate the percentage of urban population into the consumption function, as it was considered that the increase in urbanization would have the effect of increasing the level of consumption. Also, the consumption function was estimated on a per capita basis. This is usually done to improve the statistical properties of the estimated equation, but also could be used to introduce the effect of population into the model. Finally, all functions were estimated using the Ridge Regression method of Hoerl and Kennard (1970a, 1970b). In part to illustrate the Ridge Regression technique, Tables 4.2 through 4.5 present some examples of the results obtained.

Now, the question arises as to which equation to choose for the model. Clearly, we are not restricted to any particular equation. However, for the purposes of this dissertation, we

Table 4.1. Terms of trade effect, Panama 1950-1972 (millions of 1960 Balboas).

Year	Terms of trade effect	As percent of real disposable income
1950	-0.1	-
1951	-8.6	5.0
1952	-0.6	-
1953	0.6	0.3
1954	11.3	5.2
1955	14.8	6.4
1956	7.4	3.1
1957	5.9	2.2
1958	5.8	2.2
1959	1.1	0.4
1960	0.0	0.0
1961	3.3	1.0
1962	7.9	2.3
1963	7.8	2.1
1964	15.0	3.8
1965	19.7	4.7
1966	19.3	4.2
1967	27.9	5.5
1968	31.4	5.7
1969	41.8	6.8
1970	39.7	6.1
1971	54.3	7.8
1972	52.1	7.1

have chosen to use an equation incorporating the terms of trade effect into the income term. In the post sample period the terms of trade became very unfavorable for the Panamanian economy, resulting in a large negative effect, and we wish to experiment to see how the model performs when that effect is incorporated into the consumption function(s). The estimation period is 1951-72.

Thus, the estimated equation is:

$$CPR = \underset{(13.31)}{31.81} + \underset{(.107392)}{.375853}(YDPR + \overline{TTE}) + \underset{(.135211)}{.571062}\overline{CPR1}$$

$R^2 = .9827$ S.E. = 21.000   D.W. = .9526   R.P. = .002

CPR: Private consumption, in millions of 1960 Balboas.

YDPR: Personal disposable income, in millions of Balboas, deflated by the implicit deflator for CPR.

$\overline{TTE}$: Terms of trade effect, millions of 1960 Balboas.

$\overline{CPR1}$: CPR lagged one year.

The equation is statistically satisfactory; it has a good fit, as shown by the R^2, all coefficients have the proper sign and are statistically significant, and finally, the residuals are satisfactory. The largest residuals are 8.5 percent in 1951, 10.3 percent in 1953, and 6.1 percent in 1963. All other residuals are less than 6.0 percent.

However, the MPC out of current income seems low for a country in the state of development as Panama. On the other hand, the long run, static MPC equals .8762, which is more in line with the

Table 4.2. Real private consumption (CPR), as a function of real disposable income (YDPR), and a lagged term (CPR1). Panama, 1951-1972.

Ridge parameter	Explanatory Variables				
	Intercept	YDPR	CPR1	$\bar{R}^{2}$[a]	APE[b]
$\lambda = 0.000$	19.90 (1.9297)	0.371411 (2.6876)	0.624546 (3.9313)	.9907	3.412
$\lambda = 0.002$	25.42 (2.0523)	0.440964 (3.6338)	0.537663 (3.8586)	.9833	3.639
$\lambda = 0.004$	28.63 (2.0059)	0.457547 (3.9454)	0.511818 (3.8479)	.9762	3.793
$\lambda = 0.006$	31.36 (1.9683)	0.463606 (4.0906)	0.498167 (3.8367)	.9692	3.929
$\lambda = 0.008$	33.88 (1.9465)	0.465820 (4.1675)	0.489028 (3.8229)	.9623	4.057
$\lambda = 0.010$	36.30 (1.9269)	0.466215 (4.2097)	0.482064 (3.8074)	.9555	4.182
$\lambda = 0.012$	38.64 (1.9361)	0.465617 (4.2320)	0.476325 (3.7908)	.9488	4.311

[a] R squared adjusted for degrees of freedom.

[b] Average percent error.

Table 4.3. Real private consumption as a function of real disposable income plus terms of trade effect (YDPR + TTE), and a lagged term. Panama, 1951-1972.

Ridge parameter	Explanatory Variables				
	Intercept	YDPR+TTE	CPR1	R^{-2}[a]	APE[b]
λ = 0.000	23.13 (2.0244)	0.284307 (2.4944)	0.693259 (4.8231)	.9903	3.507
λ = 0.002	31.81 (2.3891)	0.375853 (3.4998)	0.571062 (4.2235)	.9828	3.844
λ = 0.004	36.12 (2.4190)	0.404138 (3.8790)	0.528857 (4.0381)	.97581	4.033
λ = 0.006	39.35 (2.4021)	0.416808 (4.0705)	0.506458 (3.9409)	.9690	4.184
λ = 0.008	42.12 (2.3809)	0.423280 (4.1797)	0.491967 (3.8766)	.96241	4.334
λ = 0.010	44.65 (2.3642)	0.426677 (4.2453)	0.481436 (3.8282)	.95588	4.476
λ = 0.012	47.04 (2.3530)	0.428335 (4.2853)	0.473178 (3.7888)	.9494	4.611

[a] R squared corrected for degrees of freedom.

[b] Average percent error.

Table 4.4. Real private consumption incorporating the effect of increased urbanization, as shown by the percent of urban population (%POBU). Panama, 1951-1972.

Ridge parameter	Explanatory Variables					
	Intercept	YDPR	CPR1	%POBU	$\bar{R}^2$[a]	APE[b]
λ = 0.000	-320.52 (4.4962)	0.583141 (5.6136)	0.130261 (0.8723)	1029.52 (4.7986)	.9957	1.829
λ = 0.002	-79.91 (1.2575)	0.447980 (3.8643)	0.454459 (3.2032)	310.601 (1.6871)	.9848	2.871
λ = 0.004	-47.13 (0.7826)	0.451643 (3.9597)	0.465345 (3.4327)	221.643 (1.2936)	.9770	3.209
λ = 0.006	-32.08 (0.5446)	0.454518 (4.0263)	0.464512 (3.5067)	184.744 (1.1180)	.9696	3.424
λ = 0.008	-22.69 (0.3891)	0.455647 (4.0637)	0.461775 (3.5361)	164.203 (1.0165)	.9624	3.599
λ = 0.010	-15.85 (0.2731)	0.455643 (4.0831)	0.458638 (3.5467)	150.970 (0.9497)	.9553	3.754
λ = 0.012	-10.39 (0.1794)	0.454922 (4.0910)	0.455449 (3.5478)	141.646 (0.9021)	.9483	3.898

[a]R squared corrected for degrees of freedom.

[b]Average percent error.

Table 4.5. Per capita real private consumption as a function of per capita real disposable income (YDPR/N) and a lagged term (CPR1/N1). Panama, 1951-1972.

Ridge parameter	Explanatory Variables				
	Intercept	YDPR/N	CPR1/N1	$\bar{R}^2$[a]	APE[b]
λ = 0.000	27.98 (2.0158)	0.404438 (3.1841)	0.540315 (3.5817)	.9708	3.009
λ = 0.002	36.91 (2.2528)	0.447856 (3.9412)	0.468955 (3.4966)	.9498	3.136
λ = 0.004	43.28 (2.3292)	0.454202 (4.1564)	0.442599 (3.4516)	.9299	3.280
λ = 0.006	48.94 (2.3938)	0.452770 (4.2252)	0.426222 (3.4079)	.91087	3.412
λ = 0.008	54.22 (2.4595	0.448581 (4.2353)	0.413790 (3.3642)	.89251	3.536
λ = 0.010	59.23 (2.5269)	0.443201 (4.2174)	0.403398 (3.3209)	.8749	3.676
λ = 0.012	64.02 (2.5952)	0.437270 (4.1847)	0.394249 (3.2785)	.85774	3.844

[a] R squared corrected for degrees of freedom.

[b] Average percent error.

textbooks.

As a comparison, Naranjo (1973), working with Costa Rican data, found the MPC equal to .3027 and the long run MPC equal to .7724.

The disaggregated consumption functions

The National Accounts provide total apparent consumption, defined as consumption in the national territory by resident and nonresident households, disaggregated into twelve categories as follows:

1. Food (CFOODR)
2. Drinks (CDRINKR)
3. Tobacco (CTBCOR)
4. Clothing, shoes, other personal effects (CCTHINGR)
5. Housing (CHSINGR)
6. Fuel and electric power (CELECTR)
7. Furniture and household equipment (CFNTRER)
8. Domestic services (CDSER)
9. Personal and health care (CHLTHR)
10. Transport and communications (CTRANSFR)
11. Entertainment (CENTER)
12. Other services (COTSER)

These functions were all specified in terms of Panamanian economic variables. However, due to the presence in Panama of the Panama Canal and the Panama Canal Zone, one would expect that other variables, such as income in the Canal Zone, should enter as arguments in the functions. Unfortunately, it was not possible to obtain the military component of income in the Canal Zone, this portion being considered a more important component of the total in terms of expenditures in Panama than the civilian. However, there is a series of purchases in Panama by civilian and military residents of the Canal Zone (CZC*PMAR), which was deflated by the implicit deflator of private consumption, and used as a proxy for the Canal Zone income. The results, however, were not satisfactory. The estimated coefficient was negative or caused other coefficients to become negative in most of the equations, and in the one or two instances where all variables had the proper sign, it was statistically insignificant and in a category where one would not expect very many Canal Zone purchases, such as clothing.

For this reason the Canal Zone variable was left out, even though this remains a problem to be solved in the future.

Similarly, a relative price term, using the implicit deflators for the series, was experimented with but with very negative results. The relative price coefficients as a rule were of the wrong sign and statistically nonsignificant. It was not possible to improve the results using the Ridge Regression technique, and furthermore, a tight computer budget did not permit the use of other types of estimating procedures. This problem remains for future research.

Food

The equation for food consumption was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CFOODR = \underset{(7.982)}{37.11} + \underset{(.035464)}{.214161}(YDPR + \overline{TTE}) + \underset{(.134356)}{.268072}\overline{CFOODR1}$$

$R^2 = .9840$ S.E. = 6.952 D.W. = 1.2041 R.P. = .002

CFOODR: Consumption of food in the national territory by resident and nonresident households, in millions of Balboas of 1960.

$\overline{TTE}$: Terms of trade effect, in millions of Balboas of 1960.

$\overline{CFOODR1}$: CFOODR lagged one year.

The equation is statistically satisfactory, has a good fit, and all parameters are statistically significant. The largest residuals are 5.1 percent in 1951, 6.2 percent in 1952, all other residuals are less than or equal to 5.0 percent. When estimated by OLS, the coefficient of CFOODR1 was nonsignificant.

Drink

The equation for drink was specified as a function of real disposable income plus the terms of trade effect, a lagged dependent variable and a dummy to account for changes in the import and excise taxes on alcoholic beverages, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$\begin{aligned} CDRINKR = \underset{(2.46)}{9.31} + \underset{(.008519)}{.039343}(YDPR + \overline{TTE}) + \underset{(.195149)}{.144456}\overline{CDRINKR1} \\ - \underset{(.919255)}{1.39489}\overline{DLIQUOR} \end{aligned}$$

$R^2 = .9295$ S.E. = 2.057   D.W. = 1.2153   R.P. = .002

CDRINKR: Consumption of drink in the national territory by resident and nonresident households, in millions of Balboas of 1960.

$\overline{\text{CDRINKR1}}$: CDRINKR lagged one year.

$\overline{\text{DLIQUOR}}$: Dummy variable to account for changes in the import and excise taxes on alcoholic beverages. Equals 0.0 for 1951-1957, 1.0 for 1958-1962, 2.0 for 1963-1971, and 3.0 in 1972.

The equation is statistically satisfactory and has a good fit. $\overline{\text{DLIQUOR}}$ comes with a negative sign as expected, but is not quite significant. $\overline{\text{CDRINKR1}}$ is also nonsignificant. The negative sign for $\overline{\text{DLIQUOR}}$ shows the impact of the increases in the excise and import taxes.

The residuals, however, are less desirable; 1954, 1955, 1958, 1960, and 1962 have residuals in excess of 10 percent of the observation and the reason is clear if one looks at the data for

1954. All other residuals are less than 10 percent of the observation.

Tobacco

This equation was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and was estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CTBCOR = \underset{(.4030)}{.8898} + \underset{(.001393)}{.001422}(YDPR + \overline{TTE}) + \underset{(.107589)}{.849802}\overline{CTBCOR1}$$

$R^2 = .9514$ S.E. = .5343 D.W. = 1.2727 R.P. = .002

CTBCOR: Consumption of tobacco in the national territory by resident and nonresident households, in millions of Balboas of 1960.

$\overline{CTBCOR1}$: CTBCOR lagged one year.

The equation is statistically satisfactory and has a good fit. The largest residuals are 19.4 percent in 1951, 15.4 percent in 1953, 10.0 percent in 1956, and 10.4 percent in 1960. All other residuals are less than 10 percent.

Clothing

The equation for clothing was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CCTHINGR = \underset{(2.390)}{10.51} + \underset{(.009390)}{.044757}(YDPR + \overline{TTE}) + \underset{(.171676)}{.176876}\overline{CCTHINGR1}$$

$R^2 = .9443$ S.E. = 2.534   D.W. = 1.3788   R.P. = .004

CCTHINGR: Consumption of clothing and shoes in the national territory by resident and nonresident households, in millions of Balboas of 1960.

$\overline{CCTHINGR1}$: CCTHINGR lagged one year.

The equation is statistically satisfactory. It has a fairly good fit; however, the residuals are fairly large in some years. The residual in 1951 is 23.2 percent; in 1954, 9.4 percent; in 1958, 15.1 percent; in 1958, 10.1 percent. All other residuals are less than 6.0 percent.

Housing

The equation for housing was specified as a function of real disposable income plus the terms of trade effect and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CHSINGR = \underset{(2.48)}{5.46} + \underset{(.010595)}{.038397}(YDPR + \overline{TTE}) + \underset{(.150517)}{.569245}\overline{CHSINGR1}$$

$R^2 = .9826$ S.E. = 2.001   D.W. = .6050   R.P. = .002

CHSINGR: Consumption of rent and water in dwellings in the national territory by resident and nonresident households, in millions of 1960 Balboas.

$\overline{\text{CHSINGR1}}$: CHSINGR lagged one year.

The equation is statistically satisfactory and has a good fit. The largest residual in 1960 is only 5.6 percent. All other residuals are much less than 5.0 percent.

Fuel and electric power

The equation for the consumption of fuel and electric power was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1971 using the Ridge Regression method.

The estimated equation is:

$$\text{CELECTR} = \underset{(.4631)}{-.8898} + \underset{(.003807)}{.008536}(\text{YDPR} + \overline{\text{TTE}}) + \underset{(.180304)}{.785404}\overline{\text{CELECTR1}}$$

$R^2 = .9628$ S.E. = .848 D.W. = 1.022 R.P. = .004

CELECTR: Consumption of electricity and fuel in the national territory by resident and nonresident households, in millions of 1960 Balboas.

$\overline{\text{CELECTR1}}$: CELECTR lagged one year.

The equation is statistically satisfactory and has a fairly good fit. The equation was estimated only to 1971 because the observation for 1972 was so large relative to the other values in the series, that it caused the estimated equation to have wrong signs in some coefficients and a poor fit. The largest residuals are 10.5 percent in 1951, 6.7 percent in 1952, 18.3 percent in 1960, 19.6 percent in 1962, 12.4 percent in 1963, 8.0 percent in 1968, and 8.5 percent in 1971. While some of these residuals appear large on a percent basis, their absolute values are small.

Furniture

The equation for furniture consumption was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$\underset{}{CFNTRER} = \underset{(1.74)}{-1.08} + \underset{(.015581)}{.030442}(YDPR + \overline{TTE}) + \underset{(.193085)}{.656036}\overline{CFNTRER1}$$

$R^2 = .9697$ S.E. = 2.820 D.W. = 1.3199 R.P. = .002

CFNTRER: Consumption (purchases) of furniture and household equipment in the national territory by resident and nonresident households, in million of 1960 Balboas.

$\overline{CFNTRER1}$: CFNTRER lagged one year.

The equation is statistically satisfactory. It has a good fit even though it has large residuals of 21.1 percent in 1951, 10.2 percent in 1952, 20.2 percent in 1953, 15.2 percent in 1954, 15.1

percent in 1960, and 16.2 percent in 1965. However, the absolute value of the residuals is small. All other residuals are less than 10.0 percent.

Domestic services

The equation for consumption of domestic services was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CDSER = \underset{(1.41)}{4.83} + \underset{(.005323)}{.018837}(YDPR + \overline{TTE}) + \underset{(.152610)}{.485622}\overline{CDSER1}$$

$R^2 = .9737$ S.E. = 1.123 D.W. = .9349 R.P. = .002

CDSER: Consumption of domestic services in the national territory, by resident and nonresident households, in millions of 1960 Balboas.

$\overline{CDSER1}$: CDSER lagged one year.

The equation is statistically satisfactory and has a good fit. The largest residuals are 8.9 percent in 1951, 9.6 percent in 1955, 6.4 percent in 1960 and 6.5 percent in 1968. All other residuals are less than five percent.

Personal and health care

The equation for personal and health care consumption was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$CHLTHR = \underset{(.8319)}{.8313} + \underset{(.005880)}{.016676}(YDPR + \overline{TTE}) + \underset{(.153526)}{.662582}\overline{CHLTHR1}$$

$R^2 = .9748$ S.E. = 1.291 D.W. = 1.1762 R.P. = .002

CHLTHR: Consumption of personal and health care products and services in the national territory by resident and nonresident households, in millions of 1960 Balboas.

$\overline{CHLTHR1}$: CHLTHR lagged one year.

The equation is statistically satisfactory and has a good fit. The largest residuals are 9.7 percent in 1953; 10.0 percent in 1955, 15.3 percent in 1956, 6.7 percent in 1965, and 6.9 percent in 1967. The remaining residuals are all less than 6.0 percent.

Transportations and communications services and equipment

The equation for transportation and communications services and equipment was specified as a function of real disposable income plus the term of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimate equation is:

$$CTRANSPR = \underset{(1.822)}{.7346} + \underset{(.013423)}{.048542}(YDPR + \overline{TTE}) + \underset{(.150649)}{.560532}\overline{CTRANSPR1}$$

$R^2 = .9699$ S.E. = 3.320 D.W. = .9123 R.P. = .004

Entertainment services

The equation for the consumption of entertainment services was specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$\underset{}{CENTER} = \underset{(1.36)}{-2.05} + \underset{(.012291)}{.034758}(YDPR + \overline{TTE}) + \underset{(.153448)}{.720648}\overline{CENTER1}$$

$R^2 = .9771$ S.E. = 2.718 D.W. = .7268 R.P. = .004

CENTER: Consumption of entertainment services in the national territory by resident and nonresident households, in millions of 1960 Balboas.

$\overline{\text{CENTER1}}$: CENTER lagged one year.

The equation is statistically satisfactory and has a good fit. The largest residuals are 5.4 percent in 1952, 6.5 percent in 1958, 10.0 percent in 1968, and 6.0 percent in 1972. All other residuals are less than 5.0 percent.

Other services

The equation for consumption of other services is specified as a function of real disposable income plus the terms of trade effect, and a lagged dependent variable, and is estimated for the period 1951-1972 using the Ridge Regression method.

The estimated equation is:

$$\underset{(.328828)}{COTSER = -.0485} + \underset{(.002984)}{.010700}(YDPR + \overline{TTE}) + \underset{(.124044)}{.633773}\overline{COTSER1}$$

$R^2 = .9826$ S.E. = .6624   D.W. = .5881   R.P. = .004

COTSER: Consumption of other services in the national territory, by resident and nonresident households, in millions of 1960 Balboas.

$\overline{\text{COTSER1}}$: COTSER lagged one year.

The equation is statistically satisfactory. It has a good fit and the largest residuals are 6.3 percent in 1952, 6.1 percent in 1955, 6.9 percent in 1960, and 6.5 percent in 1963.

Total private apparent consumption

$$CPATR = CFOODR + CDRINKR + CTBCOR + CCTHINGR + CHSINGR + CELECTRIC + CFNTRER + CDSER + CHLTHR + CTRANSPR + CENTER + COTSER$$

CPATR: Total consumption in the national territory by resident and nonresident households, in millions of 1960 Balboas.

Discrepancy between total apparent consumption and aggregate private consumption

$$CDISCR = CPATR - CPR$$

CDISCR: Discrepancy between total apparent consumption and aggregate private consumption, in millions of 1960 Balboas.

Total consumption

$$CR = CPR + \overline{CGR}$$

CR: Total consumption, in millions of 1960 Balboas.

$\overline{CGR}$: Government consumption, millions of 1960 Balboas.

Private consumption, current Balboas

$$CPC = CPR * \overline{PC}$$

CPC: Private consumption, millions of 1960 Balboas.

