The application of macroeconomic models to development planning: Peru

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Apostolos Condos

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Head of Major Department

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Dean of Graduate College

Iowa State University
Of Science and Technology
Ames, Iowa
1966
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CHAPTER I. INTRODUCTION

The purpose of this study is twofold. It is first to obtain quantitative knowledge of the Peruvian economy by means of econometric models. Second, it is intended to use these models to explore some major economic policy alternatives and the effective limits to Peruvian economic development.

The Peruvian economy presents many challenges to the economic analyst. Many characteristics of underdeveloped countries discussed in the theoretical literature are readily visible in Peru, together with a few additional factors which are particular to it.

Low per capita income, unequal income distribution, an apparent labor "surplus", small size of internal market and lack of an organized capital market are typical features of underdeveloped economies which can be observed also in Peru.

The extreme regional disparities add a particular set of problems of an ethnological, sociological and economic nature, proper to Peru.

The treatment of the above mentioned aspects in an operational framework (bringing out their interrelationships) is an exceedingly difficult task to be completed given the present state of available statistical data. No doubt, more will be known in the near future about these aspects, if the Peruvian planning authorities carry out their assigned
program. When this study began, the dearth of crucial information made it impossible to hope to establish quantitatively a model reflecting the characteristics of the Peruvian economy in an incisive and detailed manner.

The goal of obtaining empirical results with formal models at this stage is associated with the cost of too much simplicity and limited coverage of the constructs and consequently with the inability to answer from within the models questions which are really important to economic development.

Nevertheless, there is enough scope for the use of simpler macroeconomic models, such as presented in this study, to justify their undertaking. To begin with, macroeconomic models appear to be capable of giving answers to important questions in a relatively efficient manner. The movement of such economic aggregates as national income, total savings, total imports and the impact of economic policy instruments such as tax rates, government consumption, government investment, on economic variables included in the system, can be traced without unnecessary complications arising from more detailed models. Further, the economic planning process in any country can be divided in stages. Each stage may be thought of as consisting of a model standing in a hierarchy of mutually consistent models of increasing order or complexity or detail. Any concrete problem arising may be treated in the most efficient way, according to its nature, by any one or more models.
For example, a revision of forecasts of total exports may lead to the problem whether to adopt measures to bring imports to a level consistent with ex ante equilibrium in the balance of payments.

An aggregate macroeconomic model is, obviously, first needed to give an estimate of the order of magnitude of the balance of trade gap which will arise if no measures are adopted. Only after such knowledge is obtained can the specific questions associated with the particular policy measures be investigated in a more detailed analytical framework.

The basic empirical problems to which the present study addresses itself are the determination of global growth rate and its dependence on specific structural parameters, the adequacy or inadequacy of domestic resources under alternative conditions to finance economic growth expressed in global growth rate terms and the arising requirements for foreign capital assistance.

The study is divided into eight chapters. Chapter II offers an overview of the structure of the Peruvian economy on the basis of official statistics covering the period 1950-1954. The national income components are discussed in terms of their observed growth rates and importance in the overall economy. It is shown that the main limitations the available data impose on the analysis are related to the fact that they cover only the expenditure side of national income. The alternative set of national accounts available is of wider
coverage, but, unfortunately, during the time the present work was being done, an extensive revision of the material was being carried out to correct substantial deficiencies. No regional breakdown of the macroeconomic aggregates is available so that a quantitative investigation of the interaction of the two principal regions of Peru was precluded.

Chapter III offers a discussion of some major problems facing an underdeveloped country arising from the possible conflict of the aims of economic policy. The aims are classified into five groups associated with: level of income or aggregate economic growth, level of employment, price stability, income distribution (functional and regional) and balance of payments.

Questions of strategy connected with the above aims have not been answered uniformly by economic theory. The extent of the conflict between aims of policy cannot be ascertained by theoretical considerations alone. A foremost example of opposite views may be considered the case of choice of technology in a labor-abundant economy and its relation to economic growth. On the basis of traditional theory, labor-intensive technology and promotion of capital-saving sectors guarantees compatibility of the goals of economic growth and unemployment absorption. Against this conclusion, one has the development experience both in Asia and Latin America according to which the leading sectors in the development process failed to provide employment opportunities as a
rate comparable to their growth. The classical paper by Eckaus offering a set of taxonomic explanations has recently been supplemented by Baer and Hervé, who show that the observed tendency toward capital-intensive techniques in developing countries need not be attributed to conscious or wrong choices.

A particular explanation of the adoption of capital-intensive techniques in Peru is offered in terms of the familiarity of foreign managers and entrepreneurs with the prevalent technology in the advanced countries and mistrust of local labor.

Some attention is given to the possible complementarity between inflation (originating mainly with food shortages) and regional income redistribution favoring the poorer classes under the assumptions of extensive agrarian and marketing reforms. The latter are discussed in the context of a dual-economy theory of development as presented by Thorbecke.

Finally, the aim of balance-of-payment equilibrium is discussed in a taxonomic manner in terms of its compatibility or conflict with the other aims.

Chapter IV is a brief expository summary of the theory of quantitative economic policy developed mainly by Tinbergen and Theil. It is needed as a background to the method of use of the three models presented in the three subsequent chapters.
Ideally, the empirical models of the Chapters IV, V and VI should deal with the problems of Chapter II by means of the analytical tools outlined in Chapter III. But, as has already been said, no quantitative empirical analysis of these important questions can be made with the available data.

As for the tools of the theory of economic policy no social welfare function could be formulated reflecting the views of the policymakers. It has, however, been possible to specify some fixed targets and to examine their implications with respect to side variables and policy instruments.

Chapter V presents a Harrod-Domar type model where the fundamental equation of growth expresses the aggregate growth rate as a function of the marginal (and average) capital output ratio, the marginal (and average) propensity to save of the private sector, the public saving ratio, the direct and the indirect tax rates and the ratio of foreign capital inflow to income. The parameters were computed for averaging the historical ratios involved. The main question which the model intends to answer is whether the structure of the Peruvian economy as given by the estimated parameters supports the target global growth rate (0.07) set by the planning authorities without radical departures from the observed historical pattern. A detailed investigation of combinations of policy instrument values, mainly of domestic versus foreign savings, is undertaken which achieve the same target and tentative conclusions about feasibility of alternative policies are accepted.
Chapter VI attempts to give more specific quantitative estimates of the limits to Peruvian economic growth. A capacity equation is incorporated where marginal and average capital-output ratios are different.

Saving and marginal tax rates are unknowns to be solved in order to attain horizon-year targets. The foreign trade sector consists of an aggregate import function and an exogenously given export trend. The focus of the analysis is the idea, developed and applied (mainly by Chenery) to several countries that in an ex ante sense either the savings-investment gap or a disequilibrium in the balance-of-payments may provide ineffective limit to economic expansion. In this sense foreign capital has a dual role to perform, namely, either to supplement domestic savings if the invest-savings gap is larger than the balance-of-payments disequilibrium or to provide foreign exchange for purchase of imports in the opposite case. This type of "disequilibrium" analysis locates the broad classes of bottlenecks to economic development and may serve as a first-step guide to development policy.

Chapter VII develops an econometric model of the Peruvian economy estimated on the basis of data covering the period 1950-1962. In contrast to the model of the preceding chapter, the econometric model is oriented towards obtaining estimates of the various expenditure multipliers and tracing the "moving equilibrium" path of the major endogenous
variables and alternative fiscal and foreign trade policies. In Chapter VI it is intended to offer a formal quantitative description of the Peruvian economy "normalized" to the historical experience of the recent years. The projected picture of the Peruvian economy is contrasted to that of the previous model and the differences discussed and explained.

Finally, Chapter VIII is a brief summary of the conclusions.
CHAPTER II. OVERVIEW OF THE STRUCTURE OF THE PERUVIAN ECONOMY

Sources of quantitative information about the macroeconomic aspects of the Peruvian economy and discussion of the data used in this study

All data used in the present study are based on, or derived from official statistics of the Instituto Nacional de Planificación, henceforth abbreviated to INP.

The basic documents are:
1. Estadísticas Preliminares Básicas Para la Programación del Desarrollo Económico y Social, April 1965 (1).
3. Cuadros del Sector Público, 1-4-65 (3).

The Banco Central de Reserva publishes regularly national account statistics. Yet a major revision of the published material is going on during the time of completion of this study and consequently it has not been possible to make use of this source of information.

The limitations to the present work imposed by the nature of available statistical information are heavy. The INP provides essentially the expenditure side of national income accounts and detailed information regarding foreign trade variables.

Table 1 includes time series 1950-1964 for the variables entering the national product and national income identities.
Table 1. Basic macroeconomic data in millions of soles 1960 (INF)

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<tr>
<th>Year</th>
<th>(1) Gross Domestic Product X</th>
<th>(2) Gross Domestic Income Y</th>
<th>(3) Private Consumption CP</th>
<th>(4) Public Consumption CG</th>
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<th>(3) Indirect Taxes Ti</th>
<th>(4) Disposable Gross Income Y-Td</th>
<th>(5) $G^P - M^C$</th>
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expressed in constant market prices (base 1960). According to the INP scheme:

Gross national income = gross national product + terms-of-trade effect and gross national product = private consumption + public consumption + private gross investment + public gross investment + exports-imports.

In terms of the column number of Table 1, \( (2) = (1) + (8) \) and \( (1) = (3) + (4) + (5) + (6) + (7) - (9) \). Columns 9a, 9b and 9c disaggregate total imports into consumer goods, capital goods and all other imports (i.e. raw materials, combustibles and services).

While the other macroeconomic variables mentioned are standard, the public sector aggregates are briefly examined below.

The terms-of-trade effect is defined with respect to some base year as follows: Let \( P_{E_o}, P_{M_o} \) denote the export and import prices of the base year, respectively. For any year \( t \) the terms-of-trade effect is then measured by

\[
Z_t = \left( \frac{P_{E_t}}{P_{E_o}} \right) \left( \frac{P_{M_t}}{P_{M_o}} - 1 \right) P_{E_o} EQ_t
\]

where \( P_{E_t} \) and \( P_{M_t} \) are the export and import prices prevailing in the year \( t \) and \( EQ_t \) the quantity (volume) of exports of that year. For example, if the year 1960 is selected as the base year, \( Z_{1960} = 0 \) by definition. The terms-of-trade effect in
the year 1961 is obtained from the information that\
$P_{Eo}^{Q} 1961 = 15898$,

\[
\frac{P_{E1961}}{P_{E1960}} \times \frac{P_{M1961}}{P_{M1960}} = \frac{73.5}{75.5} \approx 97.74 \% ,
\]

\[
z_{1961} = 15898 (0.9774 - 1) = -350 .
\]

Table 2 contains public sector data partly derived by assumption (which will be explained) and one series of relative prices of imported to domestically produced consumer goods constructed by the author.

The public sector, according to the INP accounts, comprises central government and all other local governments and public organisms. The relevant variables included in Tables 1 and 2 do not make up a complete accounting scheme. On the expenditure side public consumption and public gross investment exhaust the public sector's contribution to INP, while taxes are the largest but not the exclusive source of public revenues. A fuller treatment can be sketched in the following manner employing the terminology of the sources.

One distinguishes public revenues and expenditures. Revenues are classified into two major categories:

1) Current revenues
2) Capital revenues.
Current revenues are classified into:
   1a) Tax proceeds
   1b) Non-tax proceeds.

Capital revenues are distinguished into:
   2a) Proceeds from domestic debt
   2b) Proceeds from foreign debt.

A third but minor source of capital revenues is donations and gifts. So that,

Total Revenues = Current Revenues + Capital Revenues
Tax Revenues + Non-tax Revenues + Domestic Debt
Foreign Debt.

Tax revenues are classified by source into:
   a) Direct taxes
   b) Export taxes
   c) Indirect taxes.

Category (c) includes import taxes, stamps, consumption taxes, property transfer taxes and other similar proceeds. Export taxes can be taken together with direct taxes because of the manner of assessment and collection. This procedure will be adopted in this study.

Non-tax proceeds consist mainly of public enterprise revenues. Expenditures are similarly divided into:
   1) Current expenditures
   2) Capital expenditures.

Two major classes make up current expenditures:
1a) Operating current expenditures (gastos corrientes de funcionamiento).

1b) Current expenditures for development.

Class (1a) includes wages and salaries of public sector employees, interest payments on domestic and foreign debt and other transfer payments. Class (1b) consists of health, education and welfare expenditures and factor outlays of public enterprises.

Capital expenditures are distinguished into:

2a) Gross public capital formation

2b) Amortization of domestic debt

2c) Amortization of foreign debt.

So that,


The balancing item between revenues and expenditures is a mixed term consisting of public loans to private enterprises (inversion financiera) and the budgetary surplus or deficit.

The definitional relationships between the variables included in Tables 1 and 2 and those of the fuller accounting scheme presented can be summarily stated:

\[ C^G + I^G = \text{current expenditures} - \text{interest payments on domestic and foreign debt} - \text{other transfer payments} - \text{inputs} \]
into public enterprises and gross public capital formation. It has not been possible to obtain series for each one of the above referred variables, which led to the decision to treat the public sector only with respect to its INP contribution on the expenditure side (neglecting the transfer payments) and the tax receipts on the revenue side. The resulting misspecification is not very serious because the absolute level of subsidies and social security payments is not considerable.

While total tax revenues are given by the sources for the whole of the period under consideration, the breakdown into direct and indirect taxes for the missing years 1950-1954 and 1962-1963 had to be done by employing the observed proportions in the remaining years.

Table 3a. Proportions of direct and indirect taxes in tax totals

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Taxes</td>
<td>37.9</td>
<td>38.2</td>
<td>34.2</td>
<td>34.2</td>
<td>35.5</td>
<td>40.6</td>
<td>38.1</td>
</tr>
<tr>
<td>Indirect Taxes</td>
<td>62.1</td>
<td>61.8</td>
<td>65.8</td>
<td>65.3</td>
<td>64.5</td>
<td>59.4</td>
<td>61.9</td>
</tr>
</tbody>
</table>

Since no major tax reforms took place in the period 1950-1954 and 1962-1963, the average indirect tax proportion, 62.97%, was applied to the tax totals.
Description of the main macroeconomic features of the Peruvian economy

In describing the main macroeconomic characteristics of the economy as observed within the period 1950-1964, the major aggregate variables appearing in Tables 1 and 2 will be discussed in terms of their importance in the gross domestic produce or income, their growth rate and, whenever possible, their internal composition.

The expenditure side of national income reveals only part of the structural picture. Apart from a complete and consistent set of national accounts including the factor payments aspect (which at the time of writing this study was not available to the author), at least two additional features are most noteworthy for an adequate understanding of the Peruvian economy and the policy problems most relevant to it; the state of income distribution and the regional divisions of economic, geographic and ethnic character. A brief exposition will suffice to underline their importance. Nevertheless, for lack of appropriate statistical information, they will remain outside the main stream of analysis.

Income distribution data without additional family budget and expenditure studies cannot be incorporated into the type of models which will be employed here. As for regional information, whenever not scanty and unreliable, it is mostly of a microeconomic nature.
**Gross domestic product**

The GDP of Peru increased at considerably high rates throughout the fourteen years with pronounced acceleration during the sixties. The picture is, however, different if one considers per capita product growth.

Table 3b. Growth rates of GDP of Peru in percent

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>28.34</td>
<td>26.01</td>
<td>21.56</td>
<td>96.61</td>
</tr>
<tr>
<td>Annual</td>
<td>5.11</td>
<td>4.81</td>
<td>6.72</td>
<td>5.34</td>
</tr>
<tr>
<td>Annual per capita</td>
<td>2.61</td>
<td>2.06</td>
<td>4.08</td>
<td>2.69</td>
</tr>
</tbody>
</table>

Population estimates indicate that the annual growth for 1950-1963 has been 2.65%.

To compare the GDP performance of Peru with that of other Latin American countries, the following table is presented.
Table 4. Growth rates of GDP for selected Latin American countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>1950-55</th>
<th>1960-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentine</td>
<td>3.2</td>
<td>-0.8</td>
</tr>
<tr>
<td>Brazil</td>
<td>5.7</td>
<td>4.9</td>
</tr>
<tr>
<td>Chile</td>
<td>3.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Columbia</td>
<td>5.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Ecuador</td>
<td>5.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Uruguay</td>
<td>4.2</td>
<td>-0.2</td>
</tr>
<tr>
<td>Venezuela</td>
<td>8.7</td>
<td>4.6</td>
</tr>
<tr>
<td>Central America</td>
<td>4.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>6.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Peru</td>
<td>5.1</td>
<td>5.3</td>
</tr>
</tbody>
</table>

The composition of gross domestic product in terms of proportion of value added by economic sectors is shown in Table 5.

It is seen that during the period no substantial transformation of the economic structure took place.

Primary production as a proportion of total output changed but little. A slow reduction, within primary production, was observed with respect to agriculture, compensated by considerable increases in mining and fishing.
Table 5. Composition of GDP by economic sector in percent of the total in constant values of 1960 soles

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>25.7</td>
<td>0.5</td>
<td>5.3</td>
<td>15.6</td>
<td>3.4</td>
<td>4.6</td>
<td>16.0</td>
<td>3.1</td>
<td>9.3</td>
<td>10.1</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td>24.9</td>
<td>0.5</td>
<td>5.5</td>
<td>15.8</td>
<td>3.9</td>
<td>4.7</td>
<td>16.8</td>
<td>3.2</td>
<td>8.9</td>
<td>9.6</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1952</td>
<td>24.5</td>
<td>0.5</td>
<td>5.5</td>
<td>15.8</td>
<td>4.5</td>
<td>4.8</td>
<td>16.6</td>
<td>3.7</td>
<td>8.7</td>
<td>9.2</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>23.5</td>
<td>0.4</td>
<td>6.1</td>
<td>16.5</td>
<td>4.4</td>
<td>5.1</td>
<td>16.9</td>
<td>3.9</td>
<td>8.3</td>
<td>8.8</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1954</td>
<td>23.1</td>
<td>0.5</td>
<td>6.4</td>
<td>17.1</td>
<td>4.5</td>
<td>5.3</td>
<td>16.5</td>
<td>3.7</td>
<td>8.3</td>
<td>8.6</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td>22.2</td>
<td>0.5</td>
<td>6.3</td>
<td>17.6</td>
<td>4.4</td>
<td>5.4</td>
<td>16.9</td>
<td>3.7</td>
<td>8.3</td>
<td>8.5</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1956</td>
<td>20.7</td>
<td>0.6</td>
<td>6.8</td>
<td>17.7</td>
<td>4.7</td>
<td>5.5</td>
<td>17.3</td>
<td>3.7</td>
<td>8.4</td>
<td>8.4</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>19.9</td>
<td>0.6</td>
<td>6.9</td>
<td>18.5</td>
<td>4.4</td>
<td>5.4</td>
<td>17.5</td>
<td>3.8</td>
<td>8.4</td>
<td>8.4</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>21.2</td>
<td>0.9</td>
<td>6.3</td>
<td>17.7</td>
<td>3.8</td>
<td>5.8</td>
<td>16.6</td>
<td>4.1</td>
<td>8.7</td>
<td>8.5</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>21.4</td>
<td>1.2</td>
<td>6.2</td>
<td>18.3</td>
<td>3.3</td>
<td>5.8</td>
<td>16.4</td>
<td>3.9</td>
<td>8.7</td>
<td>8.4</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>20.4</td>
<td>1.4</td>
<td>8.8</td>
<td>18.8</td>
<td>3.2</td>
<td>5.4</td>
<td>16.7</td>
<td>3.7</td>
<td>8.0</td>
<td>7.7</td>
<td>5.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>20.3</td>
<td>1.7</td>
<td>8.6</td>
<td>19.0</td>
<td>3.4</td>
<td>5.3</td>
<td>17.2</td>
<td>3.6</td>
<td>7.6</td>
<td>7.6</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>20.8</td>
<td>1.8</td>
<td>7.6</td>
<td>19.2</td>
<td>3.8</td>
<td>5.2</td>
<td>17.5</td>
<td>3.7</td>
<td>7.3</td>
<td>7.5</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>19.9</td>
<td>1.7</td>
<td>7.8</td>
<td>19.5</td>
<td>3.9</td>
<td>5.3</td>
<td>17.5</td>
<td>3.7</td>
<td>7.4</td>
<td>7.7</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>19.6</td>
<td>1.8</td>
<td>7.6</td>
<td>19.6</td>
<td>4.1</td>
<td>5.3</td>
<td>17.6</td>
<td>3.7</td>
<td>7.4</td>
<td>7.8</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The industrial sector improved its position at a low annual rate especially in construction.

Services as a whole remained nearly a constant proportion of total output while government and residential construction declined.

What may perhaps most tellingly describe the slow pace of structural change in the Peruvian economy is the position of the sector "transportation and communication". Over a period of fifteen years it grew only by 15%.

It is interesting to underline the structural characteristics of output composition by reference to two essays: Chenery's "Patterns of Industrial Growth" (4) and Thorbecke's "Sectoral Projection" (5).

Chenery's basic ideas emerge from the observation that formal growth models omit the treatment of those elements, such as given natural resources, changing factor supplies, nonhomogeneous consumption functions, economies of scale and international trade, which can explain economic growth with changes in the structure of output composition. In fact, the models of Walras, von Neumann, Leontief, Samuelson and others imply optimality and necessity of proportionate sectoral expansion in the long run. Chenery's purpose is to incorporate these characteristics in a general scheme of changing supply and demand conditions which explains observed patterns of sectoral growth. The expectation of a certain degree of uniformity in growth patterns is based on assumed fundamental
similarities in supply and demand conditions in all countries. He calls them "universal factors" i.e. 1) common technological knowledge; 2) similar human wants; 3) access to the same markets for imports and exports; 4) accumulation of capital as the level of income increases; 5) increases of skills as income increases. All other factors are considered "particular".

The operational use of the model developed leads to a simplified version of sectoral growth equations. Since for any particular country, it is not possible to separate the effects of universal and particular factors and technology and trading patterns change substantially over a long period; while among countries, size (in terms of population) and income levels are practically uncorrelated, estimation from a sample of cross-section data from various countries can be expected to yield significant estimates of the effects of the two explanatory variables (population and income), holding technology and trading patterns nearly constant.

The regression sectoral growth equations take then, the form

\[ \log V_1 = \log \beta_{10} + \beta_{11} \log Y + \beta_{12} \log N \]

where \( V_1 \) is per capita value-added, \( Y \) is per capita income and \( N \) the size of population.
The coefficient $\beta_{i1}$ can be interpreted as the growth elasticity of sector $i$ with respect to a change in per capita income,

$$ (2.4) \quad \beta_{i1} = \frac{dV_i}{V_i} \frac{dY}{Y} $$

and $\beta_{i2}$ as the size (population) elasticity,

$$ (2.5) \quad \beta_{i2} = \frac{dV_i}{V_i} \frac{dN}{N} $$

The two elasticities incorporate both supply and demand effects. Chenery proceeded to estimate these coefficients for different sectors from a sample of cross-section data from 51 countries covering the period 1950-1956.

The interpretation of the cross-section results, according to Chenery, is as follows: The development of a country takes place among constantly changing trading possibilities and technology. The derived growth functions represent the adaptation of countries at different levels of income and of different size to given technology and trade. They may indicate, as it were, the development path of a typical country, if technology and trading patterns are assumed unchanging.

The table below shows selected estimated coefficients from Chenery's work.
Table 6. Sectors

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Mining</th>
<th>Manufacturing</th>
<th>Construction</th>
<th>Transportation</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth Coefficient</td>
<td>0.474</td>
<td>0.935</td>
<td>1.441</td>
<td>1.152</td>
<td>1.288</td>
<td>1.066</td>
</tr>
<tr>
<td>Size Coefficient</td>
<td>-0.082*</td>
<td>0.129*</td>
<td>0.199</td>
<td>-0.055*</td>
<td>-0.048*</td>
<td>0.014*</td>
</tr>
</tbody>
</table>

*Coefficient not significantly different from zero at 95 per cent confidence level.

Thorbecke based himself on Chenery's results to make sectoral projections for the Peruvian economy given the unavailability of more direct information at the time. Before accomplishing that, he had to establish the "goodness of fit" of Chenery's equations to Peruvian data. The references here will be made to this part of his study.

If one accepts Chenery's interpretation of his results, one may use them to classify the sectors of the Peruvian economy according to the degree of conformity to the normal pattern indicated by the empirically established regressions.

Thorbecke made the necessary adjustments to achieve comparability, and derived the results presented below which summarize the relevant findings. He used the figure 5522 soles $206.00 as per capita gross domestic product in 1960 and population size in the same year 10,000,000.
Table 7. Sectors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product culture</td>
<td>ing</td>
<td>try facture</td>
<td></td>
<td>tation</td>
<td>Services</td>
</tr>
<tr>
<td>VI Actual per capita</td>
<td>63.47</td>
<td>45.16</td>
<td>18.31</td>
<td>45.65</td>
<td>39.06</td>
<td>6.60</td>
</tr>
<tr>
<td>added 1960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.23</td>
</tr>
<tr>
<td>Herbert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>87.30</td>
</tr>
<tr>
<td>VI Computed per capita</td>
<td>71.08</td>
<td>58.90</td>
<td>3.53</td>
<td>42.75</td>
<td>31.46</td>
<td>9.07</td>
</tr>
<tr>
<td>added 1960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.21</td>
</tr>
<tr>
<td>Herbert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>69.52</td>
</tr>
</tbody>
</table>

The entries are expressed in dollars at 1960 purchasing power.

Interpreting these results, Thorbecke finds an adequate correspondence between Peruvian data and those of the "typical" country for transportation and communications, industry and primary production.

Some of the structural peculiarities of Peru are brought to focus by comparing the actual with the "typical" values listed.

Real agricultural value-added per capita (\$45.16) is substantially below the calculated norm (\$58.90). Actual value for mining is, on the other hand, tremendously higher than the calculated one.

The manufacturing sector within industry appears higher than the norm while construction lags behind it. Actual value-added in transportation fits closely with the calculated and services appear overextended.
Summarizing his conclusions from this part of his analysis, Thorbecke states: The realities of the Peruvian economy in terms of sectoral structure are: 1) an underdeveloped agriculture resulting wholly from the low-efficiency utilization of Sierra's resources; 2) an extremely large, compared to the norm, mining sector; 3) an "overdeveloped manufacturing sector which is regionally highly concentrated catering almost exclusively to the higher income groups in the coastal urban centers; 4) a lag in construction, reflecting the low level of construction in the Sierra; 5) a relatively large amount of resources expended on services.

**Gross domestic income**

The conceptual difference between product and income is, as explained, the magnitude reflecting the effect of the terms of trade.

Table 8. Growth rates of GDI (in percent)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>26.79</td>
<td>21.90</td>
<td>23.08</td>
<td>90.23</td>
</tr>
<tr>
<td>Annual</td>
<td>4.86</td>
<td>4.04</td>
<td>7.17</td>
<td>5.07</td>
</tr>
<tr>
<td>Annual per capita</td>
<td>2.36</td>
<td>1.29</td>
<td>4.47</td>
<td>2.42</td>
</tr>
</tbody>
</table>

It is seen that the terms of trade have exerted overall a dampening effect yet given impetus to the economy in the
sixties. A more detailed discussion of the terms-of-trade effect is attempted in the analysis of the foreign trade sector.

Private consumption

The available statistics on private consumption are to a certain extent unsatisfactory. They include a proportion based essentially on guesswork reflecting the consumed barter-output (and the non-marketable output consumed by its own producers).

The proportion of private consumption in the gross domestic income reported by the INP exhibits a mild cyclical character in the first ten years falling from 0.749 in 1950 to the lowest point in the subperiod 0.701 in 1952 and rising (almost monotonically) to 0.747 in 1959. From that level it drops to 0.624 in 1964.

Table 9. Proportion of private consumption in GDI

<table>
<thead>
<tr>
<th>Year</th>
<th>( \frac{C^P}{Y} )</th>
<th>Year</th>
<th>( \frac{C^P}{Y} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>0.749</td>
<td>1956</td>
<td>0.711</td>
</tr>
<tr>
<td>1951</td>
<td>0.723</td>
<td>1957</td>
<td>0.719</td>
</tr>
<tr>
<td>1952</td>
<td>0.701</td>
<td>1958</td>
<td>0.744</td>
</tr>
<tr>
<td>1953</td>
<td>0.703</td>
<td>1959</td>
<td>0.747</td>
</tr>
<tr>
<td>1954</td>
<td>0.712</td>
<td>1960</td>
<td>0.670</td>
</tr>
</tbody>
</table>
Table 9. (Continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>$C_p/Y$</th>
<th>Year</th>
<th>$C_p/Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>0.719</td>
<td>1961</td>
<td>0.667</td>
</tr>
<tr>
<td>1962</td>
<td>0.662</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>0.667</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>0.624</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By studying the growth rates of private consumption in conjunction with those of gross domestic product one observes that with the exception

Table 10. Growth rates of private consumption (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>21.72</td>
<td>13.75</td>
<td>22.44</td>
<td>69.50</td>
</tr>
<tr>
<td>Annual</td>
<td>4.09</td>
<td>2.61</td>
<td>6.99</td>
<td>4.18</td>
</tr>
<tr>
<td>Annual per capita</td>
<td>1.59</td>
<td>-0.14</td>
<td>4.29</td>
<td>1.53</td>
</tr>
</tbody>
</table>

of the period 1960-63 private consumption has been increasing more slowly than gross domestic product. In the sixties consumption increased by slightly more than domestic product,
probably in response to the growing employment in the fish-meal export industries of the coast. The fact that the proportion in the domestic income was falling in the same period 1960-1963 is due to the favorable terms-of-trade effect of 1963 occurring principally to the saving classes. The overall difference of 27% approximately by which private consumption lagged behind domestic product in cumulative growth represents the situation where the marginal propensity to consume is smaller than the average; which allows the interpretation that progressively a larger amount of resources is released for capital formation associated with the observed growth. The "welfare cost" may be suggested by the very slow progress of per capita consumption growth which has been a mere 1.53% annually.

**Gross investment**

A detailed sectoral classification for gross investment is not available at present. The only available breakdown is that between machinery and equipment and general construction.

The level of gross investment has generally been very high in Peru.
Table 11. Ratio of gross investment to GDI

<table>
<thead>
<tr>
<th>Year</th>
<th>$I^P/I^G/Y$</th>
<th>Year</th>
<th>$I^P/I^G/Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>0.183</td>
<td>1960</td>
<td>0.192</td>
</tr>
<tr>
<td>1951</td>
<td>0.226</td>
<td>1961</td>
<td>0.208</td>
</tr>
<tr>
<td>1952</td>
<td>0.259</td>
<td>1962</td>
<td>0.225</td>
</tr>
<tr>
<td>1953</td>
<td>0.271</td>
<td>1963</td>
<td>0.223</td>
</tr>
<tr>
<td>1954</td>
<td>0.210</td>
<td>1964</td>
<td>0.228</td>
</tr>
<tr>
<td>1955</td>
<td>0.228</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1956</td>
<td>0.267</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>0.275</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>0.226</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>0.156</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The predominance and development of the export sector, and, to a certain extent, the prevailing income inequality account for the observed high investment-to-income ratios.

The growth profile of gross investment is shown in Table 12.

Table 12. Growth rates of total gross investment (in %)

<table>
<thead>
<tr>
<th>Years</th>
<th>1950-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>62.22</td>
<td>42.92</td>
<td>131.84</td>
</tr>
<tr>
<td>Annual</td>
<td>4.96</td>
<td>12.64</td>
<td>6.65</td>
</tr>
</tbody>
</table>
The tendency has been noted for public investment to become an increasing proportion of the total. The corresponding rates of growth are shown in Table 13.

Table 13. Growth rates of private and public gross investment (in %)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>113.70</td>
<td>242.06</td>
<td>26.02</td>
<td>191.14</td>
</tr>
<tr>
<td>Cumulative</td>
<td>6.01</td>
<td>9.92</td>
<td>8.01</td>
<td>42.79</td>
</tr>
<tr>
<td>Annual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The outlined satisfactory performance of total investment, especially in the last years, was financed principally through a corresponding increase in gross domestic savings. The latter was made possible chiefly by the impetus of the export sector as will be discussed in more detail below. This fact constitutes one of Peru's particular structural characteristics. Few countries of Peru's per capita income may claim the same pace of capital formation with so little foreign capital assistance.
Table 14. Ratios of gross domestic savings and foreign capital inflow to GDI (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDS/GDI</th>
<th>F/GDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>18.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>1951</td>
<td>21.4</td>
<td>1.2</td>
</tr>
<tr>
<td>1952</td>
<td>23.4</td>
<td>2.5</td>
</tr>
<tr>
<td>1953</td>
<td>23.3</td>
<td>3.8</td>
</tr>
<tr>
<td>1954</td>
<td>21.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>1955</td>
<td>21.3</td>
<td>1.5</td>
</tr>
<tr>
<td>1956</td>
<td>20.5</td>
<td>6.2</td>
</tr>
<tr>
<td>1957</td>
<td>20.1</td>
<td>2.4</td>
</tr>
<tr>
<td>1958</td>
<td>17.4</td>
<td>5.2</td>
</tr>
<tr>
<td>1959</td>
<td>16.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>1960</td>
<td>23.3</td>
<td>-4.1</td>
</tr>
<tr>
<td>1961</td>
<td>23.4</td>
<td>-2.6</td>
</tr>
<tr>
<td>1962</td>
<td>23.9</td>
<td>-1.4</td>
</tr>
<tr>
<td>1963</td>
<td>22.2</td>
<td>0.1</td>
</tr>
<tr>
<td>1964</td>
<td>20.1</td>
<td>-2.7</td>
</tr>
</tbody>
</table>

Table 14 verifies the description in absolute terms, over the whole period in consideration, the net sum of foreign capital inflow amounts to 5.658 billion 1960 soles which is about 3.66% of total gross investment.
The foreign trade sector

The foreign trade sector is the key sector to the observed economic development of Peru, and most likely, is going to continue being the single most important factor of economic growth for the country in the years ahead.

Its strength and its weaknesses account for many of the overall features of the economy. A relatively diversified export sector (for a primary product exporting country) facing a strong and expanding market and consequently allowing a high level of import requirements to be met without substantial recourse to foreign capital borrowing, constitutes the principal strength of Peru's foreign trade sector. On the other hand, the prevalence of the export sector in the economy as a whole has channeled the greatest part of private investment into a direction which may not necessarily be the most favorable from a national policy point of view, considering the relatively weak links which connect it with the rest of the economy. So, the employment effect of an increase in the level of activity of the export sector is considered to be generally low. The level of derived demand for domestically produced inputs is also thought to be quite low. These aspects along with the usual arguments with respect to the terms of trade, constitute the weaknesses of Peru's foreign trade sector.

Nevertheless, if a prima facie exaggerated proportion of total private investment is channeled into the export sector,
it is relevant to ask about the source of savings which finance the investment flow. The export sector appears to have generated its own savings.

The principal export growth is sketched in Table 15. It is seen that exports grew much faster than domestic product, or income as reported by the INP.

Imports, on the other hand, developed as shown in Table 16.

Table 15. Growth rates of exports (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-64</th>
<th>1950-64</th>
<th>1955-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>49.83</td>
<td>67.70</td>
<td>29.27</td>
<td>224.8</td>
<td>116.79</td>
</tr>
<tr>
<td>Annual</td>
<td>8.42</td>
<td>10.89</td>
<td>6.63</td>
<td>5.96</td>
<td>8.98</td>
</tr>
</tbody>
</table>

Table 16. Growth rates of total imports, imports of consumption goods and imports of capital goods (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>49.97</td>
<td>215.75</td>
<td>158.28</td>
</tr>
<tr>
<td>Annual</td>
<td>46.34</td>
<td>66.86</td>
<td>144.19</td>
</tr>
<tr>
<td></td>
<td>8.24</td>
<td>6.42</td>
<td>11.81</td>
</tr>
</tbody>
</table>
Table 16. (Continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>8.48</td>
<td>15.4</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>7.9</td>
<td>6.6</td>
<td>11.8</td>
</tr>
</tbody>
</table>

First entry in each block refers to total imports, second to imports of consumption goods, third to imports of capital goods.

It is noted that imports of capital goods did not grow as fast as those of consumption goods, although they exhibited a high rate of growth which over the whole period is nearly the double of the growth rate of total investment.

Similarly, imports of consumption goods exceeded by even wider margins the rate of growth of private consumption.

This indicates that no policy of import substitution was followed to any considerable extent.

The terms of trade for the Peruvian foreign trade sector as a whole were very favorable in the first half of the fifties, deteriorated very sharply, because of falling export prices facing relatively stable import prices, afterwards. In the last years before 1962 the deterioration was caused by increasing import prices with export prices relatively stabilized. In general, in the sixties the level in comparison with the period 1950-1956.
Of the main export products in the recent years, copper prices have been maintained stable with a tendency to increase, silver prices have gone up, while lead and zinc prices have been declining. Sugar prices were in the ascending until 1963, while cotton is actually facing a crisis.

The government sector

The income component of government sector that remains to be briefly discussed is government consumption. The definition aspects have already been referred to.

Table 17. Growth rates of government consumption (in %)

<table>
<thead>
<tr>
<th>Years</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>31.08</td>
<td>72.26</td>
<td>41.33</td>
<td>219.13</td>
</tr>
<tr>
<td>Annual</td>
<td>5.6</td>
<td>11.5</td>
<td>12.2</td>
<td>9.3</td>
</tr>
</tbody>
</table>

The listed growth rates indicate a relative expansion of government services.