$\overline{PC}$: Implicit deflator for aggregate private consumption, 1960 = 100.

Consumption of services

$$CTSER = CHSINGR + CDSER + CHLTHR + CTRANSPR + CENTER + COTSER$$

CTSER: Total consumption of services, millions of 1960 Balboas.

The Investment and Capital Formation Sector

The structure of the investment and capital formation sector is determined by the data availability in the National Accounts. The accounts give investment data for the public and private sectors by type of good: housing, other construction, transportation and communications equipment, and machinery and other equipment and changes in inventories. The series are given in current and in constant prices, but their length is not uniform, some series starting in 1950 and others in 1956.

Depreciation is given in current prices and disaggregated only between the public and private sectors.

In the model, private investment is endogenous and divided into:

1. Residential construction (IPHR)
2. Other construction (IPOCR)
3. Capital goods (IPKGR)
4. Changes in inventories (IPEXR)

Government investment is divided into the same categories, but is left exogenous.

The equations were specified as simply as possible. However, special attention was paid to the role of bank credit in Panama.

It is a widely held opinion in Panama that credit availability would be decisive in determining the amount of investment done. As Panama virtually has no national currency with the U.S. dollar used instead, and the banking sector is formed by some of the largest U.S. and European banks, a bank loan in Panama is a loan in foreign exchange, that could be used to buy domestically, or import goods and services. Thus, it was decided to include credit as an explanatory variable in the investment equations.

Now, the quality of the banking sector credit data is very poor. During the sample period there were several major and minor redefinitions of the different credit categories; however, in every case a consistent series was not calculated for the years prior to the change, so that one is using series which are a mixture of groups of mutually inconsistent observations. A further criticism which is made of the data is that the categories do not reflect the final purpose of the loans, so that, at best, one should expect the series on credit by sector to be very crude approximations to the true credit variables. However, in spite of all these shortcomings, it was considered useful to introduce a credit variable in the investment equations.

After many trials, the credit variable that gave the best results, was the stock of bank loans by sector, outstanding at the end of each year. The one exception was housing, where the change (net increment) in credit gave good results. In the other investment equations, the change in credit variable gave very poor results, usually coming with a negative sign.

The equations were specified as simply as possible. Housing was made a function of disposable income, credit to the housing sector, urban population and the implicit deflator for fixed private investment, which is not a relative price.

The equations for investment in other construction and in capital goods were specified in terms of a naive accelerator and a credit variable.

The equation for private change in inventories was specified as an accounting identity: total output and imports minus the other components of final demand. It should be mentioned that several alternative specifications using a flexible accelerator, flow of funds, and profit variables were tried for investment in other construction and in capital goods, without any great success. The alternative equations had about the same fit as the present ones, and further complicated the model, for the new explanatory variables were very difficult to explain, and equally difficult to leave exogenous.

Finally, it may be said that these equations are neither the strongest nor the most satisfactory relationships in the model, but after many experiments, nothing better was found.

Other construction

Private investment in nonresidential construction was made a function of a naive accelerator and the stock of credit to commerce and nonresidential construction. The estimation period was 1958-1972.

$$IPOCR = \underset{(3.23796)}{4.384} + \underset{(.099148)}{.111969}DGDPFCR + \underset{(.016293)}{.115757}\overline{BKCOM+R}$$

R^2 = .8835 S.E. = 4.524 D.W. = 2.8152

IPOCR: Private nonresidential construction, millions of 1960 Balboas.

DGDPFCR: Change in gross domestic product at factor cost between year t and year t-1, millions of 1960 Balboas.

$\overline{BKCOM+R}$: Stock of loans outstanding to commerce and nonresidential construction, deflated by the implicit deflator of gross domestic product.

The equation is statistically satisfactory in the sense that all coefficients have the expected signs. The residuals, however, are fairly large, as the following table will show:

Year	Percentage Error
1958	21.8
1959	8.4
1960	29.8
1961	25.5
1962	11.7
1963	4.0
1964	9.7
1965	44.3
1966	22.1
1967	7.0
1968	5.3
1969	18.6
1970	11.9
1971	13.4
1972	10.4

Capital goods

Private investment in capital goods was made a function of a naive accelerator, a credit variable, and a dummy variable to separate the period 1966-1972 from the rest of the sample period.

In this latter period, there is a sharp increase in the level of investment, which is not accounted for by the explanatory variables. However, it coincides with the period of granting import quotas to promote the import substitution policy, already discussed. The estimation period was 1958-1972.

The estimated equation is:

$$
\begin{aligned}
IPKGR = \underset{(3.41587)}{19.871} + \underset{(.109491)}{.139019}DGDPFCR + \underset{(.019469)}{.182156}\overline{CREC\&IR} \\
+ \underset{(3.96218)}{19.2832}\overline{DUM66I}
\end{aligned}
$$

$R^2 = .9758$ S.E. $= 4.501$ D.W. $= 2.4049$

$\overline{\text{IPKGR}}$: Private investment in capital goods, millions of 1960 Balboas.

$\overline{\text{CREC\&IR}}$: Stock of loans outstanding to commerce and industry deflated by the implicit deflator of gross domestic product.

$\overline{\text{DUM66I}}$: Dummy variable. Equals 1.0 from 1966 to 1972, and zero elsewhere.

The equation is statistically satisfactory. It has a good fit, all coefficients have the expected signs, and the residuals are acceptable. The largest residuals are at the beginning of the sample period; 18.7 percent in 1958, 16.6 percent in 1959, 37.2 percent in 1960, and 14.0 percent in 1961.

Residential construction

Private investment in housing was made a function of real personal disposable income, changes in the stock of credit, the change in urban population and the implicit deflator for residential construction. Urban population was changing very rapidly during the sample period and was thus included, even though it would seem like a long run variable. The estimation period was 1959-1972.

The estimated equation is:

$$\text{IPHR} = \underset{(38.42)}{-1.62} + \underset{(.018210)}{.089861}\text{YDPR} + \underset{(.150225)}{.710295}\overline{\text{DPRESTR}}$$

$$+ 251.029\overline{DPOBU} - 22.0040\overline{PIHP}$$
$$(213.538) \qquad (43.2913)$$

R^2 = .9497 S.E. = 3.970 D.W. = 1.8255

IPHR: Private investment in housing, millions of 1960 Balboas.

$\overline{DPRESTR}$: Annual change in the stock of loans to residential construction, millions of Balboas, deflated by the implicit deflator for gross domestic product.

$\overline{DPOBU}$: Annual change in urban population, millions of persons.

$\overline{PIHP}$: Implicit deflator for private residential construction, 1960 = 100.

The equation is statistically satisfactory, even though not all coefficients are statistically significant. This was a difficult equation to estimate and it was necessary to experiment with many formulations to obtain a reasonably good fit. All coefficients have the expected sign, but the residuals are large in some years, notably 1959, 1961 and 1965. The largest residuals are 43.0 percent in 1959, 35.4 percent in 1961, 20.0 percent in 1964, 36.3 percent in 1965 and 12.1 percent in 1969.

Private change in inventories

Private inventories were defined as being simply the difference between inflow and outflow of output. It may be said that gross domestic product and imports contribute to inflow, and that consumption, investment and exports contribute to outflow. The dummy variable was included to take out two anomalous observations in 1953 and 1958. The estimation period was 1951-1972.

The estimated equation is:

$$\underset{}{IPEXR} = \underset{(.924267)}{12.40} + \underset{(.088338)}{.736858GDPR} - \underset{(.088802)}{.730248ITP} - \underset{(.091829)}{.719501CR}$$

$$+ \underset{(.095523)}{.675581MGSR} - \underset{(.095356)}{.684502XTR} + \underset{(.830312)}{1.9472}\overline{DUM\ 1953}$$

$R^2 = .9920$ S.E. = .5705 D.W. = 2.7938

IPEXR: Change in private inventories, millions of 1960 Balboas.

$\overline{DUM\ 1953}$: Dummy variable; equals 1.0 in 1953 and 1958, zero elsewhere.

The equation is statistically satisfactory. All coefficients have the expected sign and the residuals are quite small.

<u>Private depreciation</u>

Private depreciation, in current prices, was deflated by the implicit deflator of private fixed investment (PIPF), and made a linear function of private capital stock in the previous year (KSPR1) and a time trend. The period of estimation was 1958-1972.

The estimated equation is:

$$\text{DEPREPR} = \underset{(5.56261)}{-2.932} + \underset{(.012909)}{.038792}\overline{\text{KSPR1}} + \underset{(.533958)}{3.05094}\overline{\text{TTREND}}$$

$R^2 = .9844$ S.E. = 2.5960 D.W. = .9250

DEPREPR: Private depreciation, in millions of Balboas, deflated by the implicit deflator for private fixed investment.

$\overline{\text{KSPR1}}$: Private capital stock, lagged one period, millions of 1960 Balboas.

The equation is statistically satisfactory and has a good fit. The largest residuals are 17.7 percent in 1958, 8.7 percent in 1960, and 9.4 percent in 1961. All other residuals are less than 5.0 percent.

Private capital stock

$$\text{KSPR} = \text{IPOCR} + \text{IPHR} + \text{IPKGR} - \text{DEPREPR} + \overline{\text{KSPR1}}$$

KSPR: Private capital stock, 1950 origin, millions of Balboas.

$\overline{\text{KSPR1}}$: KSPR lagged one year.

Private capital stock, current prices

$$\text{KSPC} = \text{KSPR} * \overline{\text{PIPF}}$$

KSPC: Private capital stock, 1950 origin, millions of Balboas.

$\overline{\text{PIPF}}$: Implicit deflator for private fixed investment, 1960 = 100.

Total depreciation

$$\text{DEPRER} = \text{DEPREPR} + \overline{\text{DEPREGR}}$$

DEPRER: Total depreciation, millions of Balboas, deflated by the implicit deflator for private fixed investment.

$\overline{\text{DEPREGR}}$: Government depreciation, millions of 1960 Balboas.

Total investment in capital goods

$$\text{ITKGR} = \text{IPKGR} + \overline{\text{IGKGR}}$$

ITKGR: Total investment in capital goods, millions 1960 Balboas.

$\overline{\text{IGKGR}}$: Government investment in capital goods, millions 1960 Balboas.

Total investment in construction

$$\text{ITCONSTR} = \text{IPOCR} + \text{IPHR} + \overline{\text{IGOCR}} + \overline{\text{IGHR}}$$

ITCONSTR: Total investment in construction, millions of 1960 Balboas.

$\overline{\text{IGOCR}}$: Government nonresidential construction, millions of 1960 Balboas.

$\overline{IGHR}$: Government housing construction, millions of 1960 Balboas.

Government fixed gross investment

$$IGFR = \overline{IGOCR} + \overline{IGHR} + \overline{IGKGR}$$

IGFR: Government fixed gross investment, millions of 1960 Balboas.

Government total gross investment

$$IGTR = \overline{IGOCR} + \overline{IGHR} + \overline{IGKGR} + \overline{IGEXR}$$

IGTR: Government total gross investment, millions of 1960 Balboas.

$\overline{IGEXR}$: Government change in inventories, millions of 1960 Balboas.

Private fixed investment

$$IPFR = IPOCR + IPHR + IPKGR$$

IPFR: Private fixed investments, millions of 1960 Balboas.

Private total investment

$$IPTR = IPOCR + IPHR + IPKGR + IPEXR$$

IPTR: Private total investment, millions of 1960 Balboas.

Total fixed investment

ITFR = IPFR + IGFR

ITFR: Total fixed investment, millions of 1960 Balboas.

Total investment

ITR = IPTR + IGTR

ITR: Total investment, millions of Balboas.

Total depreciation, current prices

$$DEPREC = DEPRER * \overline{PIPF}$$

DEPREC: Total depreciation, millions of Balboas.

The Import and Export Sector

The specification of the import functions was determined by the data availability in the Panamanian National Accounts and the customs data collected by Banco National (importers must pay duties there) and published by the Foreign Trade (Comercio Exterior) section of Contraloria.

The National Accounts publish total imports of goods and services in both current and 1960 prices. They also have unpublished data for total imports of goods, FOB, CIF and for services, also in current and 1960 prices.

In the other hand, the Comercio Exterior figures give imports of goods, both FOB and CIF, in current prices, following the first ten categories of the one digit classification of the Uniform Classification for International Trade of the United Nations.

The procedure followed here was to take the Comercio Exterior data and group the ten categories FOB as follows:

0	:	Food and foodstuffs (MFOODR)
1	:	Beverages and tobacco (MBEV+TABR)
2,4,6	:	Raw materials (MRWMATR)
3	:	Mineral fuels and lubricants (MFUELSR)
5	:	Chemical products (MCHMSR)
7	:	Machinery and transportation equipment (MMCHNR)
8	:	Manufactured products (MMANUFR)
9	:	Other imports (MOTHSR)

Together, these data should add up to total imports of goods FOB in the National Accounts, plus a statistical discrepancy (DISMGR), which is due to some small items which are included in the National Accounts and excluded in Comercio Exterior. The data are then deflated using the implicit deflator for goods FOB in the National Accounts.

Import functions are generally specified in terms of components of economic activity, either from the demand or the supply side, and a relative price variable. Other variables such as dummy variables for special periods, lagged variables, foreign exchange reserves and credit may be added according to circumstances. For a complete discussion, see Leamer and Stern (1970).

The classification used for the data results in heterogeneous categories, which include both consumer and producer goods. However, each variable was specified in terms of the appropriate components of economic activity according to its composition.

In addition, all equations were estimated from 1958 to 1972. This is due to the fact that the import substitution period began at the end of 1957; it could be expected that the composition of imports changed between the two periods.

Food and food stuffs

This category includes food products and animal feeds. Panama imports a substantial amount of meat products, dairy products, fish, cereals, sweets and fruits. The equation was specified as a function of food consumption and industrial output in the industrial sector, excluding construction related industrial output, and was estimated for the period 1958-1972.

The estimated equation is:

$$\begin{array}{llll} MFOODR = & -10.75 + & .272644CFOODR - & .267667QIND1R \\ & (2.751) & (.041658) & (.065169) \end{array}$$

$R^2 = .9574$ S.E. = 1.128 D.W. = 2.4392

MFOODR: Imports of foods and food stuffs, FOB, millions of 1960 Balboas.

QIND1R: Gross domestic product at market prices, originating in the industrial sector, but excluding construction related industrial output, millions of 1960 Balboas.

The equation is statistically satisfactory and has a good fit. The negative coefficient for industrial output is as expected in view of the import substitution process; as industrial output increased, food imports were reduced. The residuals are also satisfactory; the largest residuals are 17.0 percent in 1959, 9.6 percent in 1964, and 8.0 percent in 1969.

Mineral fuels and lubricants

The bulk of this category is oil. There are small amounts of other fuels, and the lubricant oils, but partially refined and crude oil are the most important components. Since oil is so widely used through the economy, the equation was specified in terms of gross domestic product at market prices; fuel exports to ships bunkering in the Panama Canal and the Venezuelan oil price are additional variables. The estimation period was 1958-1972.

The estimated equation is:

$$\begin{aligned} MFUELSR = \underset{(21.08)}{53.62} + \underset{(.010600)}{.030938}GDPR + \underset{(.132996)}{.791524}\overline{XOILR} \\ - \underset{(7.80149)}{19.2326}\overline{PMOIL} \end{aligned}$$

$R^2 = .9725$ S.E. = 3.245 D.W. = 1.3348

MFUELSR: Imports of mineral fuels and lubricant oils, FOB, millions of 1960 Balboas.

$\overline{\text{XOILR}}$: Exports of refined oil products, millions of 1960 Balboas.

$\overline{\text{PMOIL}}$: Venezuelan oil price, at the well.

The equation is statistically satisfactory. It has a good fit and all coefficients have the expected signs. The residuals are also satisfactory. The largest residuals are 36.8 percent in 1958, 13.9 percent in 1959, 16.9 percent in 1960 and 24.2 percent in 1961. While these percentages are large, the absolute values are small, and after these years, the equation works better.

Raw materials

This category includes raw materials, oils and fats, and manufactured products classified by material (wood, rubber, glass, metal, etc.). It consists mainly of product used as intermediate goods by Panamanian industry, even though it includes some items that would go directly to final demand. For this reason, the equation was specified only as a function of industrial output, and was estimated for the period 1958-1960.

The estimated equation is:

$$MRWMATR = \underset{(2.178)}{5.985} + \underset{(.019380)}{.435344}QINDR$$

$R^2 = .9730$ S.E. = 3.155 D.W. = 1.9403

MRWMATR: Imports of raw materials, oils and fats, and manufactured producrs, classified by material, FOB, millions of 1960 Balboas.

The equation is statistically satisfactory and has a good fit. The largest residuals are 11.4 percent in 1959, 8.3 percent in 1961, and 11.1 percent in 1968.

Chemical products

This category includes industrial chemicals, medicines, toiletries, cosmetics, fertilizers, pesticides, etc. It was specified in terms of CHLTHR, which includes all personal and health care products; and industrial output, QINDR, which would include all other remaining items in the list above. QINDR is also a proxy for agricultural chemicals since all sugar, milled rice, meat packing and so on is classified as industrial output. The equation was estimated from 1958 to 1972.

The estimated equation is:

$$MCHMSR = \underset{(1.057)}{-1.811} + \underset{(.131286)}{.497186}CHLTHR + \underset{(.020668)}{.093094}QINDR$$

$R^2 = .9924$ S.E. = .6504 D.W. = 1.7042

MCHMSR: Imports of chemical products, FOB, millions of 1960 Balboas.

The equation is statistically satisfactory and has a good fit. The coefficient of industrial output has a positive sign since these products are not produced in Panama, and there is no import substitution. The residuals are also satisfactory. The largest residuals are 9.1 percent in 1958, 5.4 percent in 1962, and 5.7 percent in 1966.

Machinery and transportation equipment

This category contains all machinery and spare parts, be it capital goods, personal transportation equipment or consumer durables such as radios, sewing machines or irons. For this reason, it was specified as a function of total investment in capital goods and consumption of transportation and furniture. The estimation period was 1958-1972.

The estimated equation is:

$$\underset{}{MMCHNR} = \underset{(2.86743)}{-10.217} + \underset{(.0650053)}{.320098ITKGR}$$

$$+ \underset{(.161197)}{.516050CTRANSPR} + \underset{(.140187)}{.35661CFNTRER}$$

$R^2 = .9939$ S.E. = 1.9668 D.W. = 1.1871

MMCHNR: Imports of machinery and transportation equipment, FOB, millions of 1960 Balboas.

ITKGR: Total investment in capital goods, millions of 1960 Balboas.

The equation is statistically significant and has a good fit. The coefficients have the expected signs. The residuals are also satisfactory, all being less than 5 percent.

Manufactured products

This category includes diverse manufactured products, ready for final users. It includes clothing, household furnishings and furniture and housing goods such as plumbing and electric items. For this reason it was specified as a function of consumption of clothing, furniture, and housing. The estimation period was 1958-1972.

The estimated equation is:

$$MMANUFR = \underset{(1.27507)}{-7.841} + \underset{(.0460695)}{.138824}(CCTHINGR + CFNTRER) + \underset{(.0804739)}{.413844}CHSINGR$$

$R^2 = .9853$ S.E. = 1.069 D.W. = 1.7889

MMANUFR: Imports of diverse manufactured products, FOB, millions of 1960 Balboas.

The equation is statistically satisfactory. It has a good fit and all coefficients have the expected sign. This equation proved fairly difficult to handle, and CCTHINGR and CFNTRER were constrained to have the same coefficient in order to have the proper sign in the coefficient. The residuals are also satisfactory. The largest residuals are 9.3 percent in 1958, 6.6 percent in

1966, and 7.2 percent in 1968.

Total imports of goods, FOB

$$MGDSR = MCHMSR + MRWMATR + MFOODR + MMANUFR + MMCHNR + MFUELSR + \overline{MBEV+ABR} + \overline{MOTHSR} + \overline{DISMGR}$$

MGDSR: Total imports of goods, FOB, millions of 1960 Balboas.

$\overline{MBEV+ABR}$: Imports of beverages and tobacco products, FOB, millions of 1960 Balboas.

$\overline{MOTHSR}$: Other imports, FOB, millions of 1960 Balboas.

$\overline{DISMGR}$: Statistical discrepancy for total imports of goods, FOB, millions of 1960 Balboas.

Insurance and freight

This is the cost of insurance and freight for imports of goods. It was specified as a simple linear function of the total amount of goods, FOB, imported and a time trend. The estimation period was 1958-1972.

The estimated equation is:

$$MCIFR = \underset{(2.90472)}{3.572} + \underset{(.0287424)}{.128454}MGDSR - \underset{(.533239)}{.548586}\overline{TTREND}$$

R^2 = .9761 S.E. = 1.286 D.W. = .9658

MCIFR: Imports of insurance and freight services, millions of 1960 Balboas.