It has already been said that it was not possible to obtain information for the whole period on non-tax public revenues, mainly from public enterprises, net of operating cost. Whatever information exists, indicates that the magnitude is relatively small. Consequently, only tax proceeds are presented as the sources of government revenue.
Table 18. Growth rates of total taxes, direct taxes, indirect taxes, (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54.95</td>
<td>45.94</td>
<td>42.03</td>
<td>221.17</td>
</tr>
<tr>
<td>Cumulative</td>
<td>58.64</td>
<td>56.36</td>
<td>29.32</td>
<td>220.79</td>
</tr>
<tr>
<td></td>
<td>52.78</td>
<td>39.58</td>
<td>50.71</td>
<td>221.40</td>
</tr>
<tr>
<td>Annual</td>
<td>9.1</td>
<td>7.9</td>
<td>12.4</td>
<td>9.4</td>
</tr>
</tbody>
</table>

First entry in each block refers to total taxes, second to direct taxes, third to indirect taxes.

Over the whole period, total realized taxes kept pace with the growth of government consumption and grew faster than public formation. No significant structural changes, over the same time, are observed with respect to kind of tax proceeds, although in the last years a very pronounced increment to indirect tax receipts was recorded.

The national accounts of the Banco Central de Reserva

It is of interest at this point, having briefly discussed the macroeconomic data upon which the subsequent analysis will be based, to have a look at the national accounts published regularly by the Banco Central de Reserva (abbreviated BCR). The paradoxical situation of an underdeveloped country possessing two sets of national
Table 19. Growth rates of GDP, private consumption and total gross investment (in °/o)

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-55</th>
<th>1955-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>37.13</td>
<td>30.26</td>
<td>26.48</td>
<td>25.92</td>
</tr>
<tr>
<td></td>
<td>28.34</td>
<td>26.01</td>
<td>21.56</td>
<td>96.61</td>
</tr>
<tr>
<td>GDP</td>
<td>6.52</td>
<td>5.43</td>
<td>8.15</td>
<td>6.47</td>
</tr>
<tr>
<td>Annual</td>
<td>5.11</td>
<td>4.81</td>
<td>6.72</td>
<td>5.34</td>
</tr>
<tr>
<td>Annual per capita</td>
<td>4.02</td>
<td>2.68</td>
<td>5.51</td>
<td>3.82</td>
</tr>
<tr>
<td></td>
<td>2.61</td>
<td>2.06</td>
<td>4.08</td>
<td>2.69</td>
</tr>
<tr>
<td>Cumulative</td>
<td>35.38</td>
<td>19.12</td>
<td>31.12</td>
<td>112.00</td>
</tr>
<tr>
<td></td>
<td>21.72</td>
<td>13.75</td>
<td>22.44</td>
<td>69.50</td>
</tr>
<tr>
<td>Private consumption</td>
<td>6.26</td>
<td>3.39</td>
<td>9.55</td>
<td>5.92</td>
</tr>
<tr>
<td>Annual</td>
<td>4.09</td>
<td>2.61</td>
<td>6.99</td>
<td>4.18</td>
</tr>
<tr>
<td>Annual per capita</td>
<td>3.79</td>
<td>0.64</td>
<td>6.80</td>
<td>3.27</td>
</tr>
<tr>
<td></td>
<td>1.59</td>
<td>0.14</td>
<td>4.29</td>
<td>1.53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>1950-60</th>
<th>1960-63</th>
<th>1950-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative</td>
<td>54.42</td>
<td>48.82</td>
<td>129.61</td>
</tr>
<tr>
<td>Total gross investment</td>
<td>62.22</td>
<td>42.92</td>
<td>131.84</td>
</tr>
<tr>
<td>Annual</td>
<td>4.44</td>
<td>14.17</td>
<td>6.61</td>
</tr>
<tr>
<td></td>
<td>4.96</td>
<td>12.64</td>
<td>6.65</td>
</tr>
</tbody>
</table>

*First entry in each subclass corresponds to BCR data. Second entry is based on IMP data.
accounts differing in very important respects presents the economist who is called upon to offer his opinion with serious difficulties, if no means are available to him to either reconcile the inconsistencies of the alternative statistics or form a definite opinion about the relative quality of the information offered. Such was the case of Peru for at least the time the author was working on the present study. To make matters worse, the source (in this case BCR) with statistics on more variables (such as the factor payment side of national income) was believed by many experts to offer the less reliable data on the expenditure side of national income than its competitor, the INP.

The strikingly different conclusions which may be drawn depending on the sources will be illustrated by reference to the major macroeconomic aggregates, national product, private consumption and total gross investment. Table 19 records the growth rates from the BCR data.

The INP figures consistently report a higher gross domestic product than the BCR data. The difference decreases in absolute value over time. Both series increase monotonically.

The main source of the discrepancy lies in diverging estimates of private consumption, specifically of the non-marketable and barter output. As is evident from Table 19, the development picture is quite different for the two sources. While according to the INP, GDP did not quite
double over the fourteen year period, according to the BCR it increased by 125.92%. This corresponds to an annual implicit rate of 5.33% for the former and 6.47% for the latter. The data and, consequently, the growth rates of total gross investment agree more or less in the two series.

Private consumption is the major macroeconomic aggregate for which the greatest relative discrepancy in the two statistical sources exists. Of the two series that of the BCR exhibits two great jumps which affect substantially the growth rate and appear to be arbitrary. So between 1953 and 1954 private consumption in real terms is shown to have increased by approximately 25% (by 5 billion soles 1960) while the relevant price index changed by very little. Such an immense increase in real terms, coupled with relative price stability, becomes in the light of experience of most countries quite incredible. Also, between 1962 and 1963 private consumption is reported to have grown in real terms by more than 12.5% with a price increase not exceeding 4%.

The BCR further show that the cumulative growth rate of gross domestic income was 116.80% while private consumption increased in the same period by 11.200%, implying an annual rate of growth of 6.13% for income and 5.92% for private consumption. If for the whole period income and consumption are recorded to have grown almost pari passu, over some intervals consumption is shown to have even exceeded the growth rate of income, as for 1950-1955 and 1960-1963.
If this is not a false picture of Peruvian development, it is certainly an exceptional case of economic growth without sacrifice of present economic welfare. On the basis of the BCR information, the idea is suggested that the near homogeneity of the consumption function is compatible with an effective-demand-pull development where expenditure multipliers in real terms are large quantities. This in turn implies a certain absence of strategic bottlenecks in the process of mobilization of more and more resources, a high productivity of investment and large margins in the degree of utilization of existing capital. Because such a picture may easily misguide both policy and expectations and the revised statistical tables of the BCR were not available to the author during his work on this study, the decision was made to base the analysis on INP source exclusively.

The state of income distribution

A detailed view of the state of income distribution in the year 1963 may be had by looking into the data collected and classified by the INP and summarized by Brady in (16).

Diagram 1 presents the Lorenz curve based on the referred sources. It should be noted that only monetary income is considered. The presumed state of income distribution, as shown in the diagram, is certainly among the world's most unequal.

Striking characteristics of the occupational structure reflecting the inequality of income are the high percentage
Diagram 1. Income Distribution Curve for Peru
of domestic servants, relatives employed, the class of vendors—distinct from shopkeepers—and the number of people engaged in primary production. In the presence of such important occupational groups whose physical productivity can hardly be assessed satisfactorily, it is not surprising that the estimates of unemployment and disguised unemployment offered by the office of Census vary in the range 7-15% for the former and 13-15% for the latter.

The regional division

The geographical division of Peru into three zones, the Coast, the Sierra and the Selva is also an approximate sociological and ethnological breakdown. In the past very little intercourse existed between these regions so that one could not really speak of Peru as an integrated country either economically or sociologically.

Although no serious national accounts on a regional basis exist for the present, it is estimated that roughly 60% of the national product is produced in the Coast, and about 40% is produced in the Sierra. The Selva, although presently not influencing significantly the Peruvian economy as a whole, remains largely unexplored with respect to its potential and may become a highly dynamic factor of growth in the distant future. Growth tendencies in the regions appear to have been highly different in the period 1950-1963. Per capita income increased in the Coast and declined both in the Sierra and the Selva.
The following propositions may describe the structural differences of the two main regions of Peru:

The Coast, producing over half of the national product, is inhabited by approximately one-third of the country's population.

Its labor productivity is relatively high, estimated to be about three times that of the Sierra. Its economy is dominated by an "advanced" sector including a highly efficient agriculture. Foreign trade as a whole affects that sector, its indirect effects not propagating themselves into other regions. Imports of capital goods take place either in connection with regional investment or otherwise are channeled into the economically isolated mining sector of the Sierra. Imports of consumption goods are almost exclusively for regional consumption.

There is an effective labor market. The labor force grows at a high rate reinforced by migratory movements from the Sierra. The degree of labor absorption is low aggravating over time the unemployment situation.

If the mining sector of the Sierra is considered to belong in a functional sense to the economy of the Coast, almost the totality of domestic savings is generated in the region.
The demand pattern is such that with economic growth the Coast obtains a growing trade balance surplus with the Sierra.

The Sierra economy has an extremely low share of industry and services, while the large mining sector is only locationally a part of its economy.

The latter consists of advanced enclaves of, mainly, foreign enterprises employing a very low proportion of the available labor force which is remunerated at the lowest wage rate among workers, and producing almost exclusively for exportation.

The economy of the Sierra is dominated by the agricultural sector. Although it accounts for less than half of the regional output—including the mining sector—almost the totality of labor force is engaged in it under a rigid institutional framework resembling feudalism.

Very little private investment has taken place; no substantial margin exists between income and consumption. It appears that the only source of additional regional savings may be a more efficient utilization of the employed resources including increasing the effective working time.

Out-migration eases partly the economic stress of the region.

The economic development implications of the above regional disparities are even harsher when such other factors
are taken into account as the ethnological differences of
the inhabitants of the two regions.

Summary

It has been seen that the Peruvian economic structure
in the period 1950-1964 exhibits both positive and negative
features from the standpoint of development.

The aggregate growth rate of income indicates that the
economy has not been stagnating; but taken on a per capita
basis, the progress is too slow to guarantee escape from near
misery for a vast segment of the population without a vig­
orous policy.

Investment has been a growing proportion of output, but
there are indications that its regional distribution favored
the more prosperous part and regional disparities widened
still further.

The foreign trade sector appears the most dynamic ele­
ment of the Peruvian economy making it possible for the
country to grow with small dependence hitherto on foreign
capital inflow.

The government sector has been growing in its economic
impact as evidenced by both the level of public investment
and the growing proportion of income paid in taxes.

The latter grew from about 10% in the year 1950 to ap­
proximately 17% in 1963.

Finally, it was shown that income distribution both re­
gional and occupational as it exists, constitutes a grave
matter for policy concern. Agrarian reforms have been shown to be a potentially very effective means of income redistribution.
CHAPTER III. PROBLEMS OF ECONOMIC POLICY OF PERU

In the preceding chapter, the Peruvian macroeconomic structure was reviewed by examining the basic economic aggregates and their evolution over time. A general picture was thus obtained which suggests a variety of problems for policymakers aiming at economic development. A selected few will be briefly discussed as preparation for the analysis which is presented in the following chapters.

The major problems of economic policy in their detailed ramifications vary with the country and, to a certain extent, the views of the government that decides on them. Nevertheless, it has become customary to indicate the principal areas of concern of contemporary economic policy, be it of economically developed or underdeveloped countries, as being:

(1) Level of income or aggregate economic growth
(2) Level of employment
(3) Price stability
(4) Income distribution
(5) Balance of payments

The above five major areas for policy concern comprise difficult problems of economic theory, many of them unsolved, which can be viewed from a variety of aspects, so as to correspond to any given empirical economy. Each one of them is not an isolated compartment, either theoretically or practically, and can be, in principle, examined fully only in a context of
general equilibrium analysis. In order to achieve this a complete economic model is needed in which the pertinent concepts are quantified and shown in their mutual relations.

Here, a less formal discussion will be undertaken and the Peruvian version of each of these questions shown.

In discussing the mentioned problems, it is possible to choose either a framework of development or of stabilization policy.

Either in short term analysis or in a medium and long term context, the level of income or the balance of payment, the level of employment, the remuneration of the factors of production or the behavior of prices, appear as possible facets of economic policy. It is mainly a matter of emphasis implying a definite direction of causation, what distinguishes short term or stabilization policy from that of economic growth and development. The formal differences are of a purely classificatory nature, namely, which economic variables are considered to reflect the aims of economic policy and which ones are available to the policymakers as instruments in achieving those aims.

Aggregate economic growth

Aggretate economic growth is reflected in the level of income on a per capita basis in a given time period.*

*If the case of population decline is excluded.
In the various documents and plans recently elaborated by the Peruvian authorities, it is indicated that the past performance of the economy is not considered satisfactory, given the observed high and increasing rate of growth of population which is projected until 1970 to grow at a rate of approximately 3% annually. Therefore, an annual growth rate for national product of 7% or 4% per capita has been considered a prime target of economic policy, whose fulfillment will meet the growing social unrest, under the condition that it will benefit the economically lower classes to a considerable extent. It also more than fulfills the international obligations of the country assumed in connection with the "Alliance for Progress" program.

If national income is a convenient aggregate economic welfare index, it has obvious limitations, especially for a country like Peru where its distribution is extremely unequal, and consequently, where an increasing level of per capita income may easily be compatible with a widening gap between poor and rich.

It may be necessary, then, as a step closer toward a more realistic economic welfare index to consider the evolution of per capita consumption. Considering the relatively small number of people who may be designated "rich", a growing per capita consumption indicates more certainly increasing general economic welfare, if the income-elasticity of consumption of the prosperous class may be assumed low, as it most likely is.
Here arises a problem of possible conflict between policy aims. A reference to the per capita growth rate of consumption, especially those of the INP, shows the observed substantial difference from per capita national income or product growth. That difference may be interpreted as the necessary, present economic welfare sacrifice to attain the overall observed economic performance. To what extent can consumption be expected to increase for a fixed growth of national income? And inversely, how does a higher growth target for consumption affect maximal attainable growth of national income?

For most developing countries, a valid qualitative answer would be that there is a range of conflict between the growth of these two economic aggregates. Additional savings for capital formation can only be secured if less is consumed of output increases.

The answer for the case of Peru may not be entirely unequivocal. The presence of vast, unutilized and underutilized resources, including labor reserves, provides, perhaps, an escape from the dilemma; to activate them, it need not require large amounts of additional capital. Similarly, the export sector generating the highest proportion of domestic savings, does not appear to compete dramatically with other sectors of potential development for those resources, whose scarcity may constitute presently the decisive bottlenecks to economic growth, namely skilled labor, managerial and technical
skills, since it employs to a considerable extent foreign services. It follows that sectors catering to domestic consumption may develop without friction with Peru's most dynamic economic activity, exporting.

The Peruvian authorities are conscious of the fact that consumption per capita must grow, but no target has been set so far officially. Nothing short of a complete econometric model can provide an answer as to what may be consistently desired and pursued with other specified aims.

Level of employment

From the "Documento de Trabajo del Programa de Inversiones Publicas 1964-1965" elaborated by the INP, the following population statistics are taken (1):

Table 20a. Population data

<table>
<thead>
<tr>
<th>Year</th>
<th>Total population</th>
<th>Economically active population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>7430</td>
<td>8409</td>
</tr>
</tbody>
</table>

The above figures correspond to an actual growth rate of total population of 2.64% annually for the period 1950-1963 and 2.23% for the growth of labor force.

Total population is projected to grow at about 3% annually in the period 1963-1970, whilst the labor force is assumed to grow at 2.49% in the same years. Although no data
on unemployment and even less on underemployment exist, it is estimated that as of 1963, unemployment was at a rate 7-15% of total labor force or 238-510 thousand persons. Underemployment was estimated at 13-15% of total labor force or 442-510 thousand persons. Given the assumed growth rate of labor force by 1970, the aggregate economic growth must be so designed as to provide additional employment and utilize better an estimated 1.317-1.657 million of workers.

The theoretical and practical problems of economic growth in relation to employment are among the most difficult to answer. Even the existence of underemployment in the traditional sector of underdeveloped economies has been recently challenged (8). Nevertheless, it remains a fact that a substantial part of development literature uses the assumption of presence of extensive underemployment both as the starting point of analysis and the main instrument toward economic growth (9, 10).

The existence of both extensive unemployment and underemployment in the case of Peru is not to be doubted. Their absorption in the process of economic development poses questions of strategy in the selection of investments and with respect to a possible conflict between maximum output and maximum employment.

It appears to be the case for Peru that all the types of underemployment distinguished in the literature (11) are present and important.
On the one hand, cyclical underemployment arises as a consequence of insufficiencies in effective demand, mainly in the export sector, when external demand for some principal export products falls, and in construction. Although this type of underemployment characterizes chiefly the developed economies, it affects also the underdeveloped ones in direct proportion to the share of the export sector in the whole economy. The natural remedy is a stabilization of the growth of exports guaranteed basically by sufficient diversification.

On the other hand, Peru experiences most acutely the two types of underemployment which may be attributed in general to insufficiencies in the supply of means of production.

The first may be called structural or hidden underemployment. The second may be termed (11) underemployment of expansion. Structural underemployment is explained (12) by means of three hypotheses; market imperfections, limited opportunities for technical substitution of factors in production, and inappropriate factor endowment. Although the three hypotheses can be synthesized to a certain extent as in (12), it appears that for Peru, the two final hypotheses taken together illuminate to a considerable measure the situation. Specifically, the hypothesis about market imperfections determining structural unemployment assumes that
existing technology is such as to permit greater utilization* of available labor force for some set of relative factor prices. What prevents that particular set of factor prices from prevailing is the totality of factor market imperfections likely to exist in underdeveloped areas.

A number of imperfections of the Peruvian factor markets can be listed. In general, Peruvian labor can be distinguished in two, or possibly more, presently non-competing groups. The relatively skilled organized urban labor force has achieved considerable bargaining power in recent years, whilst the rural workers—especially in the Sierra—are unorganized, unskilled, with low mobility and quite low wages. However, new development projects in the non-agricultural sector cannot easily draw upon this labor fund and have to face wage rates as determined by the urban labor market, especially when no training facilities are provided in order to establish a certain continuity between the two classes of labor.

This leads to the establishment of a higher capital-labor ratio than the one which corresponds more closely to the country's factor endowment. The situation is further

*Not necessarily full utilization of factors, because wage rates, for instance, might need to fall below subsistence levels to correspond to market equilibrium. In such a case, institutional minimum wages are adopted, preventing full use of available resources
influenced in the above direction, since in general, social policy tends to move ahead faster than economic growth.

The lack of an organized capital market in Peru makes it almost impossible to distinguish savers from investors. This is of special significance for the choice of technology. As most of investment occurs in those activities which generate savings sufficient to finance it; and these activities are connected with the export sector where foreign entrepreneurs and managers are involved, there exists a natural bias toward capital-intensive techniques, partly because of greater familiarity with production patterns of advanced economies, partly because of distrust of local labor and insufficient care to help develop its quality.

The evaluation of production patterns prevalent in advanced economies, irrespective of the nature of the actual production functions, amounts to limited substitutability of factors of production and an expansion path largely independent of the factor price ratio.

The implications of limited technical substitutability of production factors were first analyzed by A. Wald (13) in a celebrated paper and are now widely known through linear programming. The question whether the underlying production functions of the Peruvian economy allow or not substitution of factors can only be answered by means of empirical studies of the important sectors. On an a priori basis, it may be assumed that the agricultural sector and the mining sector
admit of a variety of techniques, and there growth is possible with various levels of employment depending on the level of capital employed.

The upshot of the above observations is that in a capital-scarce country like Peru, the mentioned market imperfections favor the adoption of production techniques by the investing sectors, which do not promote an adequate growth of employment. This has been specifically the case with the mining, fishmeal and sugar industries.

The authors of (11) describe the second type of underemployment due to deficiencies in the supply of means of production, the underemployment of expansion, to arise precisely in the process of growth. It is due to failure of capital and of most other complementary factors of production, to increase as fast as the supply of labor in non-primary activities. This type of underemployment is accentuated by deficit financing of development programs and the resulting inflation because of the city-ward migration of agricultural workers supplied by the vast reserves of structural or hidden underemployment in the rural areas.

Even casual observation of the urban centers of Peru, where slum areas are formed and grow rapidly to shelter those who arrive from the Sierra in search of employment, where car-washers, shoe-shinners and peddlers of all sorts of commodities proliferate daily, suffices to convince one of the existence of underemployment of the expansion type.
consistent with the characteristics attributed to it in (11) and many other studies dealing with underemployment in developing countries.

The crucial policy suggested consists first, in classifying the totality of economic activities in two groups: the ones in which growth of employment can be taken as equivalent with growth of output both in the static and dynamic sense; and those in which even if increase in employment is consistent with increase in output, adoption of labor-intensive techniques impedes the attainment of maximal growth. And second, in the specification of explicit preferences of the policy makers in relation to the conflicting aims of economic policy.

With respect to the first group of economic activities, the role of the "Cooperacion Popular" is very promising. The nature of works undertaken under its auspices is such as to allow utilization of underemployed labor force in community improvement projects requiring relatively little capital, such as public construction, community health, school building, etc.

With regard to the second group where conflict between employment and growth may emerge, relatively little is known on empirical grounds. It is a rather controversial issue in the theory of economic policy, as one can see in the debates over Indian planning and its comparison with the Japanese experience. It is closely related to the so called "new view
of investment", (14, 15, 16), whose basic idea is that the function of investment in the process of growth is not only to deepen the capital but to impart a progressive, more advanced technology as well. The rate of growth of output is shown by this view to depend, among other things, on the vintage distribution of existing capital and the growth of labor productivity is directly related to the modernity of the capital stock.

It is undeniable that the stimulus of advanced and advancing technology toward higher levels of skills, in general, can be great.

It requires, of course, that investment in education, especially in vocational training, be granted a high priority. There may be little to be gained in the long run from a policy favoring a rapid expansion in employment at the cost of more efficient methods of production when available technology as a whole develops continuously. It may only mean postponement of a solution guaranteeing in the long run employment of the labor force at competitive internationally level of skills.

On the other hand, the social cost of continuing unemployment and of extremely low-level occupation for a huge section of the Peruvian labor force may be considered by the government too expensive an alternative adopting at the same time the well-known Keynesian view of the "long-run". At any rate, there seems little scope for discussing fruitfully the
problem of conflict between employment and growth in a highly aggregative context. The best method to proceed appears to be the adoption of sound investment criteria and an attitude toward technique of production which considers it an unknown to be solved for in an appropriately formulated programming problem.

**Price stability**

Avoidance of harmful inflation is a question intricately connected with the "big push" stage of development programs.

The Peruvian economy has been experiencing in the last few years, a continuously rising general price level. As it is shown in Table 5, both statistical sources agree that consumption-good prices rose considerably faster than capital-good prices in the last five years. The rise in prices in Peru can be attributed on the one hand to some general causes present in most developing countries and associated with the effort toward expansion, such as the relation between total investment and total savings, and on the other hand, to particular structural characteristics of the economy, such as prevail in many Latin American countries.

Money creation to supplement domestic voluntary savings is a frequent device of developing countries, and Peru shows the tendency to have recourse to it to an increasing extent.

The conditions which allow inflation to become an effective instrument toward accelerated capital formation are many and cannot possibly all be met in any concrete case. Some
of the most important seem to be actually present in Peru. Such, for instance, are the existence of surplus labor and high saving propensities in high-income groups.

Surplus labor can be used to produce capital goods with no reduction or cost in terms of consumption goods. High-income groups are likely to gain in the process of inflation and because of their high propensities to save, additional funds for financing capital formation are thereby created.

On the other hand, the growing strength of labor unions reduces the "money illusion" in the supply of labor and therefore to this extent, the efficiency of inflation as a source of savings.

The case against inflationary methods of financing Peruvian economic development can be stated in terms of, first, their adverse effects on saving habits; second, the possible effects on the composition of private investment; and third, the deterioration of an already very bad state of income distribution.

Where the ability of an economy to provide a sufficient quantity of domestic savings is very limited because of very low per capita income, the argument against inflation based on its effect on saving habits may be irrelevant for as long as general poverty persists. In Peru, however, it was shown that domestic savings formed the largest source of investment financing. It is also known that realized domestic savings fell considerably lower than the maximum possible, the
difference consisting in capital flight abroad. It is estimated that 191 million dollars are deposited presently in U. S. banks alone (statement by President Belaúnde to the Press).

Persisting capital flight indicates both a lack of confidence in the stability of the national monetary unit and a reaction to the absence of an organized capital market to take care of the growing middle class capacity to save. The establishment of an effective capital market in Peru must be considered a target of great importance. It will help the rise of a lacking entrepreneurial class which coincides generally with the emergence of a middle class, already in ascent in Peru, the absence of which is considered the main cause (17) of unproductive investment, such as real estate speculation and other forms of investment taking place chiefly for capital gains rather than future income, and flourishing amidst persisting inflationary pressures.

Granted the relevance of the above observations, it is seen that for Peru the two first arguments against inflation are closely interconnected, inflation preventing the establishment of a national capital market which would affect favorably saving habits and being partly responsible for capital flight and unproductive forms of investment.

The third argument against inflation, the effect on income distribution, would be partly offset by the structural characteristics of the Peruvian economy, if agrarian reform
had been implemented. G. Maynard (18) in his study on economic development and the price level, reviewing the Latin American situation, concludes that the most important inflationary pressure is produced by unbalanced development. Expansion of industry at the expense of agriculture unavoidably leads to a rise in the cost of living, influenced mainly by food prices. In other words, the internal terms of trade between agricultural and non-agricultural commodities change in favor of the former.

However, in Peru such a development hardly benefits the rural population under the present structure of land distribution and actual relations between producing farmers and agricultural product merchants.

The Peruvian economy is exposed, also, to the pressures of inflation for reasons largely independent of domestic policies. The degree of dependence on external demand conditions makes it possible for sudden pressures on prices to appear without significant short-term capacity on the part of the government to adopt stabilization measures.

Nevertheless, it should also be remarked that favorable demand conditions reflected in imposing terms of trade enable the economy to proceed toward capital formation via increased capital imports without excessive derived demand for domestic factors of production which would be equivalent to additional strain on current consumption.
Income distribution

The state of income distribution is affected by three main types of policy: 1) Taxation, 2) Social policy, 3) Redistribution of assets or wealth.

Progressive income taxation combined with social policy has been the classical instrument of income redistribution in the economically advanced countries.

In Peru one cannot speak of serious income taxation. The main source of direct taxes are the levies on business profits.

There appears to exist considerable scope, however, for introduction of income tax. The per capita income of such classes as professionals and technicians, managers and administrators, bureaucrats and those rendering personal services, is high enough to be taken as a taxable base.

At any rate, there exists a great need for development of public expenditures of an infrastructure character which could be financed by additional tax revenues. To the extent that these additional revenues would be channeled toward public capital formation, total export savings would not decrease, while in the process, the aim of income redistribution could also be furthered.

Indirect taxation combined with appropriate public spending can also be an effective means of income redistribution. In the case of Peru, the high rates, generally, of import
duties on consumption goods serve this purpose to a considerable extent, given that demand for imported consumption goods is exercised almost exclusively by the higher-income classes.

Social policy as a means of income redistribution need not be considered as exclusively tending to deteriorate the social climate conducive to growth of private enterprises, as feared by Schumpeter (19). For if the general tendency of social policy in the economically advanced countries has been to put a pressure on profits by progressive income taxes, furthering the strength of labor union, and by means of various welfare programs, in a country like Peru social policy, conceived in terms of imparting training and skills to the labor force and providing extension services especially to the agricultural sector, may have very large returns for the economy as a whole in the medium run.

Nevertheless, for Peru it is the third type of policy toward income redistribution, namely, redistribution of assets, which is promising to be of drastic importance and which may be viewed as an integral part of a development process envisaged by some recent theories (9, 10, 20, 20). The particular kind of asset redistribution called for in Peru can be achieved through agrarian reform. Its nature and possible influence on economic growth will be sketched in the next section.
A theory of economic development and agrarian reform

The main sources of ideas sketched in this section are: A. Lewis's seminal article (9) on economic development with unlimited supply of labor; Ranis's and Fei's (10) more formal version of Lewis's theory; and Thorbecke's discussion (21) of the above conceptual framework in connection with the multiple aspects of agrarian reforms.

The starting point of the theory of economic development contained in the mentioned references is the presence in an underdeveloped economy of a certain type of economic dualism in regard to the two main sectors, agricultural and industrial, into which the whole economy is assumed to be divided. This dualism consists essentially in the different criteria for allocation of resources, mainly labor, prevailing in the two sectors. The theory traces economic development through three distinct phases, the final being a state of integration of the sectors into an economy guided by the allocative criterion of relative market prices.

Briefly stated, phase one or stagnation phase is characterized by a considerable amount of surplus labor in the agricultural sector, indicated by a zero marginal physical productivity of labor.

The maintenance of this surplus is achieved institutionally through a feudal mode of production and rural life in general.
The supply of labor, consequently, in the agricultural sector is infinitely elastic at the institutional wage rate, which can be taken to equal the average product of labor in the sector.

At the same time the industrial sector can draw upon this infinitely elastic supply of labor at the institutional wage rate without any reduction in the total agricultural output. In other words, at this phase industrial development can take place at no cost of agricultural production up to the point where marginal physical productivity in the agricultural sector becomes positive.

This initiates phase two or take-off phase. Phase two is defined to last for as long as marginal productivity of labor is less than the institutional wage rate and greater than zero. This implies now an upward sloping supply of labor facing the industrial sector, since any additional labor absorbed by industry entails a certain reduction in agricultural output.

The opportunity cost of industrial development is positive but still worth pursuing up to the point where the last underemployed worker is removed from agriculture into industry.

Phase three, or phase of commercialized agriculture, begins thereafter. Further development in either sector is a matter mainly of market competition and market formed relative prices. It is the stage where the two sectors have
become economically integrated in the sense that factor mobility between sectors occurs in response to economic incentives.

The outlined theory seems to have relevance for Peru. The main elements of the theory have their correspondence with actual features of the Peruvian economy. The principal question remains whether the industrial sector can grow fast enough to cope with both the underemployment and unemployment reserves and the growth in the labor force. The answer can be given on empirical grounds and it will be attempted in the analysis to follow.

Agrarian reform enters into the picture in a natural fashion when a policy framework is adopted. That is to say, when the analysis of its extent and impact on the economy as a whole is done by considering explicitly the goals of economic policy to be achieved within a definite time horizon, the policy instruments which may be used for the attainment of the aims, and the formal relations linking the former variables with the latter.

Such an ideal treatment cannot be offered presently for the case of Peru for want of crucial statistical information.

It may be indicated, nevertheless, with the help of Thorbecke's analysis (21) how various measures constituting, broadly speaking, agrarian reform interact with the other aims of economic policy so far described in this chapter.
Agrarian reform may be defined as changes in rural institutions with the objective of improving rural levels of living.

Thorbecke, following Tinbergen (22, 23), in his distinction between instrument, changes in the economic structure, and reforms, lists the measures below as part of agrarian reform as just defined:

**Instruments**

1. Changes in tax rates and in tax incidence, e.g., for and as between tenants and landlords.

2. Direct or indirect subsidies such as those on fertilizers, tillage equipment and pesticides.

**Changes in structure**

1. The introduction of price support and credit programs.

2. The allocation of funds and facilities for research on improved seeds, farm management, fertilizer, etc.

3. Public investment in irrigation and fertilizer plants.

4. Public investment in social overhead capital (infra-structure), e.g., the building of intra- and inter-village roads.

5. Reclamation and settlement.

6. Improvements in credit and marketing facilities. These changes could take the form of publicly supported rural credit banks, state cooperatives, etc.

7. Education; larger public support of education, for example, higher salaries for teachers, subsidization of teacher training school construction.
8. Extension service which would include the dissemination of new information concerning farm management, farm technology, crop diversification and adult education.

9. Training of rural population in the acquirement of new industrial skills.


Reforms

1. Changes in the tenancy arrangements, relating to distribution of the product (as between owners and tenants), terms of the lease, security of the tenants, water rights, etc.

2. Land redistribution; changes in the property rights of various groups and individuals.

3. Land consolidation; reduction in fragmented and non-contiguous tracts.

4. Nationalization of agriculture; collective farming.

In practice, it is almost an impossible task to assign a phase to the actual state of development of those countries to which the outlined theory being partly histoire raisonnee is applicable, especially as regards to phases one and two. It would seem that one phase extends itself into the next, so that parts of the agricultural economy can be said to correspond to phase one while others to phase two. In fact, the agricultural sector of Peru contains sub-sectors fully commercialized, located in the Coast, in which the characteristics of phase three can be found. But for Peru, the identification of the stagnating agricultural sector from which the actual labor migration has taken place, is that of the Sierra.
A number of agrarian policy means can play an important role in regard to the present phase of Peruvian development. First, a land redistribution eliminating as much as possible of land tenancy and creating a class of small landowners, appears desirable.

Such a reform in the medium run may or may not be competitive with economic growth as a whole, the latter depending on a basic assumption and a number of specific means which can be adopted concurringly.

The basic assumption is about the nature of the production functions in the sub-sectors where the land reform takes place. Under increasing returns to scale, a division into smaller independent farms entails reduction of total output, if production was going on efficiently under the previous regime.

Under constant returns to scale, no effect is to be produced by the size of the farms. While under decreasing returns to scale through a reorganization into smaller productive units, an increase in total agricultural output is made possible.

Empirical research (24) suggest that only in the highly advanced agricultural sectors of the developed economies increasing returns to scale are present. And it may be possible to question the efficiency of the producing units as administered in a system of absentee landlords.
The concurring agrarian means, which should be adopted in order to make land redistribution complementary with the objective of economic growth, are those that first, facilitate the new landowners into the unaccustomed role of decision maker. Such are extension services which disseminate new information concerning farm management, farm technology, crop diversification and adult education. And second, those that directly or indirectly enter into the revenue-cost aspects of management, such as price support and credit programs, public investment in irrigation and fertilizer plants, direct or indirect subsidies on fertilizers, tillage equipment, etc.

To the extent that the above measures are effective, both economic growth and income redistribution in favor of the poorer classes move in the same direction. In case that the above measures are for whatever reason ineffective or not adapted, a reduction in agricultural output might be expected in the medium run which would lead to a slowdown of the aggregate rate of growth as a consequence of the increasing costs to the industrial sector. Nevertheless, in such eventuality the internal terms of trade favoring agriculture will not fail to improve the relative position of the rural areas.

From the standpoint of the employment objective, much depends on the success of the above phase in converting passive land laborers into adequate managers of productive
units. If success is assumed, there follows an increasing scope for training of rural population in the acquirement of new industrial skills. The breakdown of feudal mode of life may signify an increase in voluntary labor mobility or, in other words, a decrease of what Cho (25) calls "tradition-oriented underemployment". In such a case the presence of labor force with utilizable skills may provide an important stimulus for further development of the industrial sector along labor-intensive techniques, reducing thereby both unemployment and the growth stress on the balance of payments.

The impact of agrarian reform on price stability may be negative if adequate complementary means are adopted via budget deficits, although the direct cost of agrarian reform was calculated to be (26) well within the budget capacities of the Peruvian government.

Balance of payments

The balance-of-payments problems associated with Peruvian economic development are not as grave as is the case with most developing countries. The main reason is that the export sector has been growing, as it was shown, faster than aggregate national product, while the terms of trade have not in the recent years fluctuated too wildly, due to a satisfactory degree of diversification. This has permitted capital good imports to take place so far without significant dependence on foreign capital inflows.
An additional factor, favorable to the balance of payments, is that the rising domestic price level has not led to excessive demand for imported consumption goods, or a need for prohibitive trade restrictions, which would intensify inflation as has been the case for a large number of countries on the way to industrialization.

The state of income distribution is to be held the cause of this fact. The greatest proportion of consumption-good imports meets demand of the higher income classes and provides the basic source of indirect tax revenue for the government.

On the other hand, inflation does not affect crucially the international competitiveness of the main export products. The labor content of the mining sector is so relatively low as not to matter much, and wages in the exporting agricultural sector lag behind, rather than lead general prices. Export prices as a whole are mainly determined on the world markets.

Peru, consequently, finds itself in the exceptional position of not having to fear excessively the impact of inflation on its balance of payments because first, its exports are not greatly dependent on the domestic price level, and second, the low per capita income of the labor force prevents the demand for imported consumption goods from assuming an alarming magnitude.
The compatibility of balance-of-payments equilibrium with the other aims of economic policy can be analyzed in general terms via the impact of the pursuit of each objective on import requirements, given the level of export projections.

Thus, if economic growth is pursued mainly through industrialization, the strain on the balance of payments, due to the high import content of investment projects, may be expected to be eased by import substitution entailed by increasing domestic industrial capacity.

If, on the other hand, a more balanced path is sought via investment in infrastructure and agrarian transformation, the balance-of-payments strain may not be expected to be mitigated in the medium run.

Growth in employment signifies growth of effective demand and hence, of imports. Partly, however, increase in employment may mean substitution of labor for capital and consequently a reduction of capital-good imports.

Improvement in the state of income distribution definitely implies a higher level of demand for imported consumption goods.

The precise measure of these effects can only be attained with the help of an econometric model.

**Summary and conclusions**

The discussion centered around five major areas of economic policy concern and their interrelations in the context
of Peruvian development. Aggregate economic growth as a development target was contrasted with growth of consumption as a fairer welfare index in the case of Peru and the possibility of a conflict of these two was indicated in the absence of wide margins of unutilized resources necessary for growth.

Next, the various types of underemployment present in the economy were briefly reviewed and the objective of minimum underemployment and unemployment levels was suggested to be competitive with maximal aggregate growth because of the effect of capital-intensive techniques on the productivity of labor and their general efficiency.

Price instability and its possible effects on savings, income distribution and composition of private investment were reviewed.