The equation is statistically satisfactory, even though the coefficient of the time trend is not significant. One may also wonder about the negative sign, but as there is no a priori expectations either way, the equation is accepted. The residuals are acceptable. The largest residuals are 19.6 percent in 1958, 14.3 percent in 1959, 13.7 percent in 1960, and 11.5 percent in 1962.

Total imports of goods, CIF

MGCIFR = MGDSR + MCIFR

MGCIFR: Total imports of goods, CIF, millions of 1960 Balboas.

Services

This category includes international transportation fares, tourist expenditures abroad, insurance purchased abroad, international communications and miscellaneous government transactions. It is a mixture of consumer and business purchases, and it proved fairly difficult to obtain an acceptable equation. After many experiments, it was left as a function of net national product at factor cost (real national income) and the stock of bank loans to consumption. The estimation period was 1958-1972.

The estimated equation is:

$$\text{MSERVR} = \underset{(6.61380)}{2.228} + \underset{(.0188893)}{.053733}\text{YNALR} + \underset{(.151650)}{.234252}\overline{\text{BKCPR}}$$

$R^2 = .9481$ S.E. = 3.072 D.W. = 2.2439

MSERVR: Imports of services, millions of 1960 Balboas.

YNALR: Net national product at factor cost (real national income), millions of 1960 Balboas.

$\overline{\text{BKCPR}}$: Stock of bank loans for private consumption, deflated by the implicit deflator of private consumption.

This equation is statistically satisfactory, but not very much more. The residuals, on the other hand, are not quite that satisfactory, but it was not possible to improve them. The largest residuals are 10.5 percent in 1959, 11.3 percent in 1961, 13.9 percent in 1962, 15.7 percent in 1963, and 20.5 percent in 1966.

Total imports of goods and services

$$\text{MGSR} = \text{MGCIFR} + \text{MSERVR} + \overline{\text{MGCZR}}$$

MGSR: Total imports of goods and services, millions of 1960 Balboas.

$\overline{\text{MGCZR}}$: Miscellaneous imports from the Canal Zone, million of 1960 Balboas. Includes water, electricity, smuggling.

Total imports of goods, current prices

$$MGDSC = MGDSR * \overline{PMGDS}$$

MGDSC: Total imports of goods, FOB, millions of Balboas.

$\overline{PMGDS}$: Implicit deflator for total imports of goods, 1960 = 100.

Total exports

It was decided to leave exports exogeneous. During the sample period, Panamanian exports were roughly 30 to 40 percent goods, and the remainder services. The exact figure fluctuated, the lowest number being 29.4 percent in 1961, and the highest 39.7 percent in 1965. The most important goods are bananas and refined oil products. Bananas had roughly been about 45 percent of all goods exported; after the country's only oil refinery began production in 1962, bananas and oil products were over 60 percent of all goods exported. The remainder goods exported are shrimp, sugar, and some very minor items such as coffee, beef and cocoa. In the services, the principal items are exports to the Canal Zone, the Colon Free Zone and the rest of the world. In this respect, Carter (1970) found that the flow of funds from the Canal Zone to the Republic of Panama could be explained almost entirely by U.S. administrative decisions. The other service exports derive from Panama's geographical position and the safety and ease of operation which it offers to international corporations. Thus, they depend on the level of world trade. Even tourism is business oriented.

It can be seen then that the largest proportion of Panamanian exports are not dependent on Panamanian economic variables, the exception being sugar and other very minor items.

$$XTR = \overline{XBANANR} + \overline{XOGDSR} + \overline{XSERVS} + \overline{XCFZR} + \overline{QCZR}$$

XTR: Total exports of goods and services, millions of 1960 Balboas.

$\overline{XBANANR}$: Banana exports, millions of 1960 Balboas.

$\overline{XOGDSR}$: Exports of other goods, millions of 1960 Balboas.

$\overline{XSERVR}$: Exports of services, excluding the Canal Zone and the Colon Free Zone, millions of 1960 Balboas.

$\overline{XCFZR}$: Exports of services from the Colon Free Zone, millions of 1960 Balboas.

$\overline{QCZR}$: Gross domestic product at factor cost, or market prices, originating in the Canal Zone (identical to exports of labor services to the Canal Zone), millions of 1960 Balboas.

The Supply Sector

The supply sector has been specified following a simplified Input-Output framework:

$$X = AX + Y$$

$$X = (I - A)^{-1}Y$$

where X is a vector of gross outputs by sector, A is the technology matrix and Y is a vector of final demands by sector. If value added by sector is assumed to be a fixed proportion of gross output in that sector, say

$$Q_i = U_i X_i$$

then

$$Q = UX = U(I - A)^{-1}Y$$

where Q is a vector of values added by sector, and U is a diagonal matrix having the U_i as diagonal elements. Lacking an Input-Output table, the approach followed here has been to specify each value added as a linear function of those components of final demand considered more appropriate, and estimate it by multiple regression.

The National Accounts give value added at market prices and at factor cost, by sector of origin, for twelve sectors, according to the standard classification of the United Nations for a system of national accounts.

For the purpose of this work, the twelve sectors were regrouped as follows:

1 : Agriculture, forestry and fishing (QAGRR)

2,4	:	Construction; mining and quarries (QCONMR)
3	:	Industry (QIND1R, QIND2R, QINDR)
5	:	Electricity, gas, water and sewers (QELECR)
6,7,8,9,10,11	:	Services (QSER*R)
12	:	Canal Zone ($\overline{QCZR}$)

The Canal Zone is a special sector which is particular to Panama. It includes all labor services, sold (exported) to the Canal Zone.

<u>Agriculture, forestry and fishing</u>

The agricultural sector in Panama is a dual sector. It has a large subsistence subsector, but it also has a commercial subsector which is responsive to Government price regulation policies and consumer demand. It has another subsector, banana production, which is totally dependent on foreign conditions. Forestry is quite small (less than one percent of total output) and fishing, while steadily increasing, amounts to less than five percent of total output. As the subsistence sector could be considered roughly constant, the equation was specified as a function of food consumption and banana exports. The estimation period was 1958-1972.

The estimated equation is:

$$QAGRR = 27.334 + \underset{(.021610)}{.401050CFOODR} + \underset{(.115904)}{.993430\overline{XBANANR}}$$

$R^2 = .9913$ S.E. = 2.625 D.W. = .71279

QAGRR: Gross domestic product at market prices originating in agriculture, forestry and fishing, millions of 1960 Balboas.

$\overline{\text{XBANANR}}$: Banana exports, millions of 1960 Balboas.

The equation is statistically satisfactory except for the low D.W. Otherwise, it has a good fit, the coefficients have the expected signs, and the residuals are all quite small. The largest residuals are 3.3 percent in 1958 and 2.8 percent in 1970.

This version of the equation was chosen in spite of the low D.W. because the coefficients for food consumption and banana exports seem more reasonable (or maybe less unreasonable) than others. When adding a time trend to improve the D.W., the coefficient for CFOODR becomes .201190 and that for XBANANR becomes .743879. Both these values were considered to be on the low side, so it was decided to accept the low D.W. Furthermore, a tight computer budget did not permit to experiment with other estimation methods.

Construction and mining

Construction output is the most important output component in this sector. Mining is reduced to quarries and sand, which are also used in construction. Mining also includes some table salt production, but that is not important. The equation was specified as a function of total construction in the public and private sectors.

The sectors were separated on the assumption that the public sector would do different types of construction projects than the private sector. The equation was estimated for the period 1958-1972.

The estimated equation is:

$$QCONMR = 11.914 + \underset{(.088350)}{.320299}(IPHR + IPOCR) + \underset{(.202024)}{.511478}(\overline{IGHR} + IGOCR)$$

$R^2 = .9391$ S.E. = 4.089 D.W. = .75952

QCONMR: Gross domestic product at market prices, originating in construction and mining, millions of 1960 Balboas.

The equation is statistically satisfactory in a limited way. It has a low D.W. and some of the residuals are large. In the other hand, both the fit and the D.W. could be improved by adding a time trend, but this has the effect of lowering the coefficients of the explanatory variables to what seems unreasonable levels. When adding the time trend, the R^2 becomes .9842, but the coefficient for (IPHR + IPOCR) becomes .155897 and that for (IGHR + IGOCR) becomes .295787. But these values seem rather low, so it was decided to use the equation without the time trend in spite of the other statistical shortcomings. Furthermore, a limited computer budget did not allow experimentation with other estimation methods. Finally, the largest residuals are 18.7 percent in 1958, 43.1 percent in 1959, 10.3 percent in 1960, 12.0 percent in 1965, 13.3 percent in 1967 and 9.2 percent in 1968.

Industry

The principal industrial products in Panama are food products, clothing and footwear, furniture, printing and construction materials. Since 1962, the sector has had an oil refinery. All crude oil is imported, but a substantial part of the output of refined oil products is exported to aircraft passing through Panama, and to ships bunkering in the Canal, and to the Canal Zone.

The National Accounts provide a breakdown into 17 categories, at market prices, of industrial gross domestic product, following the standard classification of a system of national accounts of the United Nations.

The industries in this breakdown were grouped, as closely as possible, into construction and nonconstruction industries, dividing the sector into two subsectors: nonconstruction and construction related activities.

The equation for the first subsector, nonconstruction activities (QIND1R), was specified as a function of aggregate consumption in food, tobacco and drink grouped together, of aggregate consumption in clothing and furniture grouped together, and of exports of other goods ($\overline{\text{XOGDSR}}$). The estimation period was 1958-1972.

The estimated equation is:

$$QINDR = \underset{(4.586)}{-26.01} + \underset{(.064505)}{.238426}(CFOODR + CTBCOR + CDRINKR)$$

$$+ \underset{(.168374)}{.505877}(CCTHINGR + CFNTRER) + \underset{(.100966)}{.264025}\overline{XOGDSR}$$

$R^2 = .9933$ S.E. = 2.643 D.W. = 1.837

QIND1R: Gross domestic product at market prices originating in the nonconstruction segment of the industrial sector, millions of 1960 Balboas.

The equation is statistically satisfactory. It has a good fit, all coefficients have the expected sign and the residuals are all quite small.

The equation for the second subsector, construction related industries (QIND2R), was specified as a function of total public and private investment in construction and a time trend. The estimation period was 1958-1972.

The estimated equation is:

$$QIND2R = \underset{(1.188)}{-12.00} + \underset{(.012815)}{.065948}ITCONSTR + \underset{(.122472)}{1.92485}\overline{TTREND}$$

$R^2 = .9944$ S.E. = .8432 D.W. = 1.7609

QIND2R: Gross domestic product at market prices originating in the construction related industrial sector, millions of 1960 Balboas.

The equation is statistically satisfactory. It has a good fit, all coefficients have the expected signs, and the residuals are all quite small. The largest residuals are 8.5 percent in 1959 and 8.7 percent in 1960.

Finally, the two subsectors are added up to obtain industrial output.

$$QINDR = QIND1R + QIND2R$$

QINDR: Gross domestic product at market prices, originating in industry, millions of 1960 Balboas.

Electricity, gas, water and sewers

Electricity production is the most important output component in this sector. Gas, water and sewage are a small and steadily decreasing proportion of the total. The principal users of electricity seem to be the household sector and the industrial and services sectors. For these reasons, the equation was specified as a function of consumption of fuel and electric power (CELECTR) and output is in the industrial (QINDR) and services (QSER*R) sectors. The estimation period was 1958-1972.

The estimated equation is:

$$\begin{aligned} QELECR = \underset{(.766989)}{-6.637} + \underset{(.082709)}{.360463}CELECR + \underset{(.003642)}{.04545}(QINDR + QSER^{*}R) \end{aligned}$$

$R^2 = .9922$ S.E. = .7744 D.W. = 1.4972

QELECR: Gross domestic product at market prices, originating in the electricity, gas, water and sewers sector, millions of 1960 Balboas.

The equation is statistically satisfactory. It has a good fit and all coefficients have the expected sign. The residuals are satisfactory; the largest residuals are 7.2 percent in 1960, and 10.3 percent in 1967.

Services

This sector includes all services, except labor and other services exported to the Canal Zone. The equation was specified as a function of total consumption of services (CTSER), total exports of services ($\overline{XSERTR}$ + $\overline{XCFZR}$) excluding the Canal Zone, and government consumption ($\overline{CGR}$). The estimation period was 1958-1972.

The estimated equation is:

$$\underset{}{QSER{*}R} = \underset{(8.204)}{-2.956} + \underset{(.235903)}{1.01041 CTSER} + \underset{(.275575)}{.107725}(\overline{XSERTR} + \overline{XCFZR})$$

$$+ \underset{(.638424)}{1.25508\overline{CGR}}$$

R^2 = .9963 S.E. = 6.203 D.W. = 1.5873

QSER*R: Gross domestic product at market prices originating in the services sector, millions of 1960 Balboas.

The estimated equation is statistically satisfactory, even though the coefficient of total exports of services is not statistically significant. The fit is good, all coefficients have the expected signs and the residuals are less than 5.0 percent.

Industrial gross domestic product at market prices, current prices

$$QINDC = QINDR * \overline{PGDP}$$

QINDC: Gross domestic product at market prices originating in the industrial sector, millions of Balboas.

$\overline{PGDP}$: Implicit deflator for gross domestic product, 1960 = 100.

Gross domestic product at market prices

$$GDPR = QAGRR + QCONMR + QINDR + QELECR + QSER*R + \overline{QCZR}$$

GDPR: Gross domestic product at market prices, millions of 1960 Balboas.

$\overline{QCZR}$: Gross domestic product at market prices, originating in the Canal Zone.

Gross domestic product at market prices

$$GDPC = GDPR * \overline{PGDP}$$

GDPC: Gross domestic product at market prices, millions of Balboas.

$\overline{PGDP}$: Implicit deflator for gross domestic product, 1960 = 100.

<u>Gross domestic product at factor cost</u>

$$GDPFCR = GDPR - TINDTR - \overline{SUBVENR}$$

GDPFCR: Gross domestic product at factor cost, millions of 1960 Balboas.

TINDTR: Total indirect taxes, millions of 1960 Balboas; identical to TINDTC.

$\overline{\text{SUBVENR}}$: Subsidies paid to producers, millions of 1960 Balboas; identical to $\overline{\text{SUBVENC}}$.

<u>Increment in gross domestic product at factor cost</u>

$$DGDPFCR = GDPR - \overline{GDPR1}$$

DGDPFCR: Increment in gross domestic product at factor cost, millions of 1960 Balboas.

$\overline{\text{GDPFCR1}}$: Gross domestic product at factor cost, lagged one year.

The Government Sector

An effort was made to define the government sector in a way which is consistent with the National Accounts. The Ministry of Hacienda publishes tax data with more detail than the National Accounts, but it follows a different classification. However, the detail from Hacienda was used in the following manner: indirect taxes were divided into import duties (TINDMC), taxes on production (TPRODC) and property taxes (TPROPC), all of which were obtained after some rearrangement of items from the Hacienda data. Then, total indirect taxes (TINDTC), which is given in the National Accounts, was used to define all other indirect taxes (TOINDC) as a residue, that is:

TOINDC = TINDTC - TINDMC - TPRODC - TPROPC

Direct taxes are given directly by the National Accounts. They are divided into contributions to social security (TCSSC), corporation income taxes (TDCORPC) and direct taxes on all other income (TDPERC). It was not possible to obtain any more information on direct taxes than that listed above; for this reason TDPERC was not disaggregated in a different manner.

Revenue from Government enterprises, which is needed to complete the Government revenues, is given in the National Accounts. The government enterprises are a heterogeneous lot. They comprise the Post Office, airports, National Lottery, the only race track in the Republic, casinos, a commercial bank, a savings bank, a mortgage bank, the agricultural development bank, all electricity, telephone, water and sewage, most international communications, the Colon Free Zone, a railroad plus dividends, interest and rents from Government properties. After 1972 the Government has greatly increased the scope of its properties.

The model attempts to explain Government revenues, while Government expenditures are left exogenous.

The question arose as how to specify the tax functions. The data available do not permit but the simplest specifications. Thus, it is not possible to build a tax rate variable in any adequate way or to define the tax basis properly.

The simplest way to proceed is to define a linear relation

$$T = a + bB$$

where T is the aggregate tax yield and B is the aggregate tax base. This specification assumes a constant marginal tax rate, and was used for the property tax.

Another simple way is to define

$$T = a + bR + cB$$

where R would be the average legal tax rate, which is not available. However, as a proxy for this weighted average legal tax rate, we could define

$$R = T/B$$

This procedure has the advantage that one could interpret the coefficients of B and R as giving the impact upon the tax yield of a unit change in each variable. It also has the disadvantage that R and B are not statistically independent and that the results could be biased if the structure of the base or the rate or both has changed. However, one would not expect the structure of the tax bases to change from year to year. One could also assume that changes in tax rate structures have been small during the sample interval.

For these reasons then, all equations have been estimated from 1958, which is the first year of the import substitution period. It is believed that both bases and rates would have changed less during this period, than if the full sample period had been used. Thus, it may be still possible to obtain useful approximations to the true relationships with these crude methods imposed on us by data limitations.

<u>Revenue from Government enterprises</u>

The Government enterprises are a heterogeneous group as was mentioned before. For this reason, the equation was specified as a function of current gross domestic product, which measures over all economic activity, and a dummy to account for the 1972 nationalization of the utilities for Panama City and Colon, and a time trend. It was estimated for the period 1958-1972.

The estimated equation is:

$$TGEREVC = \underset{(1.339)}{-1.721} + \underset{(.004529)}{.011957}GDPC + \underset{(1.21438)}{8.17670}\overline{DUMFYL}$$

$$+ \underset{(.271006)}{.683780}\overline{TTREND}$$

$R^2 = .9896$ S.E. = .792371 D.W. = 1.3215

TGEREVC: Revenue from Government enterprises, millions of Balboas.

GDPFCC: Gross domestic product at factor cost, millions of Balboas.

$\overline{\text{DUMFYL}}$: Dummy variable equal to 1.0 in 1972, zero elsewhere. In that year the telephone and electric power utility for Panama City and Colon was nationalized by the Government.

$\overline{\text{TTREND}}$: Time trend, 1950 = 1.0.

The equation is statistically satisfactory. It has a good fit. The coefficients for GDPC and $\overline{\text{DUMFYL}}$ have the expected sign. The time trend was added to try and obtain a higher Durbin-Watson, which was below the lower limit without it. Its positive sign could be explained by the increasing scope of the Government enterprises during the sample period.

The residuals are satisfactory. The largest residuals are 7.7 percent in 1960, and 7.8 percent in 1968.

Corporate income taxes

The equation was specified in terms of a tax base, and a proxy for the average legal tax rate as discussed before. The base was approximated by subtracting the Canal Zone's and the Government's contributions from gross domestic product. The time trend was added to try and account for any errors made in specifying the base by the rough approximation used. The estimation period was 1958-1972.

The estimated equation is:

$$\underset{}{TDCORPC} = \underset{(1.41650)}{-12.64} + \underset{(.008313)}{.0755495}(YNAL - \overline{QCZC} - \overline{CGC})$$

$$+ \underset{(51.8852)}{444.999}\overline{TRCORP} - \underset{(.342137)}{1.18846}\overline{TTREND}$$

$R^2 = .9939$ S.E. = .9631 D.W. = 1.5042

TDCORPC: Corporation income taxes, millions of Balboas.

YNAL: Net national income, millions of Balboas.

$\overline{QCZC}$: Gross domestic product at market prices, originating in the Canal Zone, millions of Balboas.

$\overline{CGC}$: Government consumption, millions of Balboas.

$\overline{TRCORP}$: Proxy for the average legal tax rate for income taxes on corporations.

The equation is statistically satisfactory. It has a good fit. The coefficients for the tax base and rate have the expected sign. The negative sign of the time trend could be explained by noticing that the process of import substitution began in 1958, and that all through this period, any new enterprises could obtain a tax exemption for a period of 15 years. Also, enterprises making new investments, could also obtain additional exemptions. Thus, the time trend may be picking up the growing amount of exemptions, which would be negatively correlated with the tax yield. Finally, the residuals are all quite small.

Noncorporate income taxes

This tax is levied on all noncorporate incomes, from wages and salaries to property to nonincorporated enterprises. The problem is to define a proper base. Personal income was chosen as the best approximation to the base, for it comprises all income except government enterprises and corporate retained earnings and income taxes. The proxy for the average legal tax rate and the time trend complete the specification. The equation was estimated for the period 1958-1972.

The estimated equation is:

$$\underset{(-1.35295)}{TDPERC = -6.57} + \underset{(.006521)}{.030970YPERC} + \underset{(85.2237)}{485.728\overline{TRPER}} - \underset{(.237183)}{.491445\overline{TTREND}}$$

R^2 = .9838 S.E. = .7816 D.W. = .9723

TDPERC: Noncorporate income tax, millions of Balboas.

YPERC: Personal income, millions of Balboas.

$\overline{TRPER}$: Proxy for the average legal tax rate for income taxes on noncorporate income.