It was suggested that the objective of price stability is compatible with additional voluntary savings for capital formation, which would be secured by a domestic capital market and a reduction of capital flight, and consequently, in the long run, under Peruvian conditions avoidance of inflation is compatible with economic growth. Deficit financing can be held within reasonable limits by recourse to higher tax revenues via introduction of income tax and foreign borrowing.

In respect of income-distribution policy, agrarian reform was suggested as the most promising remedy. A newly
formed farmer class, combined with an adequate level of complementary public policies concerning extension and training, can progressively raise production and at the same time lead to higher rates of mobility of workers into industry, provided a sufficiently rapid pace of industrial development can absorb the labor surplus.

At any rate, it was shown that the objective of income distribution is served well by agrarian reform because if the primary effect of titles-on-land transfer is unquestionably beneficial to the rural population, the secondary effect, operating through a possible reduction in the first stage of total agricultural output, would improve even further the relative position of the rural population by the internal terms-of-trade effect. This effect, however, is not to be wished for because the inflationary pressures caused by food product deficits may prove a great obstacle to industrial development, and ultimately to the objective of attainment of an integrated national economy.

Balance-of-payments equilibrium as a policy objective is complementary with the aim of price stability and possibly, to some extent, with an unbalanced development path favoring industrialization, while it is competitive with the aim of greater income equality and development via social overhead investment. Nevertheless, the policy problems related to foreign trade do not seem to have the urgency of the four other major areas outlined, although it is possible to
imagine a situation for Peru, where the effective limit to the attainment of the other objectives, especially of aggregate growth and price stability, is provided by the balance of payments.

No a priori reasoning can give an exact measure of the complementarity or competitiveness of the discussed policy aims. In any concrete situation such a measure can be approximated by the use of a model describing the economic structure, quantifying the economic aims and identifying the instrument variables available to the policy makers for the attainment of the objectives.
In recent years the theory of economic policy developed into a new branch of economics separate from the study of specific economic policies. It provides a general logical framework within which any special branch of economic policy can be analyzed.

Its scope seems to be so large as to encompass all activities concerned with defining economic objectives, deciding on a course of action leading to the attainment of the objectives and providing a basis or a set of criteria, by which the results of the actions can be evaluated.

At the same time, world-wide interest in matters of planning economic development by policy means of increasing efficiency has brought about a natural union of the theory of economic policy with the disciplines related to the construction and use of economic models.

A brief outline of the theory of economic policy and of the use of macroeconomic models for development planning will be presented before introducing the policy models of the Peruvian economy in the following chapters.

The theory of economic policy was first conceived as a unified system capable of being treated in a rigorous analytical scheme by Tinbergen, whose writings in the field
(22, 23) still remain basic. Further theoretical developments are due to Theil (27, 28), Frisch (29) and a number of Dutch economists among Tinbergen's followers. A recent extension has been attempted by Fox, Sengupta and Thorbecke in Reference 30.

The largest part of this section will be devoted to a discussion of Tinbergen's main ideas based upon Reference 22.

The subject of the discussion is, more strictly, Tinbergen's theory of quantitative economic policy as distinct from qualitative economic policy. The latter consists in measures which either intrinsically resist mathematical description such as, e.g., nationalization of an industry, or by changing drastically the economic environment may produce effects which because of structural changes are very difficult to quantify in an ex ante sense, such as, for instance, an agrarian reform. The changing rules may be consumption and saving habits, production functions, etc.

Quantitative economic policy assumes a basic set of relations linking economic variables to be valid. These relations, or rules, constitute the economic model of usual economic theory.

The other elements of quantitative economic policy are a social welfare function defined on some of the model's variables and certain boundary conditions defining the permissible range of variation for others.
From the standpoint of positive economic theory, the economic model may be thought of as a collection of relatively simple rules constructed for the purpose of analytical comprehension of selected economic phenomena. Usually, the classification of the rules, having the form of mathematical relations, is in terms of behavioral (including institutional), technical and identity relations among economic variables. The latter are usually classified into two broad categories—endogenous and exogenous variables. The joint implications of the model are stated in terms of solutions for the endogenous variables, being the unknowns, while the exogenous variables and the coefficients of the original system called the structural coefficients are the knowns.

In cases of "well-behaved"* economic models, it is possible to produce the transformation by which each of the endogenous variables is expressed as a combination of the exogenous variables weighted according to the particular coefficient structure. The thus transformed system is called the reduced form of the model.

From the standpoint of Tinbergen's theory of economic policy, the endogenous variables are distinguished into target variables and irrelevant variables. Target variables

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*By "well-behaved" is meant that the economic models satisfy the mathematically necessary and sufficient conditions for solubility.
quantify the aims of economic policy. Each one of them enters the social welfare function and, in principle, social welfare is indicated by a weighted average of the values assumed by the target variables. The irrelevant variables are those explained by the system but which do not affect social welfare, and formally, which are not included in the welfare function.

The model's exogenous variables are classified into policy instruments and non-controlled variables or data. The latter are those factors influencing the course of the economy, which are not subject to control by the policymakers. The instrumental variables indicate the means available to the policymakers to attain the targets via the structural relationships connecting the former with the latter.

The economic policy problem consists in finding the constellation of values for instrument variables which satisfies either a maximum or an otherwise specified social welfare criterion subject to possible additional boundary conditions on its permissible range.

A slightly more general approach elaborated chiefly by Theil introduces the idea that the use of instruments may have direct welfare implications. Formally, then, the economic policy problem can be stated as follows, assuming linearity of the model's structural relationships:
\[(4.1) \quad \text{Max } W(y,z) \text{ subject to}\]
\[(4.2) \quad Ay = Bz - Cu\]
\[(4.3) \quad y_{\text{min}} \leq y \leq y_{\text{max}}\]
\[z_{\text{min}} \leq z \leq z_{\text{max}}\]

where \(W\) is the welfare function containing as arguments vector \(y\) of target variables and vector \(z\) of instruments; \((4.2)\) is the structural model connecting targets with instruments and non-controlled exogenous variables \(u\), after the elimination of irrelevant variables through the coefficients \(A, B, C\), being matrices of appropriate order; and \((4.3)\) being the boundary conditions on permissible range for \(y\) and \(z\).

In practice the most difficult part of the policy problem is to formulate the social welfare function. The logical purity of ordinal utility theory concerning individual choice under static conditions cannot be preserved when one moves into the field of social choice under individual values \((31)\), and an ad hoc welfare function reflecting the policymaker's preferences is called for in many concrete cases. Such a welfare function can be constructed according to procedures, which lead to the establishment of the community's prevailing values \((32)\) as, for example, in Holland where representatives of important pressure groups meet in council in order to determine the "rates of substitution" between the various policy targets. The thus determined social welfare function
has, usually, cardinal characteristics so that marginal welfare effects are assumed measurable and not only their ratios.

A profound analytical difficulty in the specification of the welfare function nevertheless remains, and is exactly the implication of inter-group or inter-target welfare comparisons that the welfare function is expressible as a scalar (3), whilst in many cases it would represent the different social goals more adequately in the form of a vector. However, vector optimization techniques have not as yet developed to constitute a general theory.

Tinbergen has not dealt at length with the problems of the specification of the objective function. He usually proceeds to specify it either by assuming fixed targets or by allowing flexible targets, and also mixed cases where some targets are fixed and others flexible.

In case of a fixed-target policy model, after elimination of the irrelevant endogenous variables, one solves for the instruments which are compatible with the target values. Formally, by rewriting (4.2)

\[(4.2') \quad Bz = Ay + Cu\]

one obtains

\[(4.4) \quad Z = B^{-1}Ay + B^{-1}Cu\]

which specifies uniquely the instrument vector compatible with the fixed ends, if matrix B is square and non-singular.
Several interesting structural cases can be distinguished in the above scheme: a) If matrices B and A are strictly diagonal then only one instrument can be used for the attainment of a given target. The economic system described by the model is not characterized by simultaneity. This corresponds to the situation envisaged by some old views according to which economic policy instruments had each its compartment of separate application. b) If the matrices B and A are triangular and of similar form, the economic model is said (33) to be recursive or consecutive. Such a structure allows a "pure causal chain" interpretation in the sense that the first equation alone determines the corresponding endogenous variable; the second equation, after the solution to the first is fed into it, determines the second endogenous variable, and so on. c) It may be possible to distinguish within each matrix sub-blocks of coefficients forming independent sub-systems. In such circumstances each sub-system can be handled independently of the others and the policy problem is decomposed into as many separate ones as there are sub-systems.

Economic-policy degrees of freedom enter into the picture if the number of instruments exceeds the number of targets. In such a case, a number of instruments equal to that difference can be assigned arbitrary values, the remaining being determined by the policy model.
In the opposite case, the fixed-target policy model is incompatible.

Equational degrees of freedom are implied if matrix B is singular. This indicates a model constructed with redundant relationships. Arbitrary values can be assigned to the surplus targets and the policy model is then determined.

In case of a flexible-target, or mixed policy model, optimization techniques must be employed such as the Langrangean method, if calculus is applicable, or linear and non-linear programming techniques. Associated with the case of flexible-target or mixed, models is the important concept of efficiency or effectiveness of instruments. Referring to (4.1), maximization implies

\[
\frac{dW}{dz_j} = \sum_i \frac{\partial W}{\partial y_i} \frac{dy_i}{dz_j} + \frac{\partial W}{\partial z_j} = 0
\]

assuming differentiability and other regularity conditions as fulfillment of the second-order conditions. The term \( \frac{dy_i}{dz_j} \) measures the effect of instrument \( z_j \) change on target variable \( y_i \), when all other instruments are held constant. The term \( \frac{\partial W}{\partial y_i} \) measures the welfare impact of a change in \( y_i \) target variable. The partial welfare effect of a change in instrument \( z_j \) is given by the term \( \frac{\partial W}{\partial z_j} \). Under cardinal interpretation of the function \( W \), instruments can be classified according to their welfare impact within each model.
The recent developments of the theory of quantitative economic policy are mainly concerned with problems of specification of the social preference function and some basic logical and technical aspects of optimality of policy solutions under more complicated situations than those envisaged by Tinbergen. Dynamic structures with stochastic elements are being progressively studied with tools borrowed from control theory which promise to enlarge the scope of economic policy theory and models in regard to the subtlety of questions capable of being adequately answered within their framework.

Construction and use of macroeconomic models for development planning

The discussion in this section will be confined to some non-statistical* aspects of aggregate macroeconomic model building for the purpose of application to development design. Macroeconomic models designed primarily for stabilization policies will not be discussed although it may be said that fundamental formal differences arise not so much in the specification of the relationships as in the problems considered central to the analysis given the model.

Of course, differences in the specification of relationships also exist as models for development planning are

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*Extensive discussion of statistical methods and data requirements for policy models may be found in (30, 34).
mainly concerned with trends to prevail in the medium and long run and future conditions for macroeconomic equilibrium (34), while stabilization models focus chiefly on short-term fluctuations of various components of aggregate demand. The longer the time horizon the more important the capacity-generating effects of investment will be whilst price movements, in general, are extremely difficult to explain in the long run. Consequently, development models may not incorporate price-formation equations and stabilization models may neglect the capacity effect of capital formation. Similarly, introduction of lags may be important for short-run analysis; over long periods they may be neglected without great loss.

It is usual for development policy models to specify a fixed proportions production function although both capital and labor are in elastic supply over time. This may reflect to a large extent ignorance of the actual production functions underlying the economy, inability to forecast the evolution of technology and the cost factors detemining the aggregate expansion path.

Nevertheless, the practically more important differences are those arising from the type of problems posed and the mode of analysis.

With respect to the latter, the scope of ceteris paribus analysis in a development planning model is substantially more limited than in a stabilization model. The reason is that partial effects may be correctly estimated only as long
as counterforces are not activated in response to the change caused by the partial effect. In a long enough time period, such forces would cause the observable effect of the initial change to be confounded with theirs, while the model may not be (and in practice never is) complete enough to account for these forces. Economic systems, as currently formulated, suffer not only from inability to incorporate perturbations in the large but also perturbations in the long.

It has been seen that the problem of economic development can be analyzed as an interrelated whole, whose partial components are the specific questions of level of income and employment, the degree of price stability, the state of income distribution and that of the balance of payments.

It has mainly been Chenery's contribution (35, 36, 37) to exemplify the principles of model construction specifically designed for medium and long term use and taking into account the multiplicity of aims such as stated above. The following discussion owes heavily to Chenery's ideas.

A development program must provide guiding rules for a variety of policymaking agencies such as to guarantee consistency with the overall aims. A necessary condition for consistency in the above sense is that the anticipated use of scarce resources over the planning horizon must not exceed the anticipated supply. Further, the aims must be formulated with some knowledge of the feasibility range and the principal alternatives by which they can be achieved.
The preceding statements specify thus the basic aspects
to be considered in the construction of macroeconomic models
for use in development planning. Namely: a) The effective
limits to economic growth must be evaluated. The presence
of separate and conflicting limits to growth is made into the
cornerstone of growth theory following Harrod's pioneering
analysis (38). Such may be the existing factor supply and
its change over time, the rate of savings, the foreign capi­
tal inflow, the composition of demand, and others. b) The
model must include the important policy alternatives.
c) Policy instruments must be connected with the aims through
behavioral, institutional and technical relationships which
must be valid over the planning period.

When a, b and c are satisfied, it is possible to trace
quantitatively the range of feasibility of the policy aims
expressed in terms of alternative values of the instrument
variables.

The problem of selection of a specific constellation of
targets and instruments is solved by means of the preference
function, or its rough substitutes such as boundary condi­
tions, or even by arbitrary choice by the policymakers justi­
fied in some manner.

The use of aggregate policy models does not end with the
broad program outlines achieved by solving them. Most devel­
opment decisions are finally concretized in specific projects
within each economic sector. The results of aggregate
policy analysis must be translated into their sector components. In countries with simple economic structure, the procedure of translation can be straightforward. No considerable interindustry analysis is needed and requirements for the few non-imported intermediate goods such as energy and cement, may be estimated in a simple manner. Analysis of exports by commodities is imperative for the estimate of the balance of payments limitation to which sectoral projections, made directly from aggregate results, are chiefly subject. It is suggested by Chenery that Peru is close to the lower limit of economic complexity for which extensive interindustry analysis is necessary.

The combination of an aggregate model with an input-output scheme when the latter is useful, can be achieved in a natural way by starting the sectoral analysis after limiting the range of policy alternatives attained via the former.

Values of national income, total consumption, total investment, total exports and other macroeconomic magnitudes will be taken as fixed elements of final demand and intermediate sectoral demands can be thereupon derived. Sectoral investment and imports can be tried at various levels since they may be taken as policy instruments. Import-substitution policy can be determined via the balance-of-payments equilibrium condition and final sectoral production levels solved. By this procedure, the development program outlined through the macroeconomic model attains its final expression in terms
of resource allocation decisions. It should be noted that in practice a number of iterations between the two stages may be required before consistency is achieved. This implies that some parametric coefficients of the aggregate model must be revised in the light of input-output analysis, and consequently the aggregate results, this giving rise to new sectoral implications and so on, until a satisfactory degree of agreement is reached.

The optimality aspects, formally defined, of any given solution can only be tested within a mathematical programming framework. Such a procedure would require a much higher degree of accuracy of the available data and more statistical information particularly on capital inputs for the improvements to be worth pursuing.

In the absence, as is generally the case, in developing countries of adequate quantity and quality of data, the consistency and the efficiency of the solution must be considered as sufficient tests.

Consistency is achieved by means of the iterations referred to while efficiency is tested by exploring the implications of alternative choices within a consistent overall scheme.

It seems that if development policy is to be designed for and applied to the present situation (absence of highly qualified planning experts, lack of refined empirical information), ad hoc decisions based on intuitive judgment are
almost unavoidable. On the other hand, it is quite possible to avoid certain procedures eloquently criticized by Frisch (39), according to which planning depends on forecasting the future state of affairs including the actions of policymakers, which will crucially influence the actual course instead of properly designing those actions and obtaining thereby the benefits of a higher level of rational control over the economic events.
CHAPTER V. A HOMOGENEOUS GROWTH MODEL FOR THE PERUVIAN ECONOMY

In this chapter a simple Harrod-Domar (38, 39) type of aggregate growth model will be presented for the purpose of studying the various components of the derived growth equation in their relation to the rate of growth of income, as applied to the Peruvian economy.

Use of global growth rates in development planning

The adoption of a global growth rate is, usually, a first step in many empirical attempts to design a development program, so, for instance, in (41).

At this stage the adopted assumption is intended as an approximation to a desired and feasible pace of growth. The rate of growth which is going to prevail is, of course, dependent on the actual policies, and may deviate from the one originally assumed. The purpose of the first iteration is, then, a look at the feasibility of the broad analytical requirements consistent with a quantitative specification of development. A rough estimate of the average output-capital ratio, which can also be viewed as the average rate of return on investment, and the rate of available investible resources to the economy as a whole suffice to establish a global growth rate.

Once a global rate is temporarily established, its use will depend, among others, on the following facts:
The core of the economic plan may consist in specifying investment requirements or resource use compared with supply of resources. Each of the latter's components, such as private domestic savings, government revenues available for capital formation, and imports, must be projected consistently with projected or desired growth. These magnitudes may be thought wedded in a specific manner with total income, so that once a value is given the latter, the former are also numerically determined.

Further, as the specification of sectoral investment and sectoral growth rates is in most applied development models the "concretization" stage, the overall growth imposes a first general constraint against which the sectoral rates must be checked. Such a check may be thought to complete the stage of first iteration of a development plan.

The next step may be a more detailed investigation of the global growth rate as a function of behavioral and policy parameters, examine the various constellations of the latter compatible with a given rate and assess the partial effects of changes in those parameters which specify a policy program.

In (41) the procedure did not enter into the just described analysis. The seven percent growth rate assumed amounts essentially to a direct extrapolation of the recent global economic experience of Peru making allowance for possible changes in the marginal output-capital and the
investment (or savings)-output ratio. It corresponds to the most optimistic combination from the choice set considered (Table 20).

Table 20b. Growth rates for specified values of $\alpha$ and $\nu$

<table>
<thead>
<tr>
<th>$\alpha/\nu$</th>
<th>0.27</th>
<th>0.22</th>
<th>0.17</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.22</td>
<td>0.0594</td>
<td>0.484</td>
<td>0.0374</td>
</tr>
<tr>
<td>0.23</td>
<td>0.0621</td>
<td>0.506</td>
<td>0.0391</td>
</tr>
<tr>
<td>0.24</td>
<td>0.0648</td>
<td>0.0528</td>
<td>0.0408</td>
</tr>
<tr>
<td>0.25</td>
<td>0.0675</td>
<td>0.0550</td>
<td>0.0425</td>
</tr>
<tr>
<td>0.26</td>
<td>0.0702</td>
<td>0.0572</td>
<td>0.0442</td>
</tr>
</tbody>
</table>

where $\frac{1}{\nu}$ marginal output-capital ratio and $\alpha$ investment ratio.

The model

The model consists of a set of assumptions about private saving, the foreign trade sector, the public sector, a technological relationship, the national income identity and a balanced budget equilibrium condition.