The equation is statistically satisfactory and has a good fit. What is not obvious is the negative coefficient for the time trend. It must be caused by the rough approximation to the base. The true base must be smaller than YFAM, for there are many incomes in agriculture and the service sectors which would fall below the minimum taxable income. The residuals are small in absolute value, but large percentage-wise in three years: -1.2 million and 25.3 percent in 1958, .899 million and 29.0 percent in 1960, and .690 million and 20.3 percent in 1961. In all remaining years the residuals are less than 10.0 percent, and most years are below 5.0 percent.

Indirect taxes on imports

The equation for import duties was specified in terms of a tax base and a proxy for the average legal tax rate. The tax base was defined as imports of goods minus the amount of duty free imports. The estimation period was 1958-1972.

The estimated equation is:

$$\mathrm{TINDMC} = \underset{(1.77044)}{-15.44} + \underset{(.004022)}{.155740}(\mathrm{MGDSC} - \overline{\mathrm{TAXFREEM}})$$

$$+ \underset{(7.01633)}{95.6382}\overline{\mathrm{TRM}}$$

$R^2 = .9932$ S.E. = .6600 D.W. = 1.3211

TINDMC: Indirect taxes on imports, millions of Balboas.

MGDSC: Imports of goods, FOB, millions of Balboas.

$\overline{\mathrm{TAXFREEM}}$: Duty free imports, millions of Balboas.

$\overline{\mathrm{TRM}}$: Proxy for the average legal tax rate for import duties.

The estimated equation is statistically satisfactory and has a good fit. The residuals are small. The largest residual is 6.1 percent in 1962.

<u>Indirect taxes on production</u>

The bulk of this tax is collected from the production of liquor, beer and cigarettes. For this reason, the gross domestic product at factor cost originating in the industrial sector was used to approximate the tax base. A proxy for the average legal tax rate and a time trend completed the specification. The estimation period was 1958-1972.

The estimated equation is:

$$TPRODC = \underset{(1.93284)}{-7.270} + \underset{(.017892)}{.223413}(QINDC + \underset{(15.6909)}{126.061}\overline{TRPROD}$$

$$- \underset{(.195852)}{1.15406}\overline{TTREND}$$

$R^2 = .9960$ $\quad$ S.E. = .5418 $\quad$ D.W. = 1.5639

TPRODC: Indirect taxes on production, millions of Balboas.

QINDC: Gross domestic product at market prices, originating in the industrial sector, millions of Balboas.

$\overline{TRPROD}$: Proxy for the average legal tax rate for indirect taxes on production.

The estimated equation is statistically significant and has a good fit. The negative coefficient for the time trend must again be explained by the rough approximation used in defining the tax base. There must be a component of QINDC, with a negative time trend, that must be excluded to obtain the true tax base. The largest residuals are 7.8 percent in 1958, 7.3 percent in 1959, 12.2 percent in 1961, and 11.5 percent in 1962.

Property taxes

This is primarily a real estate tax. Since there is no data on real estate aggregate value, the tax base was approximated by the accumulated stock of private capital, measured with 1950 as origin. The specification was completed by including a time trend, and the equation was estimated from 1958 to 1972.

The estimated equation is:

$$\underset{}{TPROPC} = \underset{(.538478)}{.32} + \underset{(.000792)}{.0052955KSPC} + \underset{(.048016)}{.163628\overline{TTREND}}$$

$R^2 = .9786$ S.E. $= .3142$ D.W. $= 1.997$

TPROPC: Property taxes, millions of Balboas.

KSPC: Private stock of capital, 1950 origin, millions of Balboas.

The estimated equation is statistically satisfactory. It has a good fit, all coefficients have the proper sign, and are statistically significant. Finally, the residuals are all acceptable.

Other indirect taxes

These are primarily taxes on some transactions and on goods or services subject to trade. For this reason, the tax base was approximated by private consumption, CPC. A proxy for the legal average tax rate and a time trend complete the specification. The equation was estimated for the period 1958-1972.

The estimated equation is:

$$\underset{}{TOINDC} = \underset{(.474541)}{-8.55} + \underset{(.004492)}{.0590275CPC} + \underset{(41.9037)}{545.277\overline{TRINDO}}$$

$$- \underset{(.156824)}{1.29188\overline{TTREND}}$$

$R^2 = .9959$ S.E. = .4134 D.W. = 2.425

TOINDC: Other indirect taxes, millions of Balboas.

CPC: Private consumption, millions of Balboas.

$\overline{TRINDO}$: Proxy for the average legal tax rate on other indirect taxes.

The estimated equation is statistically satisfactory, and has a good fit. The negative coefficient for the time trend must be explained by the rough approximation to the base. The residuals are all quite small, except for 1959, where the residual is 18.2 percent of the observation.

Social security contributions

Social security contributions are imposed on the payroll of all public and private employers. Self-employed workers may join voluntarily. The social security coverage has increased steadily through the sample period. Personal income was taken as the best approximation to the base. The tax rate proxy and the coverage complete the specification. The estimation period was 1956-1972.

The estimated equation is:

$$TCSSC = \underset{(2.00260)}{-30.83} + \underset{(.0062572)}{.0389885}YPERC + \underset{(50.3756)}{117.141}\overline{TRCSS}$$
$$+ \underset{(13.7873)}{97.9527}\overline{COBERCSS}$$

$R^2 = .9980$ S.E. = .6891 D.W. = 1.6275

TCSSC: Contributions to social security, millions of Balboas.

YPERC: Personal income, millions of Balboas.

$\overline{TRCSS}$: Proxy for the average legal tax rate for contributions to social security.

$\overline{COBERCSS}$: Proportion of labor force covered by social security to total labor force employed.

The estimated equation is statistically satisfactory and has a good fit. All coefficients have the expected sign and are statistically significant. The largest residuals are 16.5 percent in 1958, 5.8 percent in 1961, and 8.4 percent in 1962. All other residuals are smaller.

Total government revenue

$$\mathrm{TGRC} = \mathrm{TGEREVC} + \mathrm{TDCORPC} + \mathrm{TDIRPERC} + \mathrm{TCSSC} + \mathrm{TPRODC} + \mathrm{TINDMC} + \mathrm{TPROPC} + \mathrm{TOINDC} + \overline{\mathrm{TR{*}HTGC}} + \overline{\mathrm{TR{*}WTGC}} - \overline{\mathrm{GIPDTC}}$$

TRGC: Total government revenue, millions of Balboas.

$\overline{\mathrm{TR{*}HTGC}}$: Household transfers to the government, millions of Balboas.

$\overline{\mathrm{TR{*}WTGC}}$: Rest of the world transfers to the government, millions of Balboas.

$\overline{\mathrm{GIPDTC}}$: Interest on the public debt, millions of Balboas.

Total indirect taxes

$$\mathrm{TINDTC} = \mathrm{TINDMC} + \mathrm{TPRODC} + \mathrm{TPROPC} + \mathrm{TOINDC}$$

TINDTC: Total indirect taxes, millions of Balboas.

The Income Sector

The income side of the Panamanian National Accounts has considerably less detail than the production or final demand sides. In fact, the amount of detail given has been decreasing with time as some of the statistical series in this area have been eliminated because of low priorities assigned to them by the Government and lack of resources by Contraloria to do the field work.

Thus, national income is subdivided into wages, salaries, professional and farm income and income from all nonincorporated enterprises added together, plus other property income, corporate retained earnings, corporate direct taxes, revenue from government enterprises and interest on the public debt.

For this reason, the income side of the model is quite simple. From national income (YNAL), the model obtains personal income (YPERC) and from the latter, personal disposable income (YDPC).

National income, current Balboas

$$YNALC = GDPC - \overline{NFP} - TINDC - DEPREC$$

YNALC: Nation income, millions of Balboas.

$\overline{NFP}$: Net factor payments, millions of Balboas.

National income, 1960 Balboas

$$YNALR = GDPFCR - \overline{NFP} - DEPRER$$

YNALR: National income, millions of 1960 Balboas.

$\overline{NFP}$: Net factor payments, millions of 1960 Balboas.

Personal income

The definition of personal income is taken directly from the National Accounts.

$$YPERC = YNALC - TDCORPC - TGREC + \overline{GIPDTC} - \overline{RECORPC}$$

YPERC: Personal income, millions of Balbaos.

$\overline{\text{GIPDTC}}$: Interest on the public debt, millions of Balboas.

$\overline{\text{RECORPC}}$: Corporate retained earnings, millions of Balboas.

<u>Personal disposable income</u>

$$YDPC = YPERC - TDIRPERC - TCSSC + \overline{TR*GTHC} + \overline{TR*WTHC} - \overline{TR*HTGC} - \overline{TR*HTWC}$$

YDPC: Personal disposable income, millions of Balboas.

$\overline{\text{TR*GTHC}}$: Government transfers to households, millions of Balboas.

$\overline{\text{TR*WTHC}}$: Rest of the world transfers to households, millions of Balboas.

$\overline{\text{TR*HTGC}}$: Household transfers to the Government, millions of Balboas.

$\overline{\text{TR*HTWC}}$: Household transfers to the rest of the world, millions of Balboas.

<u>Personal disposable income, 1960 Balboas</u>

$$YDPR = YDPC/\overline{PC}$$

YDPR: Personal disposable income, millions of 1960 Balboas.

$\overline{\text{PC}}$: Implicit deflator for private consumption, 1960 = 100.

Closing the Model

This section completes the specification of the model by indicating how to close it; in addition, it discusses briefly the structure of the model and the feedback loops present in it. The last part discusses the solution algorithm and computer programs used to solve and simulate the model.

The model has the following number of behavioral equations:

Consumption functions	: 13
Investment functions	: 3
Change in inventories	: 1
Depreciation	: 1
Import functions	: 8
Production decision functions	: 6
Tax functions	: 8

In addition, it has a number of identities, which are necessary to close the model, or a very few that are included for convenience. These are

Consumption identities	: 5
Income identities	: 5
Investment identities	: 8
Depreciation identities	: 2
Capital stock identities	: 2
Tax identities	: 2

Production decision function identities: 2

Gross domestic product identities : 4

Import identities : 4

Export identities : 1

Thus the model has 75 endogenous variables and 61 exogenous variables.

All the behavioral equations are linear, but there are some nonlinearities in the identities; these are all used to convert current values into constant price values, and vice versa.

The model could be closed from the demand or the production sides, as the gross domestic product identity could be obtained either way. We have chosen to close the model from the production side. Thus, we obtain GDPR from sector outputs (the Q's); from GDPR, we obtain income components, which, in turn, determine final demand components; and these then determine sector outputs. We expect the model to perform differently if closed from the demand side, but we have not explored its properties under that specification. However, as a check, the solution program computes GDPR from the demand side and prints the results. In the simulations performed, the two estimates of GDPR are different, but the divergence between the two is usually not large.

The structure of the model is nearly recursive, but it has two feedback loops. The first loop is the Keynesian multiplier between income and consumption. This multiplier operates through the 12 consumption functions in the model.

The second feedback loop is the accelerator between GDPR at factor cost and the investment functions for plant and equipment, and for other construction. A third feedback loop, the automatic stabilizer, is not fully present in the model; in effect, while government revenues from taxes and enterprises are endogenous, government expenditures are exogenous, so that the link between government revenue and expenditure is not present. Now, this specification need not be a disadvantage; in the case of Panama, increases in government revenues do not always mean increases in government expenditure. The increased revenues could be used to pay external debt incurred to finance, say, government investment in past years. This has been the case through the seventies, when the government has financed many development projects and other public spending by rather short term foreign borrowing, so that when revenue from the projects was not forthcoming, the government had to raise taxes to satisfy its international financial institution creditors.

A further word should be said about the method of solving the model. Macroeconometric model building is quite dependent on the computer, and without the availability of computer programs nothing can be done.

The model was solved using the Gauss-Seidel algorithm, as presented by Fromm and Klein (1969). Another good discussion of the algorithm is found in Klein and Evans (1969). The solution program, named SIM, was written by Morris Norman in 1967, at the Economics

Department, University of Pennsylvania.

Two regression programs were used; the consumption functions were estimated using the program KARPELLA of the Economics Department, Univesrity of Pennsylvania; this program was modified to make it double precision and to add the ridge regression method. The remaining functions were estimated using the program FITTER, written by Ross Preston, of Wharton EFA, University of Pennsylvania.

CHAPTER V. TESTING THE MODEL

After construction, a model has to be tested in order to know its properties. In order to have any confidence at all in its ability to predict the course of the economy, we must show, at least, that it tracks the economy well during the sample period. This is not sufficient, but it is necessary. Further testing would include simulations of the model subject to various kinds of shocks such as single or sustained changes in values of a variable or a parameter, or under different specifications for an equation or group of equations. If the results obtained from these tests seem reasonable, we may place greater confidence in the model when it is used in other contexts.

A model such as this may be used for several purposes as follows:

I: Historical simulations: The model may be simulated over historical periods to test economic hypotheses or to try alternative policies to see what would have been the course of the economy.

II: Economic forecasting: These forecasts are attempts to predict the course of the economy ex ante. They will incorporate the anticipated behavior of decision making units in the economy under alternative sets of economic conditions which may occur in the next, say, six to eighteen months in the future.

III. Multiplier analysis: These are attempts to measure the quantitative impact of alternative policy measures upon the economy, both initially and over time.

The simplest way to measure the accuracy of the model would be to take each variable and inspect all pairs $(Y, \hat{Y})$, where Y would be the observed value of the variable from the sample space and $\hat{Y}$ would be the predicted value from the model. This procedure can become very cumbersome if the number of variables and model runs increases even to moderate size. For this reason we will use some commonly used summary statistics which are defined below:

Mean Absolute Error:

$$MAE = \frac{1}{N} \Sigma |\hat{Y} - Y|$$

where $\hat{Y}$ and Y are as defined above and N is the number of sample points.

Mean Absolute Percentage Error:

$$MAPE = \frac{1}{N} \Sigma \left|\frac{\hat{Y} - Y}{Y}\right| 100$$

Root Mean Squared Error:

$$RMSE = \sqrt{\frac{1}{N} \Sigma (\hat{Y} - Y)^2}$$

Root Mean Squared Percentage Error:

$$RMSPE = \sqrt{\frac{1}{N} \Sigma \left(\frac{\hat{Y} - Y}{Y}\right) 100^{2}}$$

In addition, something should be said about the definition of the multiplier. If the model is linear, say

$$AY = BX + C$$

then the usual form of the multiplier, also called impact multiplier, is given by the elements of $A^{-1}B$. However, if the model has some non-linear equations, finding an analytical expression for the endogenous variables (Y) in terms of the exogenous variables (X) could be rather burdensome. For an example of the complexities involved, see Evans (1969, Chapter 19). The concept of the multiplier may be generalized to take into account nonlinear models and changes in the parameters of the equations or even the use of different equations by calculating a benchmark or control solution, and finding its time path, say

$$Y_1^c, Y_2^c, \ldots, Y_t^c$$

for a given set of exogenous variables, say

$$X_1^c, X_2^c, \ldots, X_t^c$$

where Y_i and X_i would be vectors of endogenous and exogenous variables at time i. The next step is to calculate a disturbed solution, say

$$Y_1^d, Y_2^d, \ldots, Y_t^d$$

for a given set of disturbed exogenous variables, say

$$X_1^d, X_2^d, \ldots, X_t^d$$

or even another set of parameters, or different equations; then the difference

$$Y_i^d, k - Y_i^c, k$$

Shows the effect on the i-th variable at time k of the disturbance, whatever its nature. If the disturbance was in a single variable, say X_p, we may normalize the difference above, and calculate

$$\frac{Y_i^d, k - Y_i^c, k}{X_p^d, k - X_p^c, k}$$

which may be interpreted as a multiplier. Clearly, if the disturbance is a change in several variables, or the use of a different equation, the denominator in the expression above would have no meaning.

Model Simulations

As said before, the first test of a model is an examination of its performance over the sample period. For this purpose the model was solved in full dynamic and in one period simulations over the sample period. In the full dynamic simulation the model generates its own lagged endogenous variables, and thus it is a much more stringent test than the one period simulation, which uses the true values of the lagged endogenous variables. The results of the simulations are summarized in Tables 5.1 to 5.11 which follow.

The tables correspond to the following five groups of variables: consumption, investment and capital formation, imports and exports, government finance, and finally, production and income. Each set of tables contains 52 of the 75 variables in the model; the sets include all the stochastic equations and the most important identities for each sector.

The following summary statistics are given for each variable: mean absolute error (MAE), mean absolute percentage error (MAPE), root mean squared error (RMSE), and root mean squared percentage error (RMSPE). The mean absolute and the mean absolute percentage errors are indicators of bias in the errors, whereas the root mean squared error and the root mean squared percentage error are indicators of the spread of the errors.

Full dynamic simulation

The results of the full dynamic simulation are given in Tables 5.1 to 5.5. Overall, the model performs reasonably well over the sample period. However, there is some variation in the results, some equations performing better than others.

In the consumption sector, the worst performers are furniture, fuel, and tobacco. In all cases, the poor results can be traced to

Table 5.1. Model solution, full dynamic simulation, 1960-1972. The consumption sector.

Variable	MAE	MAPE	RMSE	RMSPE
Private consumption, real	24.40	5.42	28.80	6.47
Food	5.41	2.86	6.18	3.28
Drink	1.65	5.59	1.97	6.83
Tobacco	0.78	8.47	0.88	9.68
Clothing	1.51	3.63	1.94	4.45
Housing	1.92	3.66	2.13	4.10
Fuel	1.56	12.10	2.52	13.80
Furniture	3.71	10.20	4.40	11.9
Domestic services	1.12	4.11	1.32	4.74
Health care	1.44	6.18	1.59	7.01
Transportation	2.75	6.03	3.51	8.48
Entertainment	1.97	4.37	2.32	5.00
Other services	0.51	4.55	0.58	5.51

Table 5.2. Model solution, full dynamic simulation, 1960-1972.
The private investment and capital formation sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total investment	9.41	9.02	12.20	12.50
Change in inventories	8.28	52.90	10.00	62.70
Fixed investment	3.94	4.32	4.96	5.57
Residential construction	2.24	10.40	2.65	13.30
Other construction	4.14	20.10	4.62	22.60
Capital goods	3.04	7.29	3.68	11.40
Depreciation	1.64	3.28	2.00	4.34

Table 5.3. Model solution, full dynamic simulation, 1960-1972.
The import and export sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total imports	6.97	3.01	8.35	3.92
Services	2.16	6.54	2.75	8.62
Imports of goods, CIF	6.94	3.63	8.24	4.74
Insurance and freight	1.28	6.91	1.60	9.62
Food	1.68	8.04	2.13	9.75
Raw materials	2.78	5.43	3.02	6.15
Fuels	2.17	6.47	2.72	8.55
Chemical products	0.90	4.76	1.02	5.73
Machinery	2.36	5.88	2.97	8.05
Manufactured products	0.91	4.36	1.08	5.58

Table 5.4. Model solution, full dynamic simulation, 1960-1972. The government sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total government revenue	4.50	4.35	5.32	5.58
Government enterprises revenue	0.56	3.29	0.75	4.49
Social security contributions	0.53	2.52	0.71	3.38
Corporate income taxes	0.62	5.30	0.85	9.88
Noncorporate income taxes	0.57	9.79	0.70	15.10
Total indirect taxes	3.02	6.49	3.74	8.44
Import duties	1.18	4.74	1.43	6.04
Production taxes	1.00	9.12	1.14	12.40
Property taxes	0.25	4.88	0.29	5.44
Other indirect taxes	1.44	15.60	1.73	19.60

Table 5.5. Model solution, full dynamic simulation, 1960-1972. The production and income sectors.

Variable	MAE	MAPE	RMSE	RMSPE
Gross domestic product, real	10.60	1.76	12.60	2.14
Change in GDPR at factor cost	6.18	14.30	7.58	17.00
Agriculture	3.59	2.65	4.24	3.03
Construction and mining	2.28	5.43	2.99	7.04
Nonconstruction industry	3.64	4.75	4.00	5.26
Construction related industry	0.61	2.57	0.73	3.04
Electricity, gas, water	0.90	5.73	1.14	7.55
Services	5.35	1.91	5.87	2.23
National income	10.50	1.89	11.70	2.16
Personal income	9.67	2.02	10.80	2.30
Personal disposable income	8.83	1.93	10.00	2.22

abrupt changes in the data that were not explained by the equations. Furniture has steplike increases in 1962 and in 1965. This period is one when the import substitution process was strongest. And as the apparent consumption series are calculated from production and import figures, any change in the pattern of production and imports will cause fluctuations in the series that are hard to predict. Essentially, we would need some means to deal with structural change. Another problem with the Panamanian data is that the magnitude of the observations in many series is so small that any changes, such as the opening or closing of a factory, produce a relatively large jump in the series. Thus, in this sense, the data are like discrete data. Similarly, tobacco consumption declined in 1963 and 1964 for some unknown reason; fuel (electricity) declined in 1962 and 1963 and had a nearly 50 percent increment in 1972. All these abrupt changes are hard to predict.