Technological relationship

(5.1) \[ \Delta Y = \frac{1}{\nu} (I^P + I^G) \]

where $\Delta Y = Y_{t+1} - Y_t$ is the increment in national income made possible by the sum of private and public gross investment, $I^P$ and $I^G$ respectively, with a one-year lag. An
implicit time subscript is assumed for all variables. The marginal capital-output ratio is \( v \).

**Private saving function**

\[ S^p = s^p (Y - T^d) \]

\( S^p \) is gross private domestic saving, \( s^p \) the propensity to save out of disposable income. \( T^d \) is direct tax payments.

**Foreign trade sector equilibrium condition**

\[ M - E - Z = F^G + F^P = F \]

where \( M \) is total imports, \( E \) total exports and \( Z \) the terms-of-trade effect (as defined in Chapter II). Consequently, \( E + Z \) defines the import-capacity of exports and \( F \) the balancing foreign capital inflow.

**Direct tax function**

\[ d = \frac{\tau^d}{Y} \]

\( \tau^d \) is the direct tax rate.

**Indirect tax function**

\[ t = \frac{\tau^i}{Y} \]

\( \tau^i \) is the indirect tax rate.

**Government consumption expenditure**

\[ G = C^G (T^d + T^i) \]

\( C^G \) is the "propensity" of the government to consume out
of tax revenues. The next relationship defines gross national income. The term $C^P$ defines private consumption.

**Income identity**

\[
Y = C^P + C^G + I^P + I^G + E + Z - M
\]

**Balanced-budget equilibrium condition**

\[
I^G = S^G + F^G
\]

\[
S^G = (1 - c^G) (T^d + T^i)
\]

The government sector relationships are based on the simplifying assumption that no other sources of revenue exist than taxation for government consumption. Of course, revenues from public enterprises and domestic debt exist also. Foreign public revenues (net foreign public investment) are assumed, realistically, to be expended completely on public investment. Domestic debt is of very small magnitude in Peru while public enterprises do provide an additional source of revenue. But it is extremely difficult with existing data to distinguish net revenues of public enterprises. Many indications suggest that the level of the latter magnitude is relatively low, so that the simplification made does not alter fundamentally the picture of the real economy.

The above relationships make up a simple macroeconomic picture of the Peruvian economy. It goes without saying that the simplicity of their form is quite restrictive.
Nevertheless, the following remarks can be made in favor of such formulation at this stage.

a) If the model were to consist of general linear equations, in the long run the influence of the constant terms, from the standpoint of a growth formulation, tends to zero.

b) For medium and long-term planning, it is possible to consider a specific homogeneous structure as a desired equilibrium state.

c) It is very convenient mathematically to deduce the growth implications of alternative homogeneous structures. Since for any given time it is informative to describe an economy in terms of ratios of certain magnitudes, a homogeneous formulation simply carries such a description a few steps further.

Derivation of growth equation

Define the growth rate of income

\[ r_y = \frac{\Delta Y}{Y} \]

From the income identity (5.7) one derives the condition

\[ (5.9) \quad S^P + S^G + F = I^P + I^G \]

By substitution from the other equations, one obtains

\[ (5.10) \quad v \Delta Y = s^P (1-c^v) Y + (1-c^G) (c^d + c^i) Y + F \]
\begin{align*}
(5.11) \quad r_y &= \frac{1}{v} \left( s^P (1 - \tau^d) + (1 - c^G) (\tau^d + \tau^i) + f \right) \\
\text{by putting } f &= \frac{F}{Y} \\
(5.11') \quad r_y &= \frac{1}{v} \left[ s^P + (s^G - s^P) \tau^d + s^G \tau^i + f \right] \\
\text{by defining } 1 - c^G &= s^G
\end{align*}

The expressions \((5.11, 5.11')\) are the system's basic growth equation. The growth rate of income is expressed as a function of the marginal capital-output ratio, the propensity to save of the government, the two tax coefficients and the ratio of foreign capital inflow to income. It is readily seen as a more general version of the simple Harrod-Domar equation.

Nearly all the parameters involved in the growth equation can be considered instruments of economic policy. Of course, the capital-output ratio, the propensity to save of the private sector, and foreign borrowing are less directly amenable to economic policy control than are tax rates and the composition of public expenditure.

In order to translate the aggregate values of those parameters into concrete and consistent policy measures, an additional analytical scheme is needed to examine the structure of taxes in greater detail, as for instance, from the standpoint of incidence or its impact on the composition of foreign trade, etc.
Equally, the welfare implications of instrument use must be taken explicitly into account. Instrument use may be associated with social costs such as, for example, an increase in foreign indebtedness, limitations to the private sector entailed by direct taxation in case of a laissez-faire doctrinal orientation of the government, or positive social welfare, such as an increase in public expenditure on health, education, etc., increasing the role of the public sector in case of "socialistic" leanings of the policymakers.

The above remarks are intended as a partial indication of the limitations of this chapter's analysis.

**Global growth rate and the effectiveness of policy instruments**

The growth implications of small changes in the policy parameters are evaluated by the partial derivatives of $r_y$ with respect to each one of the arguments appearing in Equations (5.11) or (5.11').

Specifically,

\[
\begin{align*}
(5.12) \quad \frac{\partial r_y}{\partial \frac{1}{v}} &= s^p (1-\tau^d) (1-c^G) (\tau^d + \tau^i) + f \\
(5.13) \quad \frac{\partial r_y}{\partial s_p} &= \frac{1}{v} (1-\tau^d) \\
(5.14) \quad \frac{\partial r_y}{\partial s} &= \frac{1}{v} (\tau^d + \tau^i)
\end{align*}
\]
(5.15) \[ \frac{\partial r_y}{\partial 1} = \frac{1}{v} (s^g - s^p) \]

(5.16) \[ \frac{\partial r_y}{\partial t^1} = \frac{s^G}{v} \]

(5.17) \[ \frac{\partial r_y}{\partial t^f} = \frac{1}{v} \]

the expressions (5.12) through (5.17) imply, among others, the following qualitative statements.

a) The effect on growth of changes in the capital-output ratio is measured by the total rate of investible resources.

b) The higher the level of direct taxation, the smaller is the influence of changes in the propensity to save of the private sector on the rate of growth.

c) The influence of direct taxes on growth is positive only if the propensity to save of the government is higher than that of the private sector. Indirect taxes contribute to growth if government undertakes capital formation at all, and more than direct taxes by the value of the private sector's propensity to save out of disposable income.

d) Foreign capital inflow has the greatest impact on growth with the possible exception of the capital-output ratio under the unrealistic assumption that amortization and interest payments are ignored.
The stated propositions are made ceteris paribus. This means that they are valid for small changes in the structure.

What makes for "smallness" in any concrete case depends on the absence of counterforces activated by the change not accounted for by the model.

Under the just stated limitation, iso-growth curves can be derived with slopes measuring the marginal rates of substitution between policy instruments. To do so, the total differential of (5.11) or (5.11') is obtained and set equal to zero.

\[
(5.18) \quad dr = \frac{\partial r_Y}{\partial \frac{1}{V}} d\frac{1}{V} + \frac{\partial r_Y}{\partial s^P} ds^P + \frac{\partial r_Y}{\partial s^G} ds^G + \frac{\partial r_Y}{\partial c^d} dc^d + \frac{\partial r_Y}{\partial t^u} dt^u + \frac{\partial r_Y}{\partial r^v} df = 0
\]

For any two instruments, the other remaining constant, the iso-growth curve is defined by expressions such as

\[
\frac{ds^P}{dt^d} = -\frac{\partial r_Y/\partial s^P}{\partial r_Y/\partial s^P} = -\frac{s^G - s^P}{1 - c}
\]

for the case of private savings and direct taxes.

Negative slopes of the iso-growth curves imply complementarity, positive slopes competitiveness, of the instruments with respect to the policy targets.

The sense of complementarity and competitiveness is that where the former prevails, the adjustment of the one
Table 21. Marginal rates of substitution of instrument variables $\frac{\partial z_i}{\partial z_j}$

<table>
<thead>
<tr>
<th>j ( \frac{1}{v} )</th>
<th>i ( \frac{1}{v} )</th>
<th>( s )</th>
<th>( G )</th>
<th>( d )</th>
<th>( \tau )</th>
<th>( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{v} )</td>
<td>1</td>
<td>$\frac{h(*)}{v(1-\tau^d)}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{s-s}{v h}$</td>
<td>$\frac{s}{v h}$</td>
<td>$\frac{1}{v h}$</td>
</tr>
<tr>
<td>( s )</td>
<td>( \frac{v(1-\tau^d)}{1} )</td>
<td>1</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
</tr>
<tr>
<td>( G )</td>
<td>( \frac{v h}{\tau + \tau^d} )</td>
<td>( \frac{1-\tau^d}{\tau + \tau^d} )</td>
<td>1</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
<td>$\frac{1-\tau^d}{\tau + \tau^d}$</td>
</tr>
<tr>
<td>( d )</td>
<td>( \frac{v h}{G-s} )</td>
<td>( \frac{s-s}{G-s} )</td>
<td>( \frac{G-P}{G-s} )</td>
<td>1</td>
<td>$\frac{G-P}{G-s}$</td>
<td>$\frac{G-P}{G-s}$</td>
</tr>
<tr>
<td>( \tau )</td>
<td>( \frac{v h}{G} )</td>
<td>$\frac{s-s}{G}$</td>
<td>( \frac{G-P}{G-s} )</td>
<td>$\frac{G-P}{G-s}$</td>
<td>1</td>
<td>$\frac{G-P}{G-s}$</td>
</tr>
<tr>
<td>( f )</td>
<td>( \frac{v h}{1-\tau^d} )</td>
<td>( \frac{1}{1-\tau^d} )</td>
<td>( \frac{1}{\tau + \tau^d} )</td>
<td>( \frac{1}{\tau + \tau^d} )</td>
<td>( \frac{1}{\tau + \tau^d} )</td>
<td>1</td>
</tr>
</tbody>
</table>

* $h = s^P(1-\tau^d) + (1-c^G)(\tau^d + \iota) + f$
### Table 22. Effectiveness of policy instruments

<table>
<thead>
<tr>
<th></th>
<th>$v = 5$</th>
<th>$v = 4.5$</th>
<th>$v = 4$</th>
</tr>
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<tbody>
<tr>
<td>$\frac{\partial y}{\partial s^P}$</td>
<td>0.1884</td>
<td>0.2072</td>
<td>0.2355</td>
</tr>
<tr>
<td>$\frac{\partial y}{\partial s^G}$</td>
<td>0.0304</td>
<td>0.0334</td>
<td>0.0380</td>
</tr>
<tr>
<td>$\frac{\partial y}{\partial r^d}$</td>
<td>0.0024</td>
<td>0.0026</td>
<td>0.0030</td>
</tr>
<tr>
<td>$\frac{\partial y}{\partial r^i}$</td>
<td>0.0444</td>
<td>0.0488</td>
<td>0.0555</td>
</tr>
<tr>
<td>$\frac{\partial y}{\partial f}$</td>
<td>0.20</td>
<td>0.22</td>
<td>0.25</td>
</tr>
<tr>
<td>$\frac{\partial y}{\partial v}$</td>
<td>0.2947</td>
<td>0.2947</td>
<td>0.2947</td>
</tr>
</tbody>
</table>

### Table 23. Marginal rates of substitution of policy instruments

$$\frac{dzi}{dzj}$$

<table>
<thead>
<tr>
<th>$j$</th>
<th>$i$</th>
<th>$s^P$</th>
<th>$s^G$</th>
<th>$\tau^d$</th>
<th>$\tau^i$</th>
<th>$f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s^P$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>6.197</td>
<td>78.5</td>
<td>4.243</td>
<td>0.942</td>
<td></td>
</tr>
<tr>
<td>$s^G$</td>
<td>0.1614</td>
<td>1</td>
<td>12.666</td>
<td>0.6847</td>
<td>0.152</td>
<td></td>
</tr>
<tr>
<td>$\tau^d$</td>
<td>0.0127</td>
<td>0.0789</td>
<td>1</td>
<td>0.0541</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>$\tau^i$</td>
<td>0.2357</td>
<td>1.46</td>
<td>1.848</td>
<td>1</td>
<td>0.222</td>
<td></td>
</tr>
<tr>
<td>$f$</td>
<td>1.0616</td>
<td>6.579</td>
<td>8.333</td>
<td>4.51</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Diagram 2. Isogrowth Curves

SLOPE = 0.942

$T^d = 0.058$

$S^G = 0.222$

SLOPE = 0.90

$T^d = 0.10$

$S^G = 0.33$
instrument necessary to preserve a given value of the target variable, \textit{ceteris paribus}, must be made in the opposite direction to the movement of the other, and vice versa for the latter. For example, if the government savings rate is greater than the private sector's (negative slope) the same global growth rate can be achieved, \textit{ceteris paribus}, by a higher private saving propensity and an appropriately lower direct tax rate and vice versa*. If, however, the government saves a lower proportion of its revenues than does the private sector of disposable income (positive slope), then a given growth rate requires movement of private saving rate and of direct tax rate in the same direction.

By tabulating the values of the marginal rates of substitution (as in Table 21), it is possible to provide useful policy guides as to the choice of instruments given a certain aim, either by direct reference to the magnitudes involved, or indirectly by evaluating the effectiveness of a certain combination in terms of its associated social cost (or value).

\textbf{Empirical results: The growth equation for the Peruvian economy and its implications}

The empirical results of this section are based on a range of parametric values assumed acceptable and feasible.

*Provided the direct tax rate is positive. It is possible for it to be negative in case the government subsidizes the private sector in excess of the level of direct taxes. In this circumstance exactly the opposite conclusion holds.
The judgement is rather intuitive and is founded on the data of Tables 1 and 2. First, a projection will be made on the basis of average values of the parameters observed in the years since 1960.

The capital-output ratio \( \frac{\Delta(k^{P}+k^{G})}{\Delta GDP} \) cannot be estimated directly from the data. Over the period 1950-1964 it has fluctuated wildly. Three values will be taken—a high 5, a medium 4.5 and a low 4. The influence of alternative assumptions about this parameter is extremely great but no more concrete result can be obtained at this stage than assuming the mentioned range corresponding to most researchers' judgement.

The sectoral composition of investment will affect the actual ratio crucially. It may be thought that if a development policy is designed via building of infrastructure the higher value is relevant, while the lower might prevail in case of emphasis on manufacturing and other types of small industry. A balanced program between the two extremes may imply the intermediate value.

The private sector's propensity to save out of disposable income over the period 1950-1963 fluctuated around three distinct levels, corresponding to the sub-periods 1950-1955, 1955-1960 and 1960-1963: 0.178, 0.148 and 0.21. The last value will be taken as likely to hold in the medium run.
The government savings as a proportion of tax revenues in the years 1960-1963 was about 0.22 with a marked tendency to increase.

The direct tax rate was about 0.058 while the indirect tax rate averaged about 0.094 in the same period.

The country's import capacity has not been exploited to the full on the average during the last years. As a result the balance of payments realized an average surplus of 0.0214 of aggregate income.

On the basis of the above considerations, the empirical growth equation extrapolating the experience of the recent years can be stated alternatively:

\[(5.19) \ y = 0.20 \ (0.21 \times 0.942 + 0.778 \times 0.152 - 0.021) = 0.0589\]

\[(5.20) \ y = 0.22 \ (0.21 \times 0.942 + 0.778 \times 0.152 - 0.021) = 0.0648\]

\[(5.21) \ y = 0.25 \ (0.21 \times 0.942 + 0.778 \times 0.152 - 0.021) = 0.0737\]

It is evident that for lower capital-output ratios than \(4\), the recent constellation of policy instruments can achieve even higher rates of growth than the target value of 0.07.

The growth implications of small changes in the parametric ratios are evaluated below for each level of the capital-output ratio.
Diagram 3. Isogrowth Curves
Under the assumed structure, next to changes in the capital-output ratio, foreign capital inflow and the private sector's propensity to save are the most influential factors to economic growth.

Various policy combinations will be examined mainly for the case of a high capital-output ratio. In the intermediate case, attainment of the target rate of growth appears to be guaranteed by full utilization of the country's import capacity.

Policy alternatives for a rate of growth of income 0.07 annually

In the event of a sectoral investment choice favoring the formation of social overhead capital, the capital-output expected to prevail is assumed to be 5. Under such assumption, the specified structure is unable to sustain the target global growth rate of seven percent annually. The combination of various policy instruments which may be used for the purpose of a higher growth rate will be examined in the following manner:

Equations (5.11) and (5.11') will be rewritten as to involve two policy degrees of freedom, or so as to express a given policy instrument in terms of a constant structure including a specified growth rate and an unknown policy parameter. In this form a range of compatibility is defined and
a single point on this range can be selected, corresponding to one policy alternative, on the ground of additional criteria.

The question which policy instruments should be considered for joint determination can be partly resolved by looking at the empirical Table 23 of marginal rates of substitution. Extremely high or low values indicate that great changes are needed in the value of one parameter to compensate for small changes in the other.

**Case 1: Foreign lending versus private saving**

The policy equation, when the government wishes to choose between the proportion of foreign capital inflow and that of private saving to achieve a seven percent annual growth, becomes:

\[
(5.22) \quad f = \left[ vr_y - s^G \left( \tau_d + \frac{r}{\tau} \right) \right] - \left[ (1-\tau^d) \right] s^P
\]

where the terms in brackets are taken as constant.

The numerical version of Equation (5.22) is:

\[
(5.22') \quad f = 0.3163 - 0.942s^P
\]

By assuming that, ceteris paribus, the full capacity to import will be utilized, but no recourse to net foreign capital inflows will take place, the propensity to save of the private sector must be raised to 0.3358 in order to attain the target level. Some consistent pairs within the range of Diagram 2 are listed on the following page:
Table 24. Proportion of capital inflows and private savings for a seven percent growth rate

<table>
<thead>
<tr>
<th>P</th>
<th>S</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3358</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.330</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>0.3251</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>0.3198</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>0.3145</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>0.3092</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td>0.3039</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>0.2986</td>
<td>0.035</td>
<td></td>
</tr>
<tr>
<td>0.2933</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>0.2880</td>
<td>0.045</td>
<td></td>
</tr>
<tr>
<td>0.2827</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

The conclusion one may draw from inspection of the listed values is, mainly, that if the government limits itself to these two policy instruments, the target level of growth cannot be attained. The proportion of foreign capital inflow typical of the countries in development is about 3% of national income. An upper limit of 5% of net foreign borrowing must be supplemented by a propensity to save of the private sector of 0.2827, which corresponds to a private savings-income ratio of 0.2666 approximately. It does not appear likely that either such a level of private savings, or of capital inflow, can be easily realized. It is safer to
consider both of them outside an intuitive feasibility range, and investigate what other combinations may be fruitfully employed.

Case 2: Private versus public propensity to save

In this case it will be assumed that foreign capital inflow will be at two different levels, \( f = 0, f = 0.03 \).