The equations in the investment and capital formation sector, taken as a group, have the highest errors in the model. This is not surprising, for they were also the most difficult to estimate initially.

The equation for private investment in housing has large errors in 1961, 1964-66, and in 1969. In 1961 the equation predicts the turning point, but not the size of the downturn, and there is a 23.7 percent prediction error. The 1964-66 period errors are caused by the downturn in 1964; again, the equation predicts the turning point, but not the extent of the downturn. The prediction errors are 14.8

percent in 1964, 30.6 percent in 1965, and 12.4 percent in 1966. A partial explanation for the 1964 downturn could be the anti-U.S. riots which occurred in January of that year, that leaves us to explain 1961 and 1969. The answer is, we don't know.

The equation for private investment in other construction performs badly for the entire sample period. Table 5.6 shows the complete solution path from 1960 to 1972. Clearly, the equation should be respecified, and the correct specification should require further research.

The equation for private investment in capital goods has large errors in the period 1960-62. The prediction errors are 34.4 percent in 1960, 16.8 percent in 1961, and 8.0 percent in 1962. In this case, the reason is clear: the series has rather large and sustained increases in its values in 1961 and in 1965-66. Thus, we find that a graph of the series since 1958 against time, resembles a set of steps; the first step would be in 1958-60, the second in 1961-65, the third from 1966 on. We conjecture that this result must be related to changes in the import quota policy already discussed. Clearly, the equation could be improved by adding a dummy variable to represent changes in the policy.

In the import and export sector, most equations do reasonably well. The poor performers are imports of food, of insurance and freight, and of other services.

The equation for food imports performs badly in 1964 and after 1968. All these are anomalous years. In 1964 there is an increase

Table 5.6. Model solution, full dynamic simulation. Private investment in other construction.

Year	Actual	Solution	Error	Percent error	Percent error[a]
1960	14.6	9.8	4.81	32.9	29.8
1961	10.4	12.2	-1.78	-17.1	25.5
1962	11.3	13.2	-1.91	-16.9	11.7
1963	10.8	14.9	-4.11	-38.0	4.0
1964	12.4	13.6	-1.21	-9.73	9.7
1965	13.0	18.3	-5.35	-41.1	44.3
1966	25.9	19.6	6.34	24.5	22.1
1967	21.7	23.8	-2.08	-9.58	7.0
1968	23.9	26.6	-2.74	-11.4	5.3
1969	34.7	28.2	6.49	18.7	18.6
1970	31.2	36.4	-5.22	-16.7	11.9
1971	50.5	42.4	8.13	16.1	13.4
1972	44.6	48.2	-3.62	-8.11	10.4

[a]Refers to the structural equation. See page 83.

in food imports followed by a drop in 1965. In fact, the level of 1964 is not surpassed until 1968. In 1971, there is an increase of 36.2 percent over the previous year; 1972 is lower than 1971, but still 24.6 percent higher than 1970. There is no clear cut explanation for these data fluctuations. The equation for imports of insurance and freight performs badly at the beginning of the period, in 1960 and 1961. In fact, those two years form a lower step in the series; 1962 to 1970 would be the middle step, and 1971 and 1972 the upper step. This may be due to changes in shipping rates. Imports of other services was a very difficult equation to estimate and it is not surprising that it does not perform well.

In the government finance sector, the majority of the equations perform reasonably well. The exceptions are other indirect taxes, noncorporate income taxes, and production taxes.

Other indirect taxes have a very poor fit from 1960 to 1968. In 1963, 1964 and 1965 the residuals are over 30 percent of the observation. This may be traced to the explanatory variables in the equation. The culprit here is private consumption CPC, which has residuals that, while small percentage wise, are large relative to other series. In fact, the residuals from CPC are several times larger than the observations for other indirect taxes from 1960 to 1967.

Noncorporate income taxes perform badly in the 1960-63 period and in 1968-69. The estimated equation had large residuals in those same years.

Production taxes have large residuals in 1961-63 and in 1967-68.

The estimated equation had larger residuals in 1961-62, but not as large as in the simulation, which are 27.4 and 28.0 percent respectively. Thus the bad performance of the equation cannot be assigned to any specific cause.

The last group of variables is the production and income sectors which were combined into one table since gross domestic product is determined from the supply side. Among the production variables, the only poor performer is the accelerator, which is defined as the year to year change in gross domestic product at factor cost. GDPR is predicted with very little error; an examination of the errors for the productive sectors indicates that these must offset each other. Also, an examination of the components of GDPR from the demand side shows that it would be estimated with a greater error. The summary statistics fro GDPR from the demand side are: MAE = 12.2; MAPE = 2.0; RMSE = 14.8; and RMSPE = 2.5.

Finally, the income variables are all estimated with small percentage errors.

<u>One period simulation</u>

In the one period simulation, the model is solved in each period using the true values of the lagged endogenous variables. Thus, each period is solved independently of the others. For this reason, we would expect the model to perform much better than under full dynamic simulation.

Tables 5.7 to 5.11 show the results of the one period simulation.

Table 5.7. Model solution, one period simulation, 1960-1972.
The consumption sector.

Variable	MAE	MAPE	RMSE	RMSPE
Private consumption, real	15.00	3.15	17.20	3.70
Food	4.58	2.33	5.50	2.69
Drink	1.57	5.33	1.80	6.27
Tobacco	0.29	3.15	0.36	4.22
Clothing	1.46	3.61	1.83	4.32
Housing	1.23	2.24	1.69	2.88
Fuel	1.21	8.53	2.31	11.90
Furniture	2.56	6.93	3.00	8.42
Domestic services	0.70	2.56	0.90	3.34
Health care	0.94	3.84	1.12	4.47
Transportation	2.49	5.38	3.04	7.26
Entertainment	1.55	3.32	2.22	4.27
Other services	0.34	2.77	0.41	3.55

Table 5.8. Model solution, one period simulation, 1960-1972. The private investment and capital formation sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total investment	8.45	7.04	10.80	8.67
Change in inventories	6.24	37.90	8.43	46.10
Fixed investment	3.20	3.44	4.76	5.06
Residential construction	2.17	10.70	2.62	14.90
Other construction	3.94	19.60	4.48	22.60
Capital goods	3.25	7.47	3.73	11.30
Capital stock	3.64	1.41	5.13	1.98
Depreciation	1.65	3.30	1.97	4.36

Table 5.9. Model solution, one period simulation, 1960-1972. The import and export sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total imports	5.64	2.16	6.99	2.70
Services	2.22	6.91	2.78	9.12
Imports of goods, CIF	5.77	2.75	6.81	3.31
Insurance and freight	1.26	6.51	1.44	8.21
Food	1.60	7.63	2.13	9.14
Raw materials	2.50	4.78	2.84	5.55
Fuels	2.16	6.66	2.72	9.24
Chemical products	0.68	3.33	0.86	4.15
Machinery	2.03	4.55	2.68	5.73
Manufactured products	0.77	3.34	0.97	4.30

Table 5.10. Model solution, one period simulation, 1960-1972.
The government sector.

Variable	MAE	MAPE	RMSE	RMSPE
Total government revenue	2.80	2.50	3.28	3.10
Government enterprises revenue	0.54	3.10	0.73	4.28
Social security contributions	0.57	3.16	0.68	4.26
Corporate income taxes	0.64	4.66	0.78	6.96
Noncorporate income taxes	0.57	8.43	0.68	12.50
Total indirect taxes	1.66	3.50	2.05	4.65
Import duties	0.96	3.72	1.16	4.51
Production taxes	0.62	5.60	0.73	7.92
Property taxes	0.23	4.56	0.29	5.19
Other indirect taxes	0.74	7.52	0.88	9.87

Table 5.11. Model solution, one period simulation, 1960-1972. The production and income sectors.

Variable	MAE	MAPE	RMSE	RMSPE
Gross domestic product, real	6.47	0.97	7.97	1.22
Change in GDPR at factor cost	6.04	15.00	7.29	17.80
Agriculture	2.95	2.13	3.61	2.53
Construction and mining	2.36	5.64	3.09	7.33
Nonconstruction industry	1.96	2.46	2.42	3.01
Construction related industry	0.60	2.54	0.71	2.94
Electricity, gas, water	1.06	6.21	1.27	7.50
Services	4.33	1.34	5.51	1.70
National income	7.43	1.26	8.98	1.52
Personal income	6.82	1.37	8.36	1.66
Personal disposable income	6.26	1.30	7.66	1.58

As expected, the model performs much better than under full dynamic simulation. For nearly all variables, the summary statistics are smaller than in the previous simulation. However, in some cases, some equations perform better under one type of simulation than another equation performs under the other. For example, as measured by MAPE, in the consumption sector, we have that tobacco performs worse than transportation under full dynamic simulation, but transportation performs worse than tobacco under one period simulation. However, both perform worse under full dynamic simulation.

The investment equations perform almost equally bad under both simulations. In this group of variables the results are mixed, some performing better under full dynamic than under one period simulation, but in any case the differences are very small, and the results equally bad.

In the import and export sector, the one exception to the pattern is services imports, which perform better under full dynamic simulation.

In the government sector group of variables, social security contributions and noncorporate income taxes perform worse under one period simulation. Again, the differences are small. In the production and income group, construction and mining and electricity, gas, and water perform better under full dynamic simulation.

Multiplier Analysis

Another way to test the dynamic properties of the model would be to examine the sensitivity of its solution path to changes in the values of the parameters, or the endogenous and exogenous variables.

Somtimes this analysis will reveal unsuspected properties that may have to be corrected before the model can be put to further use.

We have devised three simulation experiments to check the dynamic performance of the model:

1. A B/5 million increment to the level of import taxes.
2. A B/10 million increment to the level of gross domestic product generated in the Canal Zone.
3. A B/10 million increment in the level of government consumption.

As a benchmark solution, we have used the full dynamic simulation for 1960-72 fine tuned with the residuals of the structural equations, so that the solution values are equal to the observations. Under ordinary circumstances, the model would be fine tuned before being used, so this should impose no abnormal conditions on its solution.

The size of the shock, B/5 and B/10 million, have been chosen as being of a realistic order of magnitude, in the sense that conceivably they could have been imposed on the economy. For this reason, they constitute a test of the model under conditions similar to actual usage.

Import taxes multipliers

To calculate the import taxes multipliers, a constant adjustment equal to B/5 million was added to the constant term of the indirect import taxes function, TINDMC. The model was then solved in full dynamic simulation and the solution compared to the benchmark as already indicated. The results are presented in Tables 5.12 to 5.16.

The multipliers have the theoretically expected sign, and their magnitude seems reasonable. Their dynamic path is similar for all variables: they increase or decrease steadily from the beginning to the end of the simulation period; the only difference among variables is in the magnitude of the multiplier.

This last result is different from what has been reported by other authors. For example, Naranjo (1973) reports multipliers that increase steadily to a maximum, and then, decline steadily to some asymptotic value. However, the behavior of the multipliers can be explained by the very simple lag structure of the model; for example, the longest lag is only one period. An additional feature of the multipliers is that some of them show small oscillations in some years. This is essentially due to small round-off errors or small discrepancies in the data.

The simulation shows that the added tax depresses the level of all variables, including government receipts, which fail to increase by the amount of the tax raise. Government revenues are negatively affected through the decrease in the tax bases; all revenue functions except import duties, have steadily decreasing negative multipliers. For this reason, total government revenue has a steadily decreasing multiplier.

Interestingly enough, the import multipliers are all below unity;

the import categories most affected were raw materials, machinery and other manufactures.

In the consumption sector, all consumption categories have multipliers well-below unity. The categories have the highest absolute value multipliers are food, entertainment, and transportation. However, this does not apply to the aggregate consumption function.

In the investment and capital formation sector, the private capital stock has a multiplier greater than one from the fifth period of the simulation on; this is to be expected, for the multiplier shows the accumulated effect on the capital stock of the depressed economy. The multipliers for investment in other construction and in capital goods present a somewhat different time pattern: the smallest value is achieved in the first period of the simulation; in successive periods they oscillate around zero. This is due to the accelerator, which shows the largest increase on the first simulation period, and very little change thereafter. This anomaly is another indication that the investment functions need further research.

In the production and income sector, the largest multipliers are in services, in nonconstruction industry, and in agriculture. The construction and mining sector has a smaller multiplier due to the fact that private investment did not change very much, and that public investment is exogenous.

All the income variables have multipliers larger than two. They show the accumulated effect of the changes in the other variables of

Table 5.12. Dynamic multipliers: change in the level of import taxes. The consumption sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966	1967
Private consumption	-.442	-.767	-1.005	-1.175	-1.285	-1.289	-1.414	-1.469
Food	-.252	-.362	-.420	-.456	-.473	-.484	-.506	-.513
Drink	-.047	-.061	-.069	-.073	-.076	-.080	-.082	-.082
Tobacco	-.002	-.003	-.005	-.006	-.008	-.009	-.010	-.011
Clothing	-.053	-.071	-.081	-.087	-.089	-.092	-.096	-.096
Housing	-.045	-.078	-.102	-.120	-.131	-.136	-.144	-.149
Fuel	-.010	-.019	-.028	-.036	-.042	-.046	-.051	-.055
Furniture	-.035	-.064	-.087	-.105	-.124	-.126	-.137	-.142
Domestic services	-.023	-.037	-.047	-.053	-.057	-.059	-.062	-.064
Health care	-.020	-.036	-.046	-.060	-.067	-.071	-.076	-.080
Transportation	-.058	-.100	-.130	-.151	-.165	-.172	-.181	-.188
Entertainment	-.040	-.076	-.107	-.132	-.151	-.159	-.177	-.188
Other services	-.013	-.023	-.031	-.037	-.041	-.042	-.046	-.049

Table 5.12. (continued)

Variable	1968	1969	1970	1971	1972
Private consumption	-1.514	-1.548	-1.597	-1.634	-1.615
Food	-.517	-.532	-.549	-.560	-.539
Drink	-.082	-.085	-.088	-.089	-.085
Tobacco	-.012	-.012	-.013	-.014	-.014
Clothing	-.097	-.100	-.103	-.105	-.100
Housing	-.153	-.157	-.162	-.166	-.164
Fuel	-.059	-.062	-.065	-.067	-.068
Furniture	-.146	-.151	-.156	-.160	-.159
Domestic services	-.065	-.066	-.068	-.070	-.069
Health care	-.083	-.086	-.089	-.091	-.091
Transportation	-.192	-.198	-.204	-.209	-.206
Entertainment	-.196	-.205	-.213	-.219	-.220
Other services	-.050	-.052	-.053	-.055	-.055

Table 5.13. Dynamic multipliers: change in the level of import taxes. The investment and capital formation sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total investment	-.466	-.354	-.386	-.405	-.416	-.408	-.513
Change in inventories	0.000	-.187	-.211	-.230	-.254	-.275	-.309
Fixed investment	-.466	-.167	-.175	-.175	-.162	-.142	-.205
Residential construction	-.106	-.123	-.136	-.144	-.147	-.153	-.162
Other construction	-.161	-.020	-.017	-.014	-.006	0.000	-.019
Capital goods	-.200	-.024	-.022	-.017	-.008	0.000	-.023
Capital stock	-.466	-.614	-.766	-.909	-1.040	-1.130	-1.200
Depreciation	0.000	-.018	-.024	-.030	-.035	-.040	-.044

Table 5.13. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total investment	-.436	-.469	-.471	-.485	-.480	-.201
Change in inventories	-.291	-.299	-.296	-.308	-.302	-.040
Fixed investment	-.144	-.166	-.175	-.178	-.178	-.161
Residential construction	-.158	-.159	-.165	-.170	-.173	-.163
Other construction	-.006	-.005	-.004	-.003	-.001	-.001
Capital goods	-.008	-.006	-.006	-.004	-.003	-.001
Capital stock	-1.320	-1.440	-1.560	-1.690	-1.810	-1.890
Depreciation	-.046	-.051	-.056	-.061	-.066	-.070

Table 5.14. Dynamic multipliers: change in the level of import taxes. The import and export sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total imports	-.384	-.450	-.542	-.606	-.649	-.641	-.713
Services	-.077	-.086	-.094	-.100	-.103	-.102	-.111
Imports of goods, CIF	-.307	-.364	-.449	-.507	-.546	-.539	-.602
Insurance and freight	-.035	-.041	-.051	-.058	-.062	-.061	-.069
Food	-.038	-.053	-.061	-.064	-.064	-.072	-.068
Raw materials	-.058	-.068	-.093	-.102	-.110	-.116	-.118
Fuels	-.017	-.023	-.029	-.033	-.036	-.038	-.042
Chemical products	-.022	-.035	-.045	-.052	-.057	-.060	-.063
Machinery	-.106	-.082	-.105	-.121	-.133	-.130	-.150
Manufactured products	-.031	-.041	-.066	-.076	-.084	-.083	-.092

Table 5.14. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total imports	-.712	-.751	-.752	-.773	-.768	-.795
Services	-.108	-.130	-.112	-.113	-.114	-.114
Imports of goods, CIF	-.604	-.621	-.639	-.660	-.674	-.661
Insurance and freight	-.069	-.071	-.073	-.075	-.077	-.075
Food	-.069	-.069	-.071	-.073	-.074	-.071
Raw materials	-.120	-.122	-.125	-.129	-.132	-.128
Fuels	-.040	-.042	-.043	-.045	-.046	-.047
Chemical products	-.065	-.067	-.070	-.072	-.074	-.073
Machinery	-.145	-.153	-.158	-.162	-.166	-.123
Manufactured products	-.095	-.096	-.100	-.103	-.105	-.104

Table 5.15. Dynamic multipliers: change in the level of import taxes. The government sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total government revenue	.697	.622	.566	.534	.491	.504	.445
Government enterprises revenue	-.006	-.009	-.011	-.013	-.015	-.016	-.017
Social security contributions	-.049	-.057	-.063	-.068	-.071	-.064	-.078
Corporate income taxes	-.104	-.121	-.132	-.143	-.150	-.136	-.165
Noncorporate income taxes	-.039	-.046	-.050	-.054	-.057	-.051	-.062
Total indirect taxes	.895	.855	.823	.812	.782	.771	.767
Import duties	.958	.951	.940	.933	.925	.927	.934
Production taxes	-.030	-.040	-.048	-.054	-.060	-.064	-.066
Property taxes	-.002	-.003	-.004	-.005	-.006	-.006	-.007
Other indirect taxes	-.026	-.045	-.059	-.070	-.079	-.078	-.086

Table 5.15. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total government revenue	.422	.425	.409	.380	.359	.282
Government enterprises revenue	-.018	-.018	-.019	-.020	-.021	-.023
Social security contributions	-.077	-.078	-.081	-.083	-.085	-.089
Corporate income taxes	-.162	-.165	-.171	-.177	-.181	-.188
Noncorporate income taxes	-.061	-.062	-.064	-.066	-.068	-.071
Total indirect taxes	.740	.748	.743	.726	.714	.652
Import duties	.916	.913	.910	.903	.900	.894
Production taxes	-.068	-.070	-.073	-.078	-.081	-.083
Property taxes	-.007	-.008	-.009	-.010	-.011	-.012
Other indirect taxes	-.090	-.093	-.095	-.099	-.102	-.138

Table 5.16. Dynamic multipliers: change in the level of import taxes. The production and income sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Gross domestic product	-.540	-.756	-.944	-1.077	-1.165	-1.176	-1.349
Change in GDPR at factor cost	-1.436	-.175	-.156	-.123	-.059	-.002	-.169
Agriculture	-.101	-.145	-.169	-.183	-.190	-.178	-.203
Construction and mining	-.085	-.046	-.049	-.051	-.049	-.043	-.058
Nonconstruction industry	-.116	-.170	-.202	-.224	-.241	-.259	-.260
Construction related industry	-.018	-.009	-.010	-.010	-.010	-.009	-.012
Electricity, gas, water	-.019	-.031	-.041	-.049	-.055	-.057	-.062
Services	-.201	-.355	-.472	-.559	-.620	-.630	-.694
National income	-1.376	-1.599	-1.753	-1.898	-1.988	-1.801	-2.180
Personal income	-1.265	-1.469	-1.609	-1.741	-1.823	-1.650	-1.998
Personal disposable income	-1.177	-1.366	-1.497	-1.619	-1.696	-1.535	-1.859

Table 5.16. (continued)

Variable	1967	1968	1969	1970	1971	1972
Gross domestic product	-1.320	-1.354	-1.398	-1.444	-1.478	-1.531
Change in GDPR at factor cost	.055	-.042	-.039	-.030	-.021	.008
Agriculture	-.206	-.207	-.213	-.220	-.224	-.216
Construction and mining	-.049	-.053	-.054	-.056	-.056	-.052
Nonconstruction industry	-.265	-.269	-.277	-.286	-.292	-.284
Construction related industry	-.010	-.011	-.011	-.011	-.011	-.011
Electricity, gas, water	-.065	-.068	-.070	-.073	-.075	-.075
Services	-.725	-.747	-.772	-.798	-.819	-.813
National income	-2.150	-2.180	-2.256	-2.338	-2.391	-2.491
Personal income	-1.971	-1.997	-2.067	-2.142	-2.190	-2.284
Personal disposable income	-1.833	-1.857	-1.922	-1.992	-2.037	-2.121

the system.