The policy equation becomes:

\[
(5.23) \quad s^P \left( \frac{vry-f}{1-c^d} \right) - \left( \frac{c^d + l}{1-c^d} \right) s^G
\]

when \( f = 0 \), the empirical version is given by

\[
(5.23') \quad s^P = 0.3715 - 0.1614s^G
\]

while when \( f = 0.03 \) by

\[
(5.23'') \quad s^P = 0.3397 - 0.1614s^G
\]

If \( s^G \) is set at 0.28, value realized during 1962 and 1963, \( s^P \) is required to be at 0.3263 under (5.23') and 0.2945 under (5.23''). For \( s^G = 0.33 \), \( s^P = 0.3182 \) (\( f = 0 \)), \( s^P = 0.2864 \) (\( f = 0.03 \)).

Clearly in this circumstance, also, the private savings requirements may lie outside the feasibility range, although the government may be able to commit one-third of its tax revenues for capital formation.

Case 3: Aggregate growth and private savings under an altered tax structure and composition of government
Now it is assumed that one third of tax revenues is committed to capital formation while by new income tax laws the direct tax rate is raised to 10%, the indirect tax rate remaining roughly at the same level. Under these conditions:

\[ s^p = 0.3888 - 0.2222 \times 0.33 = 0.3155 \] for \( f = 0 \)

and

\[ s^p = 0.3555 - 0.2222 \times 0.73 = 0.28222 \] for \( f = 0.03 \)

The growth equation in terms of \( s^p \) under the latter specifications becomes:

\[(5.25) \quad r_y = 0.0186 - 0.18 s^p \]

Table 25. Selected values of \( r_y \) and \( s^p \) under equation (5.24)

<table>
<thead>
<tr>
<th>( s^p )</th>
<th>( r_y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.22</td>
<td>0.0582</td>
</tr>
<tr>
<td>0.23</td>
<td>0.06</td>
</tr>
<tr>
<td>0.24</td>
<td>0.0618</td>
</tr>
<tr>
<td>0.25</td>
<td>0.0636</td>
</tr>
<tr>
<td>0.26</td>
<td>0.0654</td>
</tr>
<tr>
<td>0.27</td>
<td>0.0672</td>
</tr>
<tr>
<td>0.28</td>
<td>0.069</td>
</tr>
<tr>
<td>0.29</td>
<td>0.0708</td>
</tr>
<tr>
<td>0.30</td>
<td>0.0726</td>
</tr>
</tbody>
</table>
Conclusions

The basic conclusion to be drawn from the preceding analysis is that important policy measures will have to be adopted in the sphere of foreign trade to secure foreign capital, and in that of the public sector to increase revenues and change the composition of expenditure as well as to influence the propensity to save of the private sector, in order for the desired global growth rate to be approximated if the direction of the development effort is toward building social overhead capital, in which case the marginal capital-output ratio is very high.

The specific measures that can be made concrete in this stage are a substantial increase in government funds going for investment purposes, a doubling of the effective direct tax rate and securing that 0.25 of private disposable income increases are saved.

The latter may not be so difficult in view of the level of past performance; it may, however, be difficult to combine with a high direct tax rate.

Growth of exports is necessary as a means of providing foreign credit which will be needed to supplement domestic savings.*

*One of the weaknesses of the presented model is the absence of an explicit import function which would specify (along with the exogenously given export growth rate) foreign capital requirements consistent with a given aggregate growth rate. This will be remedied in Chapter V.
Under the conditions described, the model yields a maximum growth rate of 6.35%.

If the design of development does not emphasize infrastructure and correspondingly the capital-output ratio is not as high as 5, then the desired growth rate is attainable by assuming the same structure to prevail in the medium run as in the sixties. If development-oriented policies are followed as described in the previous case, it appears that the specified target level is lower than the maximum attainable.

The next step will be to take a closer look at the effective limits to growth by means of a more detailed aggregate model.
CHAPTER VI. EFFECTIVE LIMITS TO GROWTH AND DEVELOPMENT POLICIES: A POLICY MODEL

In this chapter it will be attempted to develop and apply a more specific model of development alternatives, along the lines mainly of Chenery and Bruno (37), in order to obtain quantitative estimates of the likely requirements for an accelerated economic growth combined with several other objectives of economic policy in terms of important macroeconomic aggregates and values of selected instruments.

In the previous chapter, foreign capital inflow, or import surplus, was assigned feasible, or more accurately intuitively likely values, without a more detailed analysis of the structure of the Peruvian foreign trade sector and its impact on the rest of economy.

In recent economic literature on applied macroeconomic planning, e.g. (37, 42), the role played by external resources has been distinguished into two principal functions: a) To supplement domestic savings, and b) to provide additional foreign exchange needed to support the import requirements.

Formally, the two functions correspond to two equilibrium conditions—one for foreign trade and the other for investment-savings, incorporated in macroeconomic analysis. The export-import gap and the investment-savings gap are, of course, equal ex post via the national income or product identity, but one of them may provide an effective limit to
economic development in the future (ex ante). The design of
development policy must be based on quantitative identifica-
tion under alternative circumstances of the development con-
straints and equate ex ante the resource transfer to both
gaps by means of a general equilibrium structure.

The theoretical model

The model is designed to be applied to Peru's current
stage of development and its theoretical structure is con-
siderably limited by the kind of economic data available to
the INP.

The mathematical relationships are the following:

Income-investment relation

\[ Y_T = Y_0 + \beta \sum_{t=0}^{T} I_t \]

Here \( Y \) denotes income (or product if the terms-of-trade
effect is set equal to zero) and the subscript \( T \) refers to
the planning horizon. \( Y_0 \) is income at the base period and
\( \sum_{t=0}^{T} I_t \) is the sum of total gross investment taking place
between base period and \( T \) year. The parameter \( \beta \) is a sort
of marginal output-capital ratio that relates gross capital
formation over \( T + 1 \) years to the \( T \) th's output or income in-
crement from the base period's level.

The constancy of \( \beta \) implies independence from the compo-
sition of investment and in particular that public and
private investment have the same returns.
Import function

The import function may be included in either of two ways. It may be assumed to reflect structural characteristics which are not going to be affected importantly over the planning period. In this case the function describing the past experience satisfactorily is incorporated without any changes, or the propensity or propensities to import may be considered policy instruments or controlled parameters and their values may be sought in the solution of the planning problem.

\[(6.2) \quad M_t = m_0 + m_c (C_t^p + C_t^g) + m_I I_t\]

In Equation \((6.2)\) \(M_t\) stands for total imports at time \(t\) as a linear function of private consumption \(C^p\), government consumption \(C^g\) and total gross investment \(I\) in the same period. The constant term of the autonomous part of imports is \(m_0\).

The coefficients \(m_c\) and \(m_I\), marginal propensities to import with respect to consumption and investment changes respectively, are assumed constant over the planning period.

Alternatively,

\[(6.2') \quad M_t = m_c C_t^p + m_I I_t\]

In this case \(m_c\) and \(m_I\) may be considered policy controlled parameters whose values are sought in respect of
certain objectives such as import substitution, balance-of-payments equilibrium, etc.

**Private saving function** Private savings may be considered a policy instrument. Its value for the final year of the planning horizon is given by

\[(6.3) \quad S_t = S_0 + s \left( \gamma_t - \gamma_0 \right) - T_d - T_0\]

where \(s\) the marginal propensity to save of disposable income is the unknown policy parameter and \(T_d\) is the level of direct tax payments.

**Government consumption** Government is assumed to realize revenues through taxation only as in the previous chapter.

The proportion of consumption expenditures may be within limits a flexible parameter as in the homogenous growth model.

\[(6.4) \quad c_t^G = c^G \left( T_t^d + T_t^i \right)\]

\(T^i\) signifies indirect tax payments.

**Tax functions**

\[(6.5) \quad T_t^d = T_0^d + T^d (\gamma_t - \gamma_0)\]

\[(6.6) \quad T_t^i = T_0^i + T^i (\gamma_t - \gamma_0)\]
Labor supply  Labor force is supposed to grow at the rate \( n \) annually.

\[ N_t = N_0 (1+n)^t \]

Labor demand  Demand for labor is assumed to depend on the level of income and the annual increase of productivity of labor.

\[ L_t = L^*_0 (1-l)^t Y_t \]

Equation (6.8) expresses labor requirements given the level of income the inverse of the average productivity of labor \( L^*_0 \) at a base year, and \( l \), the rate at which average productivity increases annually. Parameter \( l \) reflects mainly technological factors.

Equation (6.8) taken along with Equation (6.1) specifies the economy's production function of fixed factor proportions. If it were possible to establish a functional relationship between capital formation and the parameter \( l \), then a one way factor substitution could be analyzed. Peruvian data, however, do not permit at present such an analysis.

Export function  Exports will be assumed to grow at a certain rate determined by factors exogenous to the model. The export function can be stated either aggregatively or for each main product individually. No real advantage attaches at this point in disaggregating exports. So,
(6.9) \[ E_t = E_0 (1+e)^t \]

\( E_t \) may also incorporate the terms-of-trade effect, if it be possible to predict it.

**Equilibrium conditions** Assuming that the government funds available for investment are only what remains of tax revenues after government consumption plus public foreign capital, balanced-budget condition is stated as

(6.10) \[ I^G_t = (1-c^G) (T^d_t + T^i_t) + F^G_t \]

Combining private and public sector, the savings-investment equilibrium can be written

(6.11) \[ S_t + (1-c^G) (T^d_t + T^i_t) + F_t = I_t \]

where \( F \) is foreign capital inflow without distinction of its source as private or public.

The balance-of-payments equilibrium condition, as it has already been observed, is not independent ex post of condition (6.11). Since foreign capital requirements may emerge as a consequence of import requirements for a given level of exports, one writes ex ante

(6.12) \[ M_t - E_t = F_t \]

A further equilibrium condition which incorporates a policy aim refers to the level of employment. Let \( \lambda \) be
defined as the maximum acceptable unemployment rate. Then

\[(6.13) \quad L_t = (1-\lambda) N_t\]

Identities

\[(6.14) \quad Y_t = C_t^P + C_t^G + I_t^P + E_t - M_t\]

\[(6.15) \quad I_t = I_t^P + F_t^G\]

The income and investment composition identities complete the model.

From a policy classification point of view, the variables and parameters contained can be distinguished into:

a) Target variables; \(Y, C^P, L_t\) or \(\lambda\).

b) Irrelevant variables; \(M, E, N\).

c) Instrument variables; \(S(s), T^d(T^d), T^f(T^f), C^G(c^G), (I^G), F\), possibly 1, e.

d) Predetermined magnitudes; all initial values of variables under (a), (b) and (c), \(\eta\), e.

It is convenient to express the reduced form of the model in terms of final year values only. To do this one may proceed as follows:

\[(6.16) \quad I_T = k \sum_{t=0}^{T} I_t\]

where \(k\) depends on the growth rate of investment and the length of the planning horizon. Since \(I_0\) is known, once the
defined as the maximum acceptable unemployment rate. Then

\[(6.13) \quad L_t = (1-\lambda) N_t\]

Identities

\[(6.14) \quad Y_t = C_t^P + C_t^G + I_t^P + E_t - M_t\]

\[(6.15) \quad I_t = I_t^P + F_t^G\]

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b) Irrelevant variables; \( M, E, N \).

c) Instrument variables; \( S(s), T^d(T^d), T^i(T^i), C^G(c^G), (I^G), F \), possibly \( I, e \).

d) Predetermined magnitudes; all initial values of variables under (a), (b) and (c), \( \eta, e \).

It is convenient to express the reduced form of the model in terms of final year values only. To do this one may proceed as follows:

\[(6.16) \quad I_T = k \sum_{t=0}^{T} I_t\]

where \( k \) depends on the growth rate of investment and the length of the planning horizon. Since \( I_0 \) is known, once the
planning horizon is fixed, \( i \) (in Equation 6.17) is the parameter which remains to be determined.

\[
(6.17) \quad I_T = I_0 (1+i)^T
\]

Capital requirements for the planning period, \( \sum_{t=0}^{T} I_t \), are determined from Equation (6.1) under certain conditions.

Then by the equation

\[
(6.18) \quad \sum_{t=0}^{T} I_t = I_0 \sum_{t=0}^{T} (1+i)^t
\]
i can be determined.

In general, Equation (6.18) may not guarantee an economically acceptable solution as it certainly precludes uniqueness of the solution. A mathematically convenient alternative is

\[
(6.18') \quad \sum_{t=0}^{T} I_t = I_0 \int_{0}^{T} e^{it} dt
\]

Once \( i \) is determined, \( I_T \) is solved for by Equation (6.17) and \( k \), next, by Equation (6.16).
The reduced form or policy equations and their use

By substitution from Equations (6.3, 6.11 and 6.16) one arrives at the relation

\[(6.19) \quad \left(\frac{k}{p} - s\right)Y_t = \left(\frac{k}{p} - s\right)Y_0 + S_0 + (1-c)T_t^d - sT^d_0 + (1-c)T^i_t + F_t\]

and

\[(6.20) \quad Y_t = Y_0 + \frac{S_0 + (1-c)T_t^d - sT^d_0 + (1-c)T^i_t}{\frac{k}{p} - s} + \frac{1}{\frac{k}{p} - s} F_t\]

By substitution from Equations (6.1, 6.2, 6.14 and 6.16) into Equation (6.12), one obtains*

\[(6.21) \quad m_c Y_t - \frac{k}{p} (Y_t - Y_0) + F_t + m_I (Y_t - Y_0) \frac{k}{p} = E_t + F_t\]

or

\[(6.22) \quad m_c Y_t - \frac{k}{p} m_c Y_t + m_I \frac{k}{p} Y_t = E_t + F_t - m_c F_t - m_c \frac{k}{p} Y_0 + M_I \frac{k}{p} Y_0\]

and finally

\[(6.23) \quad Y_t = \frac{1}{(1 - \frac{k}{p}) m_c + m_k \frac{k}{p}} E_t + \frac{1 - m_c}{(1 - \frac{k}{p}) m_c + m_k \frac{k}{p}} F_t + \frac{k (m_c - m_c)}{(1 - \frac{k}{p}) m_c + m_k \frac{k}{p}} Y_0\]

*Considering that \(C_t^P + C_t^G = Y_t - I_t + F_t\)
If the propensities to import are not considered as subject to policy control and the existing structure is accepted as given by a least-squares fit, the only modification needed in Equation (6.23) is the incorporation of a constant term. Equation (6.23) is then rewritten

\[ Y_t = \frac{1}{(1-\frac{k}{\beta}m_c + m_k \frac{k}{1\beta})} E_t + \frac{1-m_c}{(1-\frac{k}{\beta}m_c + m_k \frac{k}{1\beta})} F_t + \frac{k(m_k-m_c)}{(1-\frac{k}{\beta}m_c + m_k \frac{k}{1\beta})} Y_0 \]

Further, by substituting Equations (6.7) and (6.13) into Equation (6.8), one gets

\[ Y_t = \frac{N_0(1+\eta)^t}{L_0^*(1-\eta)^t} (1-\lambda) \]

The forms (6.20, 6.23 or 6.24 and 6.25) constitute the reduced system, which can be augmented by Equation (6.26).

\[ c_t^p = Y_t - I_t + F_t - c^G(T_t^d + T_t^r) \]

Equation (6.20) corresponds to the investment-savings constraint, formulated to include a balanced government budget condition. Equations (6.23) or (6.24) refer to the foreign exchange constraint and (6.25) to the employment equilibrium condition. The last equation expresses private consumption as a function of total income, direct tax and
indirect tax, payments and the propensities to save of the private and public sector.

The above system of four equations may be used in a variety of ways to specify alternative policies.

The policy targets will be specified on $Y_t$, $C_t^P$, and $d_t^V$. The instruments available are $F_t$, $T_t^d$, $T_t^1$, $s$, $c_t^G$, assuming the remaining parameters given exogenously and $E_t$ determined by its trend.

It is evident that the ultimate theoretical limit to growth is provided by the supply of labor in condition (6.25). If it is assumed as it is the case for Peru, that there exist wide unutilized margins within that range, foreign capital inflows may indefinitely increase the level of income (Equations (6.20 and 6.23)). The practical limits to foreign indebtedness will be discussed in the empirical section.

For fixed parameters and exports in Equations (6.20 and 6.23) and a given target level of $Y_t$, the foreign capital inflow required may be different. The constraint implying the higher requirement may be said to provide the effective limit to growth under the specified conditions.

In case the effective limit is the investment-savings gap, it may be concluded that the role of foreign capital is to supplement domestic savings, while if it is due to the balance-of-payments gap its role is to provide scarce foreign exchange.
Ex ante analysis of this sort is helpful in identifying the critical macroeconomic bottlenecks by offering a quantitative measure of their impact in view of specified targets. It is essentially a disequilibrium analysis since ultimately the design of policy must equate the two gaps. Such a step may naturally result in a set of instrument values which may be considered unfeasible. A revision of the target level is thereupon necessary.

Some characteristics of the policy equations deserve a few comments. The specification of fixed targets with respect to levels of income and employment leaves only one instrument by which consistency may be achieved, the rate of change of the average labor-output ratio $\lambda$. Assuming that a realistic target fixing would imply too low $Y_t$ for a given $\lambda$ and too small $\lambda$ for a given $Y_t$, $\lambda$ could be decreased down to the limit 0 in the hope that in this range a compatible triplet of values for $Y_t$, $\lambda$ and $\lambda$ exists.

In terms of actual policies, this would mean a search for the most labor-intensive techniques and expansion along those.

There is nothing in the model permitting substitution of labor for capital. Given this specification constraint, the thing to do is either to fix a level of employment and
deduce* the level of income and the consistent instrument values, or regard the level of employment adjusting passively to whatever income target has been selected.

With respect to fixed target levels of private consumption and total income, there exist mainly tax instruments and the composition of public expenditure to achieve consistency. It is assumed that $s$ is determined primarily by the growth needs while tax instruments and public expenditures, having less impact on growth, may be used with greater freedom for subsidiary targets such as the proportion of private consumption to total income. It goes without saying that the instrument levels required in this case may be well outside the acceptable range and, consequently, the two fixed targets may prove to be mutually incompatible.

The empirical model

The planning horizon envisaged by the present model is 1965-1970. The initial values for most variables included will be chiefly those of the years 1963 or 1964 for lack of 1965 data. A brief discussion will be needed with respect to the labor equations, the export trend, the availability of foreign capital (mainly public) and the technological equation before numerical results can be obtained.

*Income level would be a flexible target and could be maximized for a given level of employment under a more flexible technology than the one incorporated in the model.
The labor equations

The growth of labor force has been estimated on the basis of the population trend and the shift of demographic structure. The former has been set at 2.77% annual growth rate and the latter is the progressive urbanization of the country. The labor experts conclude that the resultant effect will be a 2.5% annual growth in labor supply.

Starting with $N_0 = N_{1960} = 3145$ (in thousands of persons) the labor supply equation is thus $N_t = 3145 (1.025)^t$.