Finally, the discrepancy between the supply and demand sides of GDPR is quite small.

To summarize, the simulation shows that the model performs reasonably well, and except for the investment functions, all other equations are satisfactory.

<u>Canal Zone multipliers</u>

This is an interesting simulation; what would have happened if exports of labor services to the Canal Zone had been at a level B/10 million higher than they were through the sample period? This could have come about if, say a new Canal treaty had been negotiated in 1955.

To perform this simulation, we increase the level of $\overline{QCZR}$ (gross domestic product originating in the Canal Zone) by B/10 million and proceeded as before. The resulting multipliers are shown in Tables 5.17 to 5.21. Again, the multipliers have the theoretically expected sign, and their magnitude seems reasonable. They have the same dynamic properties as the multipliers in the previous experiment, the only difference being that the signs are reversed.

<u>Government consumption multipliers</u>

This simulation presents the behavior of the model under an increase in public spending. Whereas gross domestic product originating in the Canal Zone ($\overline{QCZR}$) enters directly into the GDPR identi-

Table 5.17. Dynamic multipliers: change in the level of gross domestic product originating in the Canal Zone. The consumption sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966	1967
Private consumption	.477	.797	1.026	1.195	1.313	1.452	1.502	1.581
Food	.272	.371	.425	.461	.482	.529	.525	.552
Drink	.050	.062	.068	.073	.076	.084	.082	.087
Tobacco	.002	.004	.005	.007	.008	.010	.011	.012
Clothing	.056	.072	.081	.086	.090	.099	.097	.103
Housing	.049	.082	.105	.122	.134	.148	.153	.161
Fuel	.011	.020	.029	.037	.043	.050	.054	.059
Furniture	.039	.069	.092	.110	.120	.136	.144	.154
Domestic services	.024	.038	.047	.053	.057	.063	.064	.067
Health care	.021	.037	.050	.060	.067	.076	.080	.085
Transportation	.061	.102	.130	.151	.166	.183	.189	.199
Entertainment	.044	.081	.111	.137	.157	.179	.191	.205
Other services	.013	.023	.031	.037	.041	.046	.048	.051

Table 5.17. (continued)

Variable	1968	1969	1970	1971	1972
Private consumption	1.640	1.698	1.765	1.836	1.892
Food	.568	.586	.610	.635	.651
Drink	.089	.092	.096	.100	.102
Tobacco	.013	.014	.015	.016	.017
Clothing	.106	.109	.114	.118	.121
Housing	.167	.173	.180	.187	.193
Fuel	.063	.067	.071	.074	.078
Furniture	.161	.168	.175	.182	.188
Domestic services	.069	.072	.074	.077	.080
Health care	.089	.092	.096	.100	.104
Transportation	.206	.213	.222	.231	.238
Entertainment	.216	.227	.237	.248	.257
Other services	.053	.055	.057	.060	.062

Table 5.18. Dynamic multipliers: change in the level of gross domestic product originating in the Canal Zone. The investment and capital formation sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total investment	.561	.433	.459	.477	.486	.522	.491
Change in inventories	.079	.265	.286	.306	.317	.328	.333
Fixed investment	.482	.168	.173	.171	.168	.194	.158
Residential construction	.114	.125	.137	.146	.150	.168	.161
Other construction	.164	.019	.016	.011	.008	.012	.001
Capital goods	.204	.024	.020	.014	.010	.014	.001
Capital stock	.482	.632	.780	.922	1.054	1.206	1.365
Depreciation	0.000	.019	.024	.030	.036	.041	.047

Table 5.18. (continued).

Variable	1967	1968	1969	1970	1971	1972
Total investment	.562	.559	.585	.608	.637	.770
Change in inventories	.362	.375	.393	.406	.426	.569
Fixed investment	.199	.184	.193	.201	.210	.202
Residential construction	.173	.176	.182	.190	.198	.202
Other construction	.012	.004	.005	.005	.005	0.000
Capital goods	.015	.004	.006	.006	.007	0.000
Capital stock	1.499	1.622	1.750	1.880	2.015	2.141
Depreciation	.053	.058	.063	.068	.073	.078

Table 5.19. Dynamic multipliers: change in the level of gross domestic product originating in the Canal Zone. The import and export sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total imports	.440	.497	.584	.646	.686	.748	.757
Services	.079	.087	.094	.100	.103	.108	.107
Imports of goods, CIF	.361	.410	.489	.546	.583	.640	.649
Insurance and freight	.041	.047	.056	.062	.066	.073	.074
Food	.040	.054	.061	.064	.067	.077	.071
Raw materials	.063	.080	.094	.104	.109	.115	.122
Fuels	.049	.055	.060	.065	.067	.071	.072
Chemical products	.024	.036	.045	.052	.057	.062	.066
Machinery	.111	.084	.106	.122	.131	.148	.148
Manufactured products	.033	.053	.067	.078	.084	.094	.097

Table 5.19. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total imports	.804	.815	.852	.883	.925	.923
Services	.113	.104	.116	.118	.121	.120
Imports of goods, CIF	.692	.711	.736	.764	.794	.812
Insurance and freight	.079	.081	.084	.087	.090	.092
Food	.074	.076	.078	.091	.084	.086
Raw materials	.129	.133	.138	.144	.150	.154
Fuels	.075	.077	.078	.080	.082	.083
Chemical products	.070	.073	.076	.079	.082	.085
Machinery	.162	.165	.172	.179	.186	.190
Manufactured products	.102	.106	.110	.114	.119	.123

Table 5.20. Dynamic multipliers: change in the level of gross domestic product originating in the Canal Zone. The government sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total government revenue	.338	.390	.447	.500	.540	.586	.597
Government enterprises revenue	.019	.021	.024	.026	.028	.029	.030
Social security contributions	.053	.058	.063	.068	.073	.080	.078
Corporate income taxes	.113	.123	.134	.145	.155	.171	.166
Noncorporate income taxes	.042	.046	.050	.054	.058	.064	.062
Total indirect taxes	.111	.143	.176	.207	.226	.241	.262
Import duties	.050	.055	.066	.072	.080	.086	.099
Production taxes	.032	.042	.049	.055	.060	.063	.068
Property taxes	.003	.003	.004	.005	.006	.007	.008
Other indirect taxes	.028	.047	.060	.071	.080	.088	.092

Table 5.20. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total government revenue	.632	.660	.684	.727	.760	.793
Government enterprises revenue	.032	.033	.034	.036	.038	.040
Social security contributions	.084	.086	.088	.094	.097	.103
Corporate income taxes	.179	.183	.188	.199	.207	.219
Noncorporate income taxes income taxes	.067	.068	.070	.074	.077	.082
Total indirect taxes	.270	.290	.303	.324	.341	.349
Import duties	.096	.100	.103	.112	.119	.131
Production taxes	.074	.076	.080	.086	.092	.099
Property taxes	.009	.009	.010	.012	.013	.014
Other indirect taxes	.097	.101	.104	.110	.114	.109

Table 5.21. Dynamic multipliers: change in the level of gross domestic product originating in the Canal Zone. The production and income sectors: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Gross domestic product	1.576	1.778	1.956	2.089	2.179	2.298	2.310
Change in GDPR at factor cost	1.466	.169	.145	.101	.072	.104	.010
Agriculture	.109	.149	.170	.185	.193	.212	.210
Construction and mining	.089	.046	.049	.050	.051	.058	.051
Nonconstruction industry	.125	.175	.206	.228	.241	.253	.269
Construction related industry	.018	.010	.010	.010	.010	.012	.010
Electricity, gas, water	.020	.032	.042	.050	.056	.062	.066
Services	.215	.365	.478	.565	.628	.701	.733
National income	1.496	1.626	1.778	1.919	2.051	2.266	2.190
Personal income	1.364	1.481	1.620	1.748	1.868	2.066	1.995
Personal disposable income	1.268	1.378	1.507	1.626	1.734	1.921	1.855

Table 5.21. (continued)

Variable	1967	1968	1969	1970	1971	1972
Gross domestic product	2.424	2.474	2.529	2.594	2.660	2.668
Change in GDPR at factor cost	.106	.031	.042	.043	.050	0.000
Agriculture	.222	.228	.235	.245	.254	.261
Construction and mining	.059	.058	.060	.062	.065	.065
Nonconstruction industry	.285	.295	.305	.318	.331	.340
Construction related industry	.012	.012	.012	.013	.014	.013
Electricity, gas, water	.070	.074	.077	.080	.084	.087
Services	.776	.809	.841	.876	.912	.942
National income	2.369	2.424	2.491	2.634	2.739	2.901
Personal income	2.158	2.208	2.268	2.398	2.494	2.642
Personal disposable income	2.007	2.054	2.110	2.230	2.320	2.457

ty, government consumption ($\overline{CGR}$) is an explanatory variable in the equation for gross domestic product originating in services; its coefficient in the equation is 1.25508. For this reason, the direct shock to GDPR is larger than in the previous simulation, where we were shocking $\overline{QCZR}$.

The results obtained are very similar to those obtained in the previous two simulations, except that, in this case, the values of the multipliers are larger. This result is due to the nonlinearities in the model, for it is known that the nonlinear terms make the values of the multiplier be different for each time period.

A forecasting simulation

A realistic simulation could be an exante prediction of the future course of the economy. If the model performs reasonably well outside the sample period, then we could place more confidence in it as a tool for analyzing the real economy.

For this test, we have solved the model in full dynamic simulation for the post sample period years of 1973 and 1974. To make the simulation more realistic, we have partially fine tuned the model; we added the 1972 structural residuals to the constant terms of all stochastic equations before solving the system.

Simulating the model outside the sample period is a stringent test of its predictive ability; this is even more so for the years of the forecast. After more than a decade of steady growth, the Panamanian economy entered a period of stagnation in 1973 and 1974. Thus the

Table 5.22. Dynamic multipliers: change in the level of government consumption. The consumption sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966	1967
Private consumption	.621	1.041	1.343	1.566	1.722	1.893	1.967	2.071
Food	.354	.486	.557	.604	.633	.688	.689	.724
Drink	.065	.081	.090	.096	.100	.109	.108	.114
Tobacco	.002	.005	.007	.009	.011	.012	.014	.016
Clothing	.074	.094	.106	.114	.118	.129	.128	.135
Housing	.064	.106	.137	.160	.175	.193	.200	.211
Fuel	.014	.027	.038	.048	.056	.065	.071	.077
Furniture	.051	.089	.120	.144	.158	.178	.189	.201
Domestic services	.031	.049	.061	.070	.075	.082	.084	.088
Health care	.028	.048	.065	.078	.088	.099	.105	.111
Transportation	.080	.133	.171	.198	.217	.239	.248	.261
Entertainment	.058	.106	.146	.179	.206	.233	.250	.268

Table 5.22. (continued)

Variable	1968	1969	1970	1971	1972
Private consumption	2.149	2.226	2.315	2.408	2.480
Food	.744	.768	.801	.833	.852
Drink	.117	.121	.126	.132	.134
Tobacco	.017	.018	.019	.020	.022
Clothing	.139	.143	.149	.155	.159
Housing	.219	.227	.236	.245	.252
Fuel	.083	.088	.092	.097	.102
Furniture	.211	.220	.229	.239	.246
Domestic services	.091	.094	.098	.102	.104
Health care	.116	.121	.127	.132	.136
Transportation	.270	.280	.291	.303	.312
Entertainment	.283	.297	.311	.325	.336
Other services	.070	.072	.075	.079	.081

Table 5.23. Dynamic multipliers: Change in the level of government consumption. The investment and capital formation sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total investment	.912	.746	.781	.805	.818	.861	.836
Change in inventories	.282	.526	.554	.580	.596	.612	.622
Fixed investment	.630	.220	.227	.225	.221	.249	.214
Residential construction	.148	.164	.179	.191	.198	.217	.212
Other construction	.215	.025	.022	.015	.011	.014	.001
Capital goods	.267	.031	.027	.019	.013	.018	.001
Capital stock	.630	.826	1.021	1.027	1.382	1.576	1.776
Depreciation	0.000	.024	.032	.040	.047	.054	.061

Table 5.23. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total investment	.914	.914	.947	.976	1.012	1.146
Change in inventories	.656	.673	.694	.712	.736	.882
Fixed investment	.258	.242	.253	.264	.276	.265
Residential construction	.226	.231	.239	.250	.260	.264
Other construction	.014	.005	.006	.006	.007	0.000
Capital goods	.017	.006	.008	.008	.009	0.000
Capital stock	1.953	2.116	2.285	2.458	2.635	2.800
Depreciation	.069	.076	.082	.089	.095	.102

Table 5.24. Dynamic multipliers: change in the level of government consumption. The import and export sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total imports	.574	.650	.765	.847	.901	.976	.995
Services	.103	.114	.124	.131	.135	.142	.142
Imports of goods, CIF	.471	.536	.641	.717	.765	.834	.853
Insurance and freight	.054	.061	.073	.082	.087	.095	.097
Food	.053	.071	.080	.085	.088	.098	.093
Raw materials	.082	.105	.123	.136	.144	.152	.160
Fuels	.064	.072	.079	.085	.088	.093	.094
Chemical products	.031	.047	.059	.068	.075	.082	.086
Machinery	.145	.110	.139	.160	.173	.192	.196
Manufactured products	.044	.070	.088	.102	.111	.122	.127

Table 5.24. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total imports	1.054	1.072	1.117	1.158	1.211	1.213
Services	.148	1.400	.153	.155	.158	.158
Imports of goods, CIF	.906	.932	.964	1.003	1.042	1.065
Insurance and freight	.103	.106	.110	.114	.119	.121
Food	.098	.100	.102	.107	.111	.113
Raw materials	.170	.175	.181	.189	.197	.202
Fuels	.098	.100	.103	.106	.108	.109
Chemical products	.092	.095	.099	.103	.108	.111
Machinery	.212	.217	.225	.234	.244	.249
Manufactured products	.134	.139	.144	.150	.156	.161

Table 5.25. Dynamic multipliers: change in the level of government consumption. The government sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Total government revenue	.441	.512	.587	.655	.708	.763	.784
Government enterprises revenue	.025	.028	.031	.034	.036	.038	.039
Social security contributions	.069	.076	.083	.089	.096	.104	.102
Corporate income taxes	.147	.161	.176	.190	.203	.222	.218
Noncorporate income taxes	.055	.060	.066	.071	.076	.083	.081
Total indirect taxes	.145	.188	.231	.270	.297	.316	.342
Import duties	.065	.072	.086	.095	.105	.113	.127
Production taxes	.042	.054	.064	.072	.078	.083	.089
Property taxes	.003	.004	.006	.006	.008	.009	.010
Other indirect taxes	.037	.061	.079	.093	.105	.115	.120

Table 5.25. (continued)

Variable	1967	1968	1969	1970	1971	1972
Total government revenue	.830	.864	.895	.953	.996	1.047
Government enterprises revenue	.042	.043	.045	.048	.050	.053
Social security contributions	.110	.113	.116	.123	.128	.135
Corporate income taxes	.234	.240	.247	.261	.272	.288
Noncorporate income taxes	.088	.090	.092	.098	.101	.108
Total indirect taxes	.356	.379	.396	.424	.446	.463
Import duties	.125	.131	.135	.147	.156	.172
Production taxes	.097	.100	.105	.113	.120	.130
Property taxes	.011	.012	.013	.015	.016	.018
Other indirect taxes	.127	.133	.137	.144	.150	.148

Table 5.26. Dynamic multipliers: change in the level of government consumption. The production and income sector: 1960-1972.

Variable	1960	1961	1962	1963	1964	1965	1966
Gross domestic product	2.064	2.329	2.564	2.740	2.860	3.006	3.040
Change in GDP at factor cost	1.919	.22	.192	.136	.095	.127	.007
Agriculture	.142	.195	.223	.242	.254	.276	.276
Construction and mining	.116	.060	.064	.066	.067	.074	.068
Nonconstruction industry	.163	.229	.270	.299	.317	.334	.354
Construction related industry	.024	.012	.013	.014	.014	.015	.014
Electricity, gas, water	.083	.099	.112	.122	.130	.138	.143
Services	1.535	1.733	1.882	1.996	2.080	2.170	2.215
National income	1.949	2.130	2.331	2.519	2.692	2.936	2.886
Personal income	1.777	1.941	2.124	2.295	2.453	2.675	2.628
Personal disposable income	1.652	1.805	1.975	2.134	2.281	2.488	2.444

Table 5.26. (continued)

Variable	1967	1968	1969	1970	1971	1972
Gross domestic product	3.178	3.244	3.318	3.404	3.491	3.510
Change in GDP at factor cost	.124	.043	.057	.058	.065	.002
Agriculture	.290	.298	.308	.321	.334	.342
Construction and mining	.077	.076	.078	.082	.086	.085
Nonconstruction industry	.374	.386	.400	.417	.434	.445
Construction related industry	.016	.016	.016	.017	.018	.018
Electricity, gas, water	.149	.153	.158	.162	.167	.171
Services	2.272	2.315	2.357	2.404	2.452	2.490
National income	3.104	3.176	3.268	3.457	3.596	3.814
Personal income	2.827	2.893	2.976	3.148	3.274	3.473
Personal disposable income	2.629	2.691	2.768	2.928	3.045	3.230

model would be predicting at a turning point and trend patterns would not be very useful.

The forecast results are presented in Tables 5.27 to 5.31, which we proceed to discuss briefly.

Overall, the results are encouraging; the model performs reasonably well. At the level of the individual equations, the results are mixed; some equations performed better than others, which is as expected.

In the consumption sector, we notice that some consumption categories increased substantially more than the overall economy, and were not explained very well by the model. Among these we find food, clothing, housing, and transportation. Fuel was over predicted in both years. The aggregate consumption function is also predicted with a large error in 1974 for the same reason as food and the other categories.

In the investment and capital formation sector, surprisingly enough, the equation for change in inventories is the only one to be completely out of line.

The import and export sector equations perform reasonably well given the circumstances prevalent during 1973 and 1974. We notice that the errors in the individual equations seem to reinforce each other in the identity for total imports.

Most equations in the government sector perform quite well. The only exceptions are the indirect tax equations for the year 1974.

A partial explanation is the introduction of new taxes that year that were not incorporated into the fine tuning of the equations.

Finally, the performance of the equations in the production and income sector is also satisfactory. Several of the equations do less satisfactorily in 1974. These are agriculture, nonconstruction industry, and personal income.

To conclude, the model performs reasonably well over the immediate post sample period. In some sense, this is encouraging, for 1973 and 1974 were rather difficult years. Some equations have much larger prediction errors in 1974, but this is to be expected.

Table 5.27. Forecast 1973-1974. The consumption sector.

Variable	1973 Observed	1973 Predicted	1974 Observed	1974 Predicted
Private consumption, real	741.6	720.6	778.1	686.2
Food	284.7	297.8	312.2	271.8
Drink	46.6	43.0	46.1	37.9
Tobacco	10.8	11.4	11.5	11.5
Clothing	50.7	56.1	54.0	50.2
Housing	88.9	88.4	93.9	87.5
Fuel	29.0	36.9	30.6	41.8
Furniture	56.8	57.1	58.1	54.2
Dometic services	36.8	37.7	38.2	36.0
Health care	40.4	42.6	43.8	43.3
Transportation	89.6	91.2	93.9	88.0
Entertainment	83.0	90.0	96.0	92.7
Other services	22.8	22.6	24.5	22.3

Table 5.28. Forecast 1973-1974. The private investment and capital formation sector.

Variable	1973 Observed	1973 Predicted	1974 Observed	1974 Predicted
Total investment	238.9	285.4	200.6	194.5
Change in inventories	24.8	61.4	42.3	53.9
Fixed investment	214.1	224.0	158.3	140.8
Residential construction	69.7	73.2	27.9	25.7
Other construction	51.6	54.4	33.0	26.1
Capital goods	92.8	96.3	97.4	88.9
Capital stock	911.4	921.3	978.2	970.1
Depreciation	91.4	91.4	91.6	92.0

Table 5.29. Forecast 1973-1974. The import and export sector.

Variable	1973 Observed	1973 Predicted	1974 Observed	1974 Predicted
Total imports	449.9	462.2	446.9	412.8
Services	59.6	61.0	64.2	62.3
Imports of goods, CIF	374.9	385.8	369.4	337.2
Insurance and freight	35.9	37.1	31.3	27.6
Food	32.8	35.0	33.0	26.1
Raw materials	84.9	87.4	97.1	90.1
Fuels	56.7	57.6	53.8	51.9
Chemical products	32.8	34.4	37.5	35.8
Machinery	93.8	95.9	81.1	73.9
Manufactured products	35.0	35.6	32.6	28.9

Table 5.30. Forecast 1973-1974. The government sector.

Variable	1973 Observed	1973 Predicted	1974 Observed	1974 Predicted
Total government revenue	298.3	305.8	334.0	298.0
Government enterprises revenue	46.6	47.0	45.8	44.6
Social security contributions	64.6	65.8	78.3	75.6
Corporate income taxes	40.8	43.4	53.7	48.1
Noncorporate income taxes	30.6	31.6	35.2	33.1
Total indirect taxes	122.1	124.4	143.8	119.4
Import duties	44.2	46.2	50.8	40.9
Production taxes	35.3	37.0	39.0	33.2
Property taxes	9.9	10.0	10.8	10.7
Other indirect taxes	32.7	31.2	43.2	34.6

Table 5.31. Forecast 1973-1974. The production and income sector.

Variable	1973 Observed	1973 Predicted	1974 Observed	1974 Predicted
Gross domestic product, real	1101.2	1129.0	1130.1	1069.8
Change in GDPR at factor cost	56.5	82.0	7.6	-53.7
Agriculture	177.9	183.1	175.2	159.0
Construction and mining	80.0	82.0	82.9	80.0
Nonconstruction industry	134.0	139.3	126.8	111.3
Construction related industry	50.6	51.0	49.6	49.0
Electricity, gas, water	38.5	42.1	40.3	42.6
Services	545.4	556.6	581.4	559.0
National income	1170.7	1205.3	1464.2	1389.6
Personal income	1032.6	1064.2	1315.3	1247.6
Personal disposable income	952.7	996.8	1208.9	1168.9

CHAPTER VI. SUMMARY AND CONCLUSIONS

We have attempted to build a Keynesian income determination model for a less developed country, namely Panama. This raises theoretical and empirical problems that must be faced before the attempt can be considered successful.

Theoretically, we face the issue of how well does the body of economic theory on stabilization, within the framework of an income determination model, apply to the less developed economies.

Empirically, the limitations lie in the nature of the available data. The Panamanian statistics have large gaps in the most crucial areas of prices, wages and salaries and other income components, and unemployment. Furthermore, the time series are short; they refer to a period of structural change in which there was steady growth so that the estimation procedure is made more difficult.

The model has as much detail as the data permitted, and was considered useful. The intention was to build a forecasting model, so that in order to forecast all variables that could be of interest, one would need a medium size model. In fact, due to the data limitations already mentioned, some crucial areas such as prices, wages, and their interactions, are omitted at the present time. Thus, we declare in favor of larger models, just because, in order to have the detail required by users of forecasts, the models become fairly large. For example, in his survey of model building in the MDC's, Waelbroeck (1975) finds that size is both a necessity and a problem.

The model was specified and estimated as an annual model. In Panama there is no choice, for the quarterly data base is very poor. The alternative of building a quarterly data base is not feasible to us due to limited resources.

The question now is what has been accomplished. As it stands, the model may be used to make ex ante forecasts of GDP and its components. It also may be used to make policy simulations about the effect of government fiscal policy. In fact, it is anticipated that most possible users of forecasts would be interested mainly in the levels of GDP and government revenues.

Clearly, this version of the model is only a first step in the task of building a reliable forecasting model of the Panamanian economy. This task can be completed only by further research, and time.

As discussed in Chapters IV and V, all sectors of the model could be improved. In the first place, the data base could be expanded and improved in many areas. Secondly, there remains much work to do in testing different formulations of the equations. A related aspect of this second part is the testing of different estimation methods other than OLS. A third part is testing the model itself. The model must be used in a variety of circumstances and its results checked against the results of the real economy.

The weakest part in the model now is the investment section. The investment equations require immediate attention if the model is to be used at all. The other areas of priority are prices and wages, salaries and employment. In the area of prices it may be possible to work with the implicit deflators; however, in the case of wages, salaries and employment the problem lies in the lack of data; the only alternative left in this case, short of an improvement in the National Accounts, is to see if the existing data could be pieced together into some useful series.

At this point we may ask again what has been accomplished. Hopefully, this model will provide some stimulus for further modelling of the Panamanian economy.

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ACKNOWLEDGEMENTS

The student is indebted to many people who hindered or helped him to complete his work. He acknowledges them all: his teachers, in the flesh or in the printed page; his fellow students; his co-workers; the many other people who had authority over him at some crucial moment; his wife and children; to them all, he acknowledges his great debt, for without their contribution nothing would have been done.

APPENDIX

Table A.1. Endogenous variables: consumption sector.

Year	CPR	CPC	CFOODR	CDRINKR	CTBCOR	CCTHINGR	CHSINGR
1950	179.5	196.1	99.0	17.5	3.6	19.3	26.2
1951	180.0	212.0	103.7	17.6	3.5	17.2	26.8
1952	199.4	221.0	99.6	19.7	4.2	23.2	27.6
1953	197.6	219.1	104.9	20.0	4.1	23.4	28.6
1954	224.5	242.0	114.6	18.9	5.0	27.5	29.8
1955	238.8	246.4	119.8	19.4	5.4	25.7	30.5
1956	250.3	260.6	116.3	21.0	5.3	25.3	32.4
1957	294.2	305.1	128.9	24.6	6.4	28.4	35.0
1958	292.5	295.8	125.1	19.9	6.4	27.6	35.1
1959	299.4	306.7	131.9	21.6	6.6	24.3	36.1
1960	322.9	322.9	128.7	24.5	7.7	28.9	38.9
1961	346.5	343.3	147.2	25.9	8.5	28.7	41.1
1962	363.9	360.8	150.9	28.8	9.0	32.3	42.2
1963	404.8	407.3	161.7	23.6	8.9	32.8	44.7
1964	432.1	448.1	169.2	24.4	8.9	33.3	45.7
1965	470.5	484.9	181.0	28.0	9.0	37.4	48.5
1966	476.2	492.9	188.7	30.5	9.3	39.0	51.6
1967	514.3	536.2	197.3	32.2	9.7	40.0	54.6
1968	526.7	551.8	211.3	34.1	10.3	48.4	58.2
1969	594.8	620.6	233.6	38.2	10.4	50.7	61.1
1970	621.8	654.7	239.6	41.0	10.9	50.0	66.0
1971	678.6	716.1	274.0	42.6	10.7	52.6	71.6
1972	685.8	767.7	278.9	38.9	11.0	52.4	80.3
1973	741.6	892.1	284.7	46.6	10.8	50.7	88.9
1974	778.1	1237.4	312.2	46.1	11.5	54.0	93.9

Table A.1. (continued)

Year	CELECTR	CFNTRER	CDSER	CHLTHR	CTRANSPR	CENTER	COTSER
1950	2.9	10.0	13.1	8.8	22.8	16.3	3.8
1951	3.1	8.6	13.1	9.4	20.9	16.1	3.9
1952	3.4	9.4	15.1	9.8	20.7	17.1	4.2
1953	3.6	9.1	14.2	9.6	21.7	17.3	4.5
1954	4.0	10.3	15.8	10.8	22.3	18.6	5.0
1955	4.2	12.1	15.6	13.4	24.7	18.9	5.4
1956	4.6	15.0	16.9	12.0	27.2	20.4	5.9
1957	5.1	16.5	19.1	13.1	29.8	22.6	6.4
1958	5.6	17.1	19.5	13.6	28.3	22.3	6.8
1959	6.0	17.3	19.3	15.2	29.5	23.8	7.7
1960	7.6	22.1	20.8	16.4	38.7	25.6	8.4
1961	7.7	22.7	20.9	18.1	39.6	28.9	8.8
1962	6.8	26.8	21.8	19.6	38.5	30.7	9.4
1963	6.8	27.8	22.5	20.0	37.9	32.7	10.6
1964	7.5	27.5	23.0	20.5	38.4	34.1	10.8
1965	8.4	36.2	25.3	23.3	45.5	36.6	11.9
1966	9.7	40.7	26.6	24.6	51.3	40.6	12.3
1967	11.2	43.8	28.6	24.3	54.2	47.0	13.4
1968	11.9	42.8	31.7	26.0	57.1	47.2	14.0
1969	14.5	48.0	32.2	27.9	62.8	53.2	16.2
1970	16.0	54.0	33.0	30.5	70.8	61.8	17.9
1971	19.8	55.3	34.1	33.0	79.3	68.4	19.0
1972	29.0	54.9	35.5	37.9	84.4	79.3	20.7
1973	29.0	56.8	36.8	40.4	89.6	83.0	22.8
1974	30.6	58.1	38.2	43.8	93.9	96.0	24.5

Table A.1. (continued)

Year	CPATR	CDISCR	CTSER	CR
1950	244.2	64.7	91.0	213.7
1951	243.9	63.9	90.2	217.4
1952	254.1	54.6	94.5	245.9
1953	262.0	64.4	96.9	237.6
1954	282.6	58.1	102.3	266.1
1955	295.2	56.3	108.5	276.8
1956	302.3	52.0	114.8	289.9
1957	335.9	41.7	126.0	331.1
1958	327.7	34.8	125.6	331.8
1959	339.3	39.9	131.6	339.3
1960	368.3	45.4	148.8	369.8
1961	398.1	51.6	157.4	396.3
1962	416.8	52.9	162.2	420.8
1963	430.0	25.2	168.4	465.9
1964	443.3	11.1	172.5	495.9
1965	491.7	21.2	191.1	537.5
1966	524.9	48.7	207.0	550.7
1967	556.3	41.9	222.1	596.6
1968	593.0	66.3	234.2	615.4
1969	648.8	54.0	253.4	682.6
1970	692.0	70.2	280.0	724.2
1971	760.4	81.8	305.4	792.2
1972	803.2	115.0	338.1	812.8
1973	840.1	98.5	361.5	873.6
1974	902.8	113.7	392.1	915.1

Table A.2. Exogenous variables: consumption sector

Year	DLIQUOR	PC	CGR	CGC	CZC*PMAR
1950	0.0	109.2	34.2	21.1	22.7
1951	0.0	117.8	37.4	21.9	20.5
1952	0.0	110.8	46.5	31.4	22.1
1953	0.0	110.9	40.0	25.6	22.2
1954	0.0	107.8	41.6	27.2	22.6
1955	0.0	103.2	38.0	35.4	23.7
1956	0.0	104.1	39.6	40.7	22.7
1957	0.0	103.7	37.1	38.9	21.6
1958	1.0	101.1	39.3	43.3	14.3
1959	1.0	102.4	39.6	45.2	13.8
1960	1.0	100.0	46.9	46.9	13.3
1961	1.0	99.1	49.8	49.8	16.1
1962	1.0	99.2	56.9	55.9	19.6
1963	2.0	100.6	61.1	67.1	21.0
1964	2.0	103.7	63.8	65.3	16.1
1965	2.0	103.1	67.0	72.4	20.8
1966	2.0	103.5	74.5	86.7	19.8
1967	2.0	104.3	82.3	102.6	29.5
1968	2.0	104.8	88.7	109.7	32.3
1969	2.0	104.3	87.8	118.2	34.3
1970	2.0	105.3	102.4	149.8	35.4
1971	2.0	105.5	113.6	164.0	36.6
1972	3.0	111.6	124.6	192.1	35.0
1973	2.0	120.3	132.0	213.6	-
1974	2.0	159.0	137.0	265.4	-

Table A.3. Endogenous variables: investment and capital formation sector.

Year	IPHR	IPOCR	IPKGR	IPEXR	DEPREPR	KSPR	KSPC
1950	8.7	5.1	9.9	4.9	17.1	6.6	6.2
1951	6.1	5.4	11.2	2.2	16.9	12.4	12.4
1952	5.2	3.0	13.1	2.4	16.1	15.8	17.7
1953	8.5	5.7	12.2	13.5	20.4	21.7	21.1
1954	8.9	5.6	14.8	3.6	23.4	27.6	24.9
1955	10.7	7.4	13.6	4.1	25.7	33.6	30.9
1956	11.4	7.5	18.7	3.8	27.2	43.9	40.7
1957	12.8	7.6	23.8	6.8	30.4	57.8	54.6
1958	10.8	9.4	25.3	10.7	29.8	73.3	70.6
1959	15.2	11.4	25.2	6.7	31.9	93.2	90.1
1960	13.3	14.6	21.5	7.0	31.5	111.1	111.1
1961	8.2	10.4	38.8	8.4	24.7	133.8	136.8
1962	12.0	11.3	36.7	12.6	40.8	153.0	156.0
1963	21.3	10.8	36.9	12.4	45.8	176.2	177.8
1964	14.2	12.4	34.0	13.8	47.5	189.3	195.0
1965	18.1	13.0	44.3	14.7	52.2	212.5	219.7
1966	24.4	25.9	65.3	15.5	55.3	272.5	286.1
1967	26.6	21.7	67.8	16.2	62.3	326.4	347.6
1968	31.8	23.9	74.6	18.7	70.8	385.9	414.4
1969	36.2	34.7	72.8	20.0	75.7	453.7	496.8
1970	41.5	31.2	90.2	20.5	79.0	537.7	620.0
1971	51.7	50.5	94.8	19.4	86.1	648.6	766.6
1972	71.3	44.6	114.9	21.7	90.7	788.7	982.0
1973	69.7	51.6	92.8	24.8	91.4	911.4	1280.5
1974	27.9	33.0	97.4	42.3	91.6	978.2	1722.8

Table A.3. (continued)

Year	DEPRER	ITKGR	ITCONSTR	IGFR	IGTR	IPFR	IPTR
1950	17.1	13.7	22.4	3.8	12.5	23.7	28.6
1951	16.9	11.8	18.6	7.7	7.8	22.7	24.9
1952	16.1	13.4	17.9	10.0	10.1	21.3	23.7
1953	20.4	14.6	21.2	9.4	9.5	26.4	39.9
1954	23.4	16.9	20.1	7.7	7.8	29.3	32.9
1955	25.7	16.4	26.2	10.9	11.0	31.7	35.8
1956	27.2	23.0	30.0	15.4	15.8	37.6	41.4
1957	30.4	24.4	27.2	7.4	7.4	44.2	51.0
1958	29.8	26.3	28.3	9.1	9.7	45.5	56.2
1959	32.0	27.7	39.8	15.7	15.9	51.8	58.5
1960	32.0	22.5	28.9	12.0	11.4	49.4	56.4
1961	35.6	40.8	37.3	20.7	20.3	57.4	65.8
1962	42.2	39.2	44.3	23.5	24.4	60.0	72.6
1963	47.6	38.0	57.8	26.8	27.6	69.0	81.4
1964	49.0	35.6	49.4	24.4	25.0	60.6	74.4
1965	53.2	45.8	51.3	21.7	22.7	75.4	90.1
1966	57.2	68.1	67.0	19.3	18.9	115.8	131.3
1967	64.3	70.8	71.9	26.6	26.2	116.1	132.3
1968	73.2	77.7	83.4	30.8	30.5	130.3	149.0
1969	78.7	85.2	98.3	39.8	41.8	143.7	163.7
1970	82.4	109.4	112.5	59.0	58.8	162.9	183.4
1971	89.8	102.1	152.6	57.7	59.6	197.0	216.4
1972	96.6	139.5	169.3	78.0	80.8	230.8	252.5
1973	98.1	120.5	171.6	78.0	76.9	214.1	238.9
1974	97.9	110.2	126.3	78.2	81.1	158.3	200.6

Table A.3. (continued)

Year	ITFR	ITR	DEPREC
1951	-	41.1	16.2
1952	30.4	32.7	16.9
1952	31.3	33.8	18.1
1953	35.8	49.4	19.8
1954	37.0	40.7	21.2
1955	42.6	46.8	23.7
1956	53.0	57.2	25.2
1957	51.6	58.4	28.8
1958	54.6	65.9	28.7
1959	67.5	74.4	30.9
1960	61.4	67.8	32.0
1961	78.1	86.1	36.4
1962	83.5	97.0	43.0
1963	95.8	109.0	48.0
1964	85.0	99.4	50.5
1965	97.1	112.8	55.0
1966	135.1	150.2	60.1
1967	142.7	158.5	68.5
1968	161.1	179.5	78.7
1969	183.6	205.5	86.2
1970	221.9	242.2	95.1
1971	254.7	276.0	106.2
1972	308.8	333.3	120.3
1973	292.1	315.8	137.8
1974	236.5	281.7	172.5

Table A.4. Exogenous variables: investment and capital formation sector.

Year	BKCOM+R	CRE&IR	DUM66I	DPRESTR	DPOBU	PIHP	DUM1953
1950	-	-	0.0	-	-	-	0.0
1951	-	-	0.0	-	.012	-	0.0
1952	-	-	0.0	-	.013	-	0.0
1953	-	-	0.0	-	.013	-	0.0
1954	-	-	0.0	-	.014	-	0.0
1955	-	-	0.0	-	.015	-	0.0
1956	-	-	0.0	-	.015	100.0	0.0
1957	-	-	0.0	-	.016	134.4	0.0
1958	20.67	0.0	0.0	0.0	.170	97.2	1.0
1959	31.57	35.85	0.0	2.52	.170	95.4	0.0
1960	33.60	39.30	0.0	2.50	.039	100.0	0.0
1961	35.09	42.74	0.0	3.48	.019	104.9	0.0
1962	36.96	45.26	0.0	1.68	.019	104.2	0.0
1963	50.62	66.30	0.0	8.13	.020	100.5	0.0
1964	58.83	74.83	0.0	2.35	.021	105.6	0.0
1965	79.79	88.59	0.0	7.67	.022	101.7	0.0
1966	95.50	103.08	1.0	1.57	.023	106.6	0.0
1967	113.35	123.62	1.0	-0.27	.024	109.0	0.0
1968	133.04	143.25	1.0	0.895	.025	109.1	0.0
1969	152.59	166.30	1.0	5.75	.026	108.0	0.0
1970	219.22	233.50	1.0	0.257	.026	113.7	0.0
1971	276.06	279.93	1.0	13.45	.027	116.8	0.0
1972	342.61	362.36	1.0	34.25	.028	120.1	0.0
1973	426.68	425.40	1.0	27.78	.029	140.9	0.0
1974	408.20	423.70	1.0	30.45	.300	185.17	0.0

Table A.4. (continued)

Year	TTREND	PIPF	DEPREFR	IGKGR	IGOGR	IGHR	IGEXR
1950	1.0	94.5	-	3.8	0.0	0.0	0.1
1951	2.0	100.0	-	0.6	0.0	0.0	0.1
1952	3.0	112.2	-	0.3	0.0	0.0	0.1
1953	4.0	97.0	-	2.4	0.0	0.0	0.1
1954	5.0	90.4	-	2.1	0.0	0.0	0.1
1955	6.0	92.1	-	2.8	0.0	0.0	0.4
1956	7.0	92.6	-	4.3	11.1	0.0	0.0
1957	8.0	94.8	-	0.6	6.8	0.0	0.0
1958	9.0	96.3	0.0	1.0	8.0	0.1	0.6
1959	10.0	96.7	0.0	2.5	11.8	1.4	0.2
1960	11.0	100.0	0.50	1.0	9.4	1.6	-0.6
1961	12.0	102.3	0.88	2.0	14.6	4.1	-0.4
1962	13.0	102.0	1.37	2.5	15.6	5.4	0.9
1963	14.0	100.9	1.78	1.1	19.5	6.2	0.8
1964	15.0	103.0	1.55	1.6	15.8	7.0	0.6
1965	16.0	103.4	0.967	1.5	18.1	2.1	1.0
1966	17.0	105.0	1.90	2.6	14.2	2.5	-0.4
1967	18.0	106.5	1.97	3.0	21.1	2.5	-0.4
1968	19.0	107.4	2.42	3.1	25.5	2.2	-0.3
1969	20.0	109.5	2.83	12.4	25.0	2.4	2.0
1970	21.0	115.3	3.47	19.2	34.9	4.9	-0.2
1971	22.0	118.2	3.72	7.3	42.6	7.8	1.9
1972	23.0	124.5	5.94	24.6	51.1	2.3	2.8
1973	24.0	140.5	6.69	27.7	46.7	3.6	-1.1
1974	25.0	176.1	6.36	12.8	63.9	1.5	2.9

Table A.5. Endogenous variables: import and export sector.

Year	MFOODR	MFUELSR	MRWMATR	MCHMSR	MMCHNR	MMANUFR	MGDSR
1950	-	-	-	-	-	-	80.4
1951	13.2	5.1	18.4	7.1	10.0	9.3	66.7
1952	14.7	6.6	21.6	8.6	11.5	11.9	78.9
1953	12.6	6.4	20.2	7.5	11.6	11.4	74.6
1954	14.5	7.0	22.2	8.0	13.1	12.1	80.3
1955	12.6	8.3	22.5	8.9	14.3	13.0	83.5
1956	11.8	7.3	24.1	9.1	17.9	12.3	86.2
1957	15.3	8.7	26.4	10.5	19.8	13.9	98.9
1958	13.9	10.1	26.6	10.1	19.5	14.2	97.2
1959	12.3	9.8	24.7	10.3	19.8	13.9	98.9
1960	13.3	10.8	30.9	11.4	24.1	15.0	109.2
1961	15.5	11.3	36.4	13.6	31.1	16.2	127.8
1962	15.0	27.8	37.5	14.2	32.7	17.8	149.7
1963	16.6	39.4	44.0	15.9	32.7	19.6	170.3
1964	18.5	35.8	42.5	17.0	32.4	19.3	167.2
1965	17.5	41.3	51.5	18.5	40.8	22.4	194.1
1966	18.5	47.3	53.6	19.3	49.4	23.1	213.5
1967	18.7	47.2	59.0	21.1	53.9	26.1	228.8
1968	19.6	52.2	57.0	23.6	57.6	27.0	239.9
1969	20.6	59.6	65.7	26.4	67.0	31.8	274.8
1970	23.2	58.6	75.5	27.5	84.8	34.8	304.6
1971	31.6	61.2	83.7	29.5	83.6	38.7	332.7
1972	28.9	58.3	81.8	34.4	96.5	39.5	240.7
1973	32.8	56.7	84.9	32.8	93.8	35.0	339.0
1974	33.0	53.8	97.1	37.5	81.1	32.6	338.1

Table A.5. (continued)

Year	MCIFR	MGCIFR	MSERVR	MGSR	MGDSC	XTR
1950	8.2	-	9.9	105.4	67.0	109.8
1951	7.7	74.4	10.9	96.0	66.1	103.8
1952	8.8	87.7	12.3	111.7	73.4	102.7
1953	8.2	82.8	12.8	109.7	71.2	109.2
1954	7.1	87.4	12.7	114.4	72.4	105.1
1955	7.3	90.8	15.3	122.6	75.0	113.7
1956	8.6	94.8	15.4	129.5	83.1	113.5
1957	9.7	108.6	18.3	140.0	99.0	116.0
1958	9.3	106.5	18.7	139.1	93.7	110.0
1959	8.8	102.0	22.6	137.6	98.2	116.1
1960	13.4	122.6	21.2	149.1	109.2	127.3
1961	14.7	142.5	20.9	167.8	124.2	146.3
1962	17.7	167.4	22.0	194.8	145.2	175.9
1963	17.8	188.1	34.1	228.9	162.8	195.5
1964	16.9	184.1	32.7	225.8	165.4	196.0
1965	19.8	213.9	33.0	256.4	189.6	223.4
1966	20.9	234.4	30.8	281.9	214.5	245.1
1967	21.9	250.7	42.9	303.6	229.3	269.4
1968	23.5	263.4	39.6	313.4	243.5	289.7
1969	27.0	301.8	45.3	361.3	278.7	309.5
1970	30.3	334.9	51.8	396.4	322.6	324.5
1971	35.0	367.7	55.3	435.8	359.0	340.2
1972	35.4	376.6	60.7	452.5	401.1	345.3
1973	35.9	374.9	59.6	449.9	454.0	361.7
1974	31.3	369.4	64.2	446.9	755.7	380.2

Table A.6. Exogenous variables: import and export sector.

Year	XOILR	PMOIL	MBEV+TBR	MOTHSR	DISMGR	BKCPR	MGCZR
1950	-	2.63	-	-	-	-	6.9
1951	-	2.63	2.92	0.71	-	-	10.7
1952	-	2.63	3.33	0.64	-	-	11.7
1953	-	2.76	3.25	1.57	-	-	13.4
1954	-	2.88	3.10	0.33	-	-	14.3
1955	-	2.87	3.34	0.44	-	-	16.5
1956	-	2.80	3.32	0.31	-	-	19.3
1957	-	3.04	4.10	0.33	-	-	13.1
1958	-	3.05	2.28	0.62	0.0	2.08	13.9
1959	-	2.84	1.99	1.43	0.0	3.61	13.0
1960	-	2.80	2.80	0.90	0.0	4.70	5.3
1961	-	2.80	2.88	0.51	0.18	3.53	4.4
1962	14.2	2.80	3.90	0.10	0.68	4.24	5.4
1963	29.5	2.80	1.57	0.10	0.36	11.23	6.7
1964	27.8	2.80	1.41	0.10	0.13	11.38	9.0
1965	28.9	2.80	1.84	0.10	0.13	22.80	9.5
1966	32.6	2.80	1.89	0.20	0.28	25.80	16.7
1967	32.0	2.80	2.19	0.20	0.28	29.64	10.0
1968	32.2	2.80	2.36	0.30	0.33	23.00	10.4
1969	35.6	2.80	2.85	0.30	0.49	34.60	14.2
1970	36.8	2.80	2.92	0.57	-3.32	41.41	9.7
1971	45.6	2.80	3.24	0.37	0.69	56.86	12.9
1972	46.2	3.21	2.48	0.17	-1.42	64.99	15.1
1973	28.3	4.40	2.70	0.16	0.0	89.48	15.4
1974	33.5	4.40	2.70	0.12	0.0	87.52	13.3

Table A.6. (continued)

Year	PMGDS	XBANANR	XOGDSR	XSERVSR	XCFZR
1950	83.3	12.5	28.6	46.4	-
1951	99.1	12.8	25.8	46.0	-
1952	93.0	10.3	26.9	44.7	-
1953	95.4	12.9	25.1	46.6	1.1
1954	90.2	16.9	20.3	44.8	1.2
1955	89.9	19.9	23.6	44.7	1.7
1956	96.4	17.5	22.7	45.7	2.5
1957	100.1	19.8	23.2	45.5	2.9
1958	96.4	18.2	22.8	40.8	3.1
1959	105.4	19.5	22.6	42.8	4.6
1960	100.0	18.2	21.7	52.4	4.6
1961	97.4	20.8	21.7	63.5	6.8
1962	97.3	19.0	39.2	71.0	7.1
1963	95.8	21.0	54.6	69.8	7.4
1964	99.0	21.5	56.4	63.0	7.8
1965	97.8	30.0	58.8	73.9	9.3
1966	100.6	33.3	63.6	81.4	10.8
1967	100.3	35.4	67.8	93.0	12.5
1968	101.6	40.8	69.1	101.5	12.7
1969	101.6	44.4	75.5	102.0	16.3
1970	106.0	42.6	80.2	111.3	20.1
1971	108.1	31.2	90.6	119.7	25.4
1972	117.9	32.1	94.3	121.1	26.5
1973	133.9	31.4	92.1	132.7	30.7
1974	223.5	25.1	113.8	137.5	34.9

Table A.7. Endogenous variables: supply sector.

Year	QAGRR	QCONMR	QIND1R	QIND2R	QINDR	QELECR	QSER*R
1950	74.5	11.2	20.3	3.2	23.5	3.2	124.5
1951	70.8	11.5	21.3	4.2	25.5	3.4	127.5
1952	68.6	12.4	24.5	5.7	30.2	3.7	134.6
1953	78.0	13.3	24.7	6.0	30.7	4.0	137.7
1954	79.2	14.8	25.8	4.8	30.6	4.2	147.1
1955	86.0	14.4	27.7	5.5	33.2	4.5	152.8
1956	82.5	16.9	30.7	5.8	36.5	4.7	165.4
1957	91.4	21.1	36.0	8.1	44.1	5.2	179.3
1958	92.5	19.0	37.6	7.5	45.1	5.7	181.2
1959	98.7	19.0	40.3	9.1	49.4	6.5	192.0
1960	95.7	24.0	43.7	10.8	54.5	8.4	202.8
1961	105.4	29.5	49.3	13.7	63.0	9.2	220.3
1962	107.7	29.7	58.6	16.7	75.3	10.0	236.6
1963	113.4	33.5	65.9	19.7	85.6	11.1	255.2
1964	118.5	31.7	69.8	20.7	90.5	12.2	265.3
1965	132.2	36.6	75.8	22.3	98.1	14.5	284.5
1966	139.2	40.0	82.5	24.5	107.0	15.0	306.6
1967	145.6	45.5	91.9	28.2	120.1	16.3	332.7
1968	154.0	48.4	102.3	29.4	131.7	18.9	352.6
1969	162.7	49.9	114.8	31.3	146.1	23.5	382.8
1970	161.1	56.3	117.1	36.5	153.6	26.0	427.2
1971	167.1	66.7	125.7	41.0	166.7	30.4	468.4
1972	172.0	74.5	133.8	43.3	177.1	34.2	504.7
1973	177.9	80.0	134.0	50.6	184.6	38.5	545.4
1974	175.2	82.9	126.8	49.6	176.4	40.3	581.4

Table A.7. (continued)

Year	QINDC	GDPR	GDPC	GDPFCR	DGDPFCR
1950	23.3	259.2	256.8	239.4	-
1951	25.1	256.9	263.7	236.8	-2.6
1952	30.3	270.7	276.0	248.6	11.8
1953	30.6	287.2	292.5	264.4	14.8
1954	30.2	297.5	307.2	273.6	9.2
1955	32.0	314.7	331.5	290.6	17.0
1956	36.1	331.1	347.4	305.4	14.8
1957	42.8	365.7	382.7	336.9	31.5
1958	44.6	368.6	381.6	342.0	5.1
1959	47.8	392.2	403.7	363.5	21.5
1960	54.5	415.8	415.8	381.2	17.7
1961	61.5	460.9	463.7	422.3	41.1
1962	74.2	498.9	504.8	457.7	35.4
1963	86.4	541.5	559.5	500.9	43.2
1964	94.6	565.5	600.8	522.4	21.5
1965	101.3	617.3	659.9	568.3	45.9
1966	109.3	664.1	719.0	610.5	42.2
1967	123.7	720.9	800.7	661.5	51.0
1968	137.2	771.2	861.4	709.6	48.1
1969	152.5	836.3	945.4	764.9	55.3
1970	166.4	894.5	1045.8	811.0	46.1
1971	185.6	972.6	1157.0	876.8	65.8
1972	207.7	1033.8	1297.8	923.0	46.2
1973	224.5	1101.2	1472.5	979.5	56.5
1974	266.4	1130.1	1834.7	987.1	7.6

Table A.8. Exogenous variables: supply sector.

Year	PGDP	QCZR	SUBVENR	TTE	QCZC
1950	99.1	22.3	0.0	-0.1	22.8
1951	102.6	18.2	0.0	-8.6	18.6
1952	102.0	20.8	0.0	-0.6	21.5
1953	101.8	23.5	0.0	0.6	23.8
1954	103.3	21.9	0.0	11.3	22.1
1955	105.3	23.8	0.0	14.8	24.2
1956	104.9	25.1	0.0	7.4	25.4
1957	104.6	24.6	0.0	5.9	25.3
1958	103.5	25.1	0.0	5.8	25.2
1959	102.9	26.0	0.0	1.1	26.5
1960	100.0	30.4	0.2	0.0	30.4
1961	100.6	33.5	0.1	3.3	33.6
1962	101.2	39.6	0.4	7.9	39.8
1963	103.3	42.7	0.1	7.8	43.0
1964	106.2	47.3	0.1	15.0	48.6
1965	106.9	51.4	0.1	19.7	53.1
1966	108.3	56.0	0.2	19.3	58.1
1967	111.1	60.7	0.1	27.9	63.8
1968	111.7	65.6	0.2	31.4	70.0
1969	113.0	71.3	0.0	41.8	77.5
1970	116.9	70.3	0.1	39.7	79.3
1971	119.0	73.3	0.2	54.3	84.0
1972	125.5	71.3	0.2	52.1	86.8
1973	133.7	74.8	0.4	37.9	97.0
1974	162.3	68.9	0.8	-13.0	104.4

Table A.9. Endogenous variables: government sector.

Year	TGEREVC	TDCORPC	TDPERC	TINDMC	TPRODC	TPROPC	TOINDC
1950	7.5	2.0	1.4	12.8	3.7	1.6	1.7
1951	6.6	2.4	2.2	12.8	3.8	1.5	1.9
1952	7.9	2.4	2.5	14.3	4.1	1.7	3.5
1953	9.4	4.4	3.0	14.8	3.8	1.8	2.4
1954	6.4	5.1	3.3	15.4	3.7	1.9	2.9
1955	6.0	6.5	4.3	15.5	3.8	1.9	3.0
1956	8.5	6.2	4.0	17.2	3.9	1.9	2.7
1957	8.9	4.4	3.0	20.0	4.0	2.4	2.6
1958	9.3	7.4	4.8	17.1	4.4	2.1	3.2
1959	10.0	5.1	3.2	18.0	5.2	2.2	3.5
1960	10.0	7.7	3.1	20.4	6.0	2.7	5.7
1961	11.9	7.2	3.4	22.1	6.3	3.3	7.0
1962	13.5	10.7	4.3	23.2	7.0	3.5	7.9
1963	15.6	10.9	4.6	20.5	9.1	3.7	7.4
1964	16.9	12.4	6.2	19.8	11.7	3.9	7.8
1965	17.0	14.6	7.6	22.5	13.5	4.3	8.8
1966	18.7	20.0	9.6	24.5	14.4	4.4	10.5
1967	19.9	24.8	9.4	27.4	15.4	4.8	11.9
1968	20.0	27.5	9.5	27.3	16.4	5.2	12.9
1969	23.1	28.9	12.1	30.5	19.9	6.4	14.6
1970	25.0	36.4	18.0	36.9	22.8	7.0	17.0
1971	27.9	39.3	20.6	40.8	25.1	8.6	21.4
1972	37.7	39.4	20.6	42.0	34.2	9.0	25.8
1973	46.6	40.8	30.6	44.2	35.3	9.9	32.7
1974	45.8	53.7	35.2	50.8	39.0	10.8	43.2

Table A.9. (continued)

Year	TCSSC	TGRC	TINDTC
1950	3.9	35.3	19.8
1951	3.3	35.4	20.0
1952	3.7	41.5	23.6
1953	3.0	44.5	22.8
1954	4.8	46.1	23.9
1955	5.2	48.7	24.2
1956	5.9	53.5	25.7
1957	6.3	56.2	29.0
1958	6.8	59.8	26.8
1959	7.5	58.0	28.9
1960	8.4	68.3	34.8
1961	9.4	76.9	38.7
1962	11.6	83.9	41.6
1963	15.4	95.2	40.7
1964	18.7	102.6	43.2
1965	20.6	116.8	49.1
1966	24.1	132.0	53.8
1967	27.6	148.6	59.5
1968	30.8	155.1	61.8
1969	33.9	173.6	71.4
1970	41.5	209.0	83.6
1971	48.9	232.1	95.9
1972	55.2	261.5	111.0
1973	64.6	298.3	122.1
1974	78.3	334.0	143.8

Table A.10. Exogenous variables: government sector.

Year	DUMFYL	TRCORP	TRPER	TAXFREEM	TRM	TRPROD	TRINDO
1950	0.0	-	0.7	-	-	-	-
1951	0.0	-	1.1	-	-	-	-
1952	0.0	-	1.2	-	-	-	-
1953	0.0	-	1.4	-	-	-	-
1954	0.0	-	1.4	-	-	-	-
1955	0.0	-	1.8	-	-	-	-
1956	0.0	-	1.5	-	-	-	-
1957	0.0	-	1.0	-	-	-	-
1958	0.0	3.0	1.7	17.3	22.4	9.9	1.1
1959	0.0	2.0	1.1	19.6	22.9	10.9	1.1
1960	0.0	3.0	1.1	23.1	23.7	11.0	1.8
1961	0.0	2.4	1.0	29.9	23.4	10.2	2.0
1962	0.0	3.4	1.2	31.6	20.4	9.4	2.2
1963	0.0	3.1	1.2	31.5	15.6	10.5	1.8
1964	0.0	3.2	1.5	29.7	14.6	12.4	1.7
1965	0.0	3.5	1.7	35.0	14.6	13.3	1.8
1966	0.0	4.5	1.9	41.3	14.1	13.2	2.1
1967	0.0	5.1	1.7	50.6	15.3	12.4	2.2
1968	0.0	5.3	1.6	58.3	14.7	12.0	2.3
1969	0.0	5.1	1.8	66.8	14.4	13.0	2.4
1970	0.0	6.0	2.5	86.2	15.6	13.7	2.6
1971	0.0	5.8	2.7	90.5	15.2	13.5	3.0
1972	1.0	5.2	2.4	123.2	15.2	16.5	3.4
1973	1.0	4.7	3.0	134.1	13.8	15.7	3.7
1974	1.0	5.0	2.7	204.9	9.2	14.6	3.5

Table A.10. (continued)

Year	TRCSS	COBERCSS	TR*HTGC	TR*WTGC	GIPDTC
1950	-	-	0.3	1.0	0.6
1951	-	-	0.4	1.3	0.8
1952	-	-	0.5	1.7	0.8
1953	-	-	0.4	2.4	0.9
1954	-	-	0.4	3.1	0.9
1955	-	-	0.3	3.2	1.0
1956	2.3	22.4	0.4	3.9	1.1
1957	2.2	21.9	0.8	5.3	1.5
1958	2.4	23.1	0.8	6.0	2.1
1959	2.5	24.5	0.7	5.0	1.7
1960	2.9	24.8	0.8	5.0	1.5
1961	2.9	25.2	1.0	7.3	2.0
1962	3.3	26.3	1.1	4.0	2.9
1963	4.0	27.1	1.2	10.2	3.4
1964	4.4	28.0	1.3	8.1	4.2
1965	4.5	29.1	1.6	10.5	4.2
1966	4.8	29.6	1.6	8.9	4.7
1967	5.0	32.2	2.2	10.2	5.0
1968	5.1	32.8	2.7	7.9	5.1
1969	5.1	33.9	3.0	7.6	6.4
1970	5.8	39.2	3.3	8.8	7.6
1971	6.3	43.1	3.7	9.5	13.7
1972	6.4	46.0	5.2	10.0	18.5
1973	6.4	47.5	7.2	11.2	24.8
1974	6.1	48.3	5.0	11.9	39.7

Table A.11. Endogenous variables: income sector.

Year	YNALC	YNALR	YPERC	YDPC	YDPR
1950	210.6	192.9	193.4	203.7	186.5
1951	215.2	208.7	202.4	210.3	178.5
1952	225.0	219.9	214.9	221.8	200.2
1953	238.7	233.6	214.6	223.0	201.1
1954	245.5	236.4	238.5	245.2	227.4
1955	266.4	250.8	244.9	244.7	237.1
1956	279.3	264.1	258.3	257.3	247.2
1957	306.6	291.1	292.1	290.1	279.7
1958	314.7	302.9	283.4	280.4	277.3
1959	331.7	321.2	296.4	297.1	290.1
1960	336.5	336.8	289.9	290.6	290.6
1961	378.1	375.5	326.7	315.3	318.2
1962	411.4	406.0	352.9	337.6	340.5
1963	462.3	445.8	388.7	368.2	365.9
1964	501.8	469.5	425.2	403.5	389.1
1965	539.1	501.0	454.8	432.7	419.8
1966	589.0	538.7	499.7	473.5	457.5
1967	650.1	577.1	551.2	524.3	502.9
1968	695.7	613.8	600.8	573.7	547.6
1969	763.3	664.1	670.6	643.8	617.0
1970	840.8	703.2	713.8	685.2	650.8
1971	923.7	756.2	777.2	738.5	699.8
1972	1034.9	795.4	861.3	817.7	732.6
1973	1170.7	838.7	1032.6	952.7	790.0
1974	1464.2	833.4	1315.3	1208.9	760.3

Table A.12. Exogenous variables: income sector.

Year	NFP	RECORPC	TR*GTHC	TR*WTHC	TR*HTWC
1950	10.6	8.3	11.5	5.1	0.7
1951	11.6	4.6	9.3	5.3	0.8
1952	10.9	0.6	8.7	5.8	0.9
1953	11.3	10.3	9.7	6.0	0.9
1954	16.7	-4.6	10.2	6.2	12.
1955	17.3	8.5	5.5	6.6	2.5
1956	17.3	5.9	5.5	6.7	2.9
1957	18.3	1.6	4.1	7.3	3.3
1958	11.4	15.7	5.1	7.5	3.2
1959	12.3	21.7	6.8	8.1	2.9
1960	12.4	29.2	7.0	8.4	3.0
1961	10.6	34.0	8.0	9.3	3.7
1962	9.2	36.4	9.1	11.2	3.8
1963	8.6	48.3	10.1	13.1	3.7
1964	5.4	50.0	11.7	10.6	3.4
1965	15.9	54.9	13.5	9.7	3.9
1966	16.3	53.6	15.2	10.8	4.7
1967	22.7	57.1	19.3	12.0	5.0
1968	25.3	51.0	22.0	12.0	5.9
1969	24.5	43.6	27.5	11.9	6.6
1970	26.4	68.1	37.9	11.5	7.8
1971	31.3	87.2	38.0	12.7	9.2
1972	33.7	101.5	41.0	14.3	10.2
1973	42.3	75.5	46.2	19.2	10.3
1974	55.0	89.1	49.3	26.5	12.3