The 1960 labor-product ratio was $L^* = L^*_{1960} = \begin{cases} 0.00004832^* \\ 0.00004380 \end{cases}$ (in millions of 1960 soles). Labor productivity is assumed to grow annually resulting in a 3-4% decrease of the labor-product ratio. Consequently, the labor-requirement equation can be written (assuming $t = 0.035$).

\[
\begin{align*}
L_t &= 0.00004832 (0.965)^t \\
L_t &= 0.00004380 (0.965)^t
\end{align*}
\]

Exports and foreign capital

The official preliminary estimates of future exports available at this time are given in (43). For the period 1964-1970 the rate of 5.2% annually has been assumed in contrast to higher earlier estimates.

---

*The ratios were obtained as follows: Given the estimates of unemployment 7-15% of economically active population, the assumption was made that 50% of the capacity of the underemployed percentage (15%) was utilized. The range 14.5-22.5% was therefore obtained by which the labor force of 1960 was reduced.*
Among exporting sectors it is predicted that mining will expand most rapidly due to favorable demand conditions on the international market and elastic internal supply.

Agricultural products will be exported at a lower rate, especially cotton and sugar, and the fishing sector as a whole will maintain a moderate rate of exports.

Export prices in particular are expected to fall by 7.5% especially those for agricultural products, mining and fishing prices remaining relatively stable. As a result of the above assumptions, it is also expected that the terms-of-trade effect will be growing at a rate of 5.4% annually. Such an assumption, however, is based on a different way of predicting future imports from the one followed in this chapter and is quite difficult to incorporate it without inconsistencies.

It is interesting to compare the export projections by main commodities elaborated by the INP with those in (44) realized one year earlier.

For cotton, INP estimates an 8% increase for the exports of 1965 and projects a 4% rate until 1970; (44) assumes 5.5% for the 1960's. For sugar, the former's estimate is 2% coinciding with the latter's. Coffee is estimated by the INP to grow at 4% while by (44) at 6.6%.

Fishmeal's growth rate is assumed by both at 9.8%. Copper is set at 5% by the INP, at 10% by (44).
On the basis of the above considerations, one may choose the INP's overall export growth rate as the moderate projection lying between an optimistic projection of 6.5% and a pessimistic of 4.5%. The export trend can be written alternatively.

\[ E_t = 17692 (1.045)^t \]
\[ E_t = 17692 (1.052)^t \]
\[ E_t = 17692 (1.065)^t \]

To estimate the availability of future foreign capital—foreign public capital—the INP used the method applied by Thorbecke (45) in an earlier attempt to predict its level.

According to this method, the demand for export goods and services was projected to 1970 and 1971. Then the existing commitments of servicing the actual public external debt in terms of amortization of principal and interest payments were calculated until the same years. The ratio of debt servicing to exports was calculated and the "rule of thumb" was used that the maximum external public borrowing capacity would be limited by the country's ability to service this debt, with the servicing charges not exceeding the 12% of projected merchandise exports.

The additional public foreign debt capacity was then derived corresponding to average maturity of 15 years and 6% average rate of interest and commission charges.

Thorbecke, using the assumption of 7% export growth, derives the figure of 847 million dollars as representing
the cumulative potential foreign public capital inflow for
the period 1965-1971.

The INP's 5.2% export assumption leads to an estimate of
836.5 million dollars for the same period.

The technological relation In order to estimate the
parameter k, the following procedure will be adopted:
On the basis of the conclusions of the previous chapter, a
6.36% income growth rate will be associated with a marginal
capital-output ratio of 5 and then of 4.5*. Also, a 7%
growth rate will be tried with the same capital-output
ratios. These specifications, along with the auxiliary equa­
tions already discussed, suffice to determine k.

Starting with \( Y_0 = Y_{1964} = 73767 \) (millions of 1960
soles)

\[ Y_{1970} = 73767 (1.0636)^6 = 106791 \]

\[ Y_{1970} = 73767 (1.07)^6 = 110705 \]

On the assumption of a marginal capital-output ratio 5,
total investment requirements for the two growth rate levels
are, respectively:

*The conceptual and statistical difficulties in estimat­
ing and projecting incremental capital-output ratios are
summarized in (46). It is seen that for some countries where
estimates are available, incremental capital output-ratios
are as high as 10 for housing and public utilities, 4 for
iron and steel, 4 for mining and 5 for communications and
transport. These are the sectors mainly emphasized in a
development design via formation of social overhead capital.
10679 = 73767 + 0.20 \frac{\Sigma I}{1964}

and

(6.25) \quad 1970 \frac{\Sigma I}{1964} = 165120

110705 = 73767 + 0.20 \frac{\Sigma I}{1964}

and

(6.26) \quad 1970 \frac{\Sigma I}{1964} = 184690

For capital-output ratio 4.5

(6.25') \quad 1970 \frac{\Sigma I}{1964} = 148608

(6.26') \quad 1970 \frac{\Sigma I}{1964} = 161721

Table 26. Implied Growth Rates of Investment

<table>
<thead>
<tr>
<th>Growth Rate</th>
<th>1970 $\frac{\Sigma I}{1964}$</th>
<th>$\frac{1}{\beta} = 5$</th>
<th>$\frac{1}{\beta} = 4.5$</th>
<th>$\frac{1}{\beta} = 5$</th>
<th>$\frac{1}{\beta} = 4.5$</th>
<th>$\frac{1}{\beta} = 5$</th>
<th>$\frac{1}{\beta} = 4.5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.36%</td>
<td>165120</td>
<td>0.111</td>
<td>0.077</td>
<td>0.1915</td>
<td>0.1765</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7%</td>
<td>184690</td>
<td>0.147</td>
<td>0.104</td>
<td>0.12073</td>
<td>0.1883</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 26 presents the consistent values implied by the technological relation under the discussed assumptions of the rate of growth of investment and the corresponding k. It is seen that both the alternative assumptions about the global growth rate and the marginal capital-output ratio affect substantially the required growth rate of total investment. The horizon year's investment levels are, respectively:

\[ I_{1970} = 16816 \times (1.111)^6 = 31625 \]
\[ I_{1970} = 16816 \times (1.147)^6 = 38290 \]
\[ I_{1970} = 16816 \times (1.077)^6 = 26238 \]
\[ I_{1970} = 16816 \times (1.104)^6 = 30447 \]

The other predetermined variables and parameters are:

- \( m_0 = -3078 \) (842)
- \( m_c = 0.1816 \) (0.034)
- \( m_I = 0.6898 \) (0.0979)

The numbers in parenthesis are the respective standard errors.

Initial values for 1964 of \( T_0^d \) and \( T_0^i \) are not directly available. Estimated regressions, which will be presented in following chapters, were used to extrapolate. The results
are $T_{1964}^1 = 7633$, $T_{1964}^d = 4590$. Realized gross private domestic savings for 1964 were at the level of 14707.

The empirical structural relations

The assembled empirical model is then:

\begin{align*}
(6.27) & \quad Y_{1970} = 73767 + 0.20 \sum_{1964}^{1970} I_t \\
(6.27') & \quad Y_{1970} = 73767 + 0.2222 \sum_{1964}^{1970} I_t \\
(6.28) & \quad M_t = 3078 + 0.1816 (C_t^P + C_t^G) + 0.6898 I_t \\
(6.29) & \quad S_{1970} = 14707 + s (Y_{1970} - 73767) - T_{1970}^d - 4590 \\
(6.30) & \quad C_t^G = c^G (T_t^d + T_t^i) \\
(6.31) & \quad T_{1970}^d = 4590 + t^d (Y_{1970} - 73767) \\
(6.32) & \quad T_{1970}^i = 7633 + t^i (Y_{1970} - 73767) \\
(6.33) & \quad N_t = 3145 (1.025)^t \\
(6.34) & \quad L_t = 0.000004832 (0.965)^t Y_t \\
(6.34') & \quad L_t = 0.000004380 (0.965)^t Y_t \\
(6.35) & \quad E_t = 17692 (1.045)^t \\
(6.35') & \quad E_t = 17692 (1.052)^t \\
(6.35'') & \quad E_t = 17692 (1.065)^t \\
(6.36) & \quad Y_t = C_t^P + C_t^G + I_t + E_t - M_t
\end{align*}
The empirical reduced-form equations and policy conclusions

\[ y_{1970} = 73767 \times \frac{14707 + (1-c^G-s)T^d_{1970} - 45905 + (1-c^G)T^i_{1970} + 1}{k \beta - s} F_{1970} \]

\[ (6.37) \]

\[ y_{1970} = \frac{1}{(1-k/\beta)0.1816 + k/\beta0.6898} \frac{0.8184}{E_{1970}^+} + \frac{k/\beta0.5082}{(1-k/\beta)0.1816 + k/\beta0.6898} \frac{73767}{k/\beta} F_{1970} \]

\[ (6.38) \]

\[ y_{1970} = \frac{3145 (1.025)^{10}}{0.0000438 (0.965)^{10}} (1-\lambda) \]

\[ (6.39) \]

\[ y_{1970} = \frac{3145 (1.025)^{10}}{0.0000438 (0.965)^{10}} (1-\lambda) \]

\[ (6.39') \]

\[ \frac{C}{1970} = Y_{1970} - I_{1970} + F_{1970} - e^G (T^d_{1970} + T^i_{1970}) \]

First, the compatibility of levels of employment with levels of income will be examined on the basis of Equations (6.39 and 6.39'). These equations are rewritten
(6.39) \[ Y_{1970} = 119245 \ (1 - \lambda) \]

(6.39') \[ Y_{1970} = 131552 \ (1 - \lambda) \]

Under the specified conditions it is seen that the labor constraint does not provide an effective limit to growth within the feasible range. For an income growth of 6.36%, 0.1055 - 0.1882, while for a 7% growth, 0.0712 - 0.1581. Full utilization of labor force by 1970 would necessitate a global rate of growth 8.3 - 10%, corresponding respectively to Equations (6.39 and 6.39').

The conclusion appears to be that in all likelihood underemployment and unemployment, although reduced, will remain a feature of the Peruvian economy in the 1970's.

Next, Equations (6.37 and 6.38) will be rewritten according to the alternative specifications and policy instrument values will be derived.

**Investment-savings constraint**

Case 1. Growth rate 6.36%, \( \frac{1}{\beta} = 5 \), \( \psi = 0.111 \), \( k = 0.1915 \)

\[
(6.37) \quad 33024 \cdot \frac{1.4707 + (1-c)^G sT^d_{1970} - 0.5090 s + (1-c)^G T^d_{1970} - \frac{1}{0.9575 - s}}{0.9575 - s} = 0
\]

It will be assumed that \( c^G \) and the tax-to-income ratios will take the values in accordance with the conclusions of Chapter IV. Hence,
the marginal tax rates are then derived as follows:

\[ 4590 + \tau \cdot 33024 = 10680 \]

\[ \tau = 0.1844 \]

\[ 7633 + \tau \cdot 33024 = 10680 \]

\[ \tau = 0.0923 \]

Equation 6.37) is finally reduced to

\[ (6.41) \quad F_{1970} = 9800 - 17754s. \]

Similarly, Equation (6.37) will be reduced as above for:

Case 2. Growth rate 6.36%, \( \frac{1}{\beta} = 4.5 \), \( i = 0.077 \), \( k = 0.1765 \)

\[ (6.41') \quad F_{1970} = 4409 - 17754s. \]

Equations (6.41) and (6.41') describe the various combinations of foreign capital inflow and marginal propensity to save of the private sector corresponding to the specified structural assumptions and on the basis of the savings-investment constraint alone. For purposes of comparing the results with those corresponding to the balance-of-payments constraint, Equation (6.38) will be reduced numerically in a similar fashion.

Balance-of-payments constraint

Case 1. Growth rate 6.36%, \( \frac{1}{\beta} = 5 \), \( i = 0.111 \), \( k = 0.1915 \)

\[ (6.42) \quad F_{1970} = 39571 - 1.222E_{1970} \]
Case 2. Growth rate 6.36%, $\frac{1}{\beta} = 4.5$, $i = 0.077$, $k = 0.1765$

(6.42') $F_{1970} = 35980 - 1.222E_{1970}$

Propensity to save, foreign capital, exports and limits to growth. In Chapter IV it was concluded that under the homogeneous structure for the 6.36% growth rate among other apparently feasible conditions a rate 0.25 of income increments should be saved over the planning period. In the present more detailed model such a condition implies that the level of private domestic savings at the final year should be 21441 millions soles, consistent with the adopted policy assumption about direct taxation. Such a level corresponds to a 20.1% of total income, a rate which must be considered feasible on the basis of recent historical experience. The foreign capital requirements due to the investment-savings gap, for several $s$-values around the basic 0.25, are listed below:

Table 27. Foreign capital requirements due to savings-investment gap $r_y = 6.36$

<table>
<thead>
<tr>
<th>$\frac{1}{\beta}$</th>
<th>$\frac{1}{\beta}$</th>
<th>$\frac{1}{\beta}$</th>
<th>$4.5$</th>
<th>$s$</th>
<th>$s/y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>6249</td>
<td>857</td>
<td>0.20</td>
<td>0.1882</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5894</td>
<td>503</td>
<td>0.22</td>
<td>0.1932</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5361</td>
<td>-30</td>
<td>0.25</td>
<td>0.2008</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 27. (Continued)

<table>
<thead>
<tr>
<th>$\beta$</th>
<th>$S$</th>
<th>$S/Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1/\beta = 5$</td>
<td>$1/\beta = 4.5$</td>
<td></td>
</tr>
<tr>
<td>5184</td>
<td>-207</td>
<td>0.26</td>
</tr>
<tr>
<td>5006</td>
<td>-385</td>
<td>0.27</td>
</tr>
<tr>
<td>4829</td>
<td>-562</td>
<td>0.28</td>
</tr>
<tr>
<td>4651</td>
<td>-740</td>
<td>0.29</td>
</tr>
<tr>
<td>4474</td>
<td>-917</td>
<td>0.30</td>
</tr>
</tbody>
</table>

The striking feature of the results listed above is the difference due to the incremental capital-output ratio. It supports the conclusion of Chapter IV that economic policy challenges emerge with high incremental capital-output ratios related to design of development via social overhead capital formation.

Even as high a capital-output ratio as 4.5 implies that domestic savings, along with government appropriate measures as specified, suffice to guarantee an income growth rate of 6.36% without recourse to foreign resources.

If a lower incremental capital-output ratio be assumed, then the target rate of growth should be set at a higher level, if there is no reluctance to employ international credit.

On the other hand, with $1/\beta = 5$, and international credit availability as estimated by the INP for the planning horizon
there should be expected no minor difficulty with respect to *ex ante* savings-investment equilibrium. According to possible patterns of foreign capital inflow worked out, foreign public capital may be expected to reach the level of 100 million dollars annually until 1970. Another 90-100 million dollars of private foreign capital may be needed to satisfy the growth requirements with respect to total available savings.

The picture from the standpoint of the balance of payments is shown in Table 28.

Table 28. Foreign capital requirements due to the balance of payments $r_y = 6.36\%$  

<table>
<thead>
<tr>
<th></th>
<th>$\frac{1}{\beta} = 5$</th>
<th>$\frac{1}{\beta} = 4.5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e$ 0.045</td>
<td>11420</td>
<td>7829</td>
</tr>
<tr>
<td>$e$ 0.052</td>
<td>10266</td>
<td>6675</td>
</tr>
<tr>
<td>$e$ 0.062</td>
<td>8025</td>
<td>4434</td>
</tr>
</tbody>
</table>

These results may come as a surprise to those who formed an intuitive "feeling" of the Peruvian economy early in the 1960's. For, it is evident, that the balance of payments offers an effective limit to growth under the structural conditions incorporated in the present analysis. It was thought earlier that under favorable export growth reaching rates as high as 7-9% annually, foreign capital was needed, principally to supplement domestic savings.
The revised export expectations imply that Peru will probably face the typical situation of developing countries of a need for foreign credit to finance its import surplus. Furthermore, the quantitative estimates of the foreign capital requirements for this purpose lie outside Peru's credit capacity in all cases with the possible exception of $1 \frac{1}{\beta} = 4.5$ and $e = 0.062$.

In view of the above considerations, a feasible and consistent development program must incorporate more policy degrees of freedom than hitherto taken into account. The additional policy instruments may belong to the sphere of trade policy in connection with measures of import substitution by domestic production.

**Trade policy and import substitution** The state of affairs, as described, indicates a severe limitation on growth imposed by a deficient domestic production and the corresponding high import requirements. The solution to this imbalance in a macroeconomic context may be either a slowing down of the rate of growth of income and consequently a diminution of the "surplus" domestic savings, if the actual import structure is preserved unaltered; or aggregate growth may be pursued with import substitution as an important means of achieving that growth.

The objective of this section is to provide some estimates of the necessary trade adjustments under alternative likely conditions.
First, the total permissible import level on the assumption of total foreign capital of 4474 million soles or 167 million dollars (approximately the INP's estimate) for the final year will be compared with the level projected under no structural change.

The maximum allowable level of imports is, for \( \epsilon = 0.045, 0.052, 0.062 \), respectively, 27511, 28455 and 30289.

Table 29. Maximum allowable imports

<table>
<thead>
<tr>
<th>Projected import level (structure unchanged)</th>
<th>( \frac{1}{\beta} = 4.5 )</th>
<th>( \frac{1}{\beta} = 5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30462</td>
<td>33200</td>
</tr>
</tbody>
</table>

Maximum allowable imports minus projected imports

\( \epsilon = 0.045 \): -2951, -5689
\( \epsilon = 0.052 \): -2007, -4745
\( \epsilon = 0.062 \): -173, -2911

The analysis will be limited to the case of \( \epsilon = 0.052 \) with a lower capital output-ratio, the adjustment in the import function must be such as to yield values of total imports by 2 billion soles lower, while with a high capital-output ratio by 4.745 billion soles.

It will be assumed that policy oriented towards a lower level of imported consumption goods and other imports
associated with the level of total consumption combined with establishing domestic industries to substitute for the former, is more desirable and feasible than policy designed to substitute for investment-originating imports.

Consequently, \( m_c \) will be freed and solved for.

The results are, \( m_c = 0.122 \) for \( \frac{1}{\beta} = 5 \) and \( m_c = 0.158 \) for \( \frac{1}{\beta} = 4.5 \).

The marginal propensity to import due to consumption decisions requires less of an adjustment for low capital-output ratios and vice-versa.

To be able to translate the needed adjustments into concrete policy measures, more detailed import functions are needed and this will be partly examined in a following chapter.

**Tentative conclusions and equilibrium values for terminal year**

The analysis carried out in this section was basically a disequilibrium-type analysis for the purpose of identifying and measuring the separate, *a priori*, limits to economic growth.

The main conclusions which may be drawn at the present depend heavily on the initial assumption of an infrastructure-oriented development design with, correspondingly, high incremental capital-output ratios. If this assumption is valid, it appears that the initial 7% target rate of target rate of growth of income is not compatible with the
internal and external conditions of the Peruvian economy, the former modified by policy within feasibility limits, the latter taken as exogenous projections. A 6.36% rate is attainable, but under considerable policy changes, such as a 0.20 (approximately) ratio of private domestic savings to income, a more than doubling of the effective marginal direct tax rate, which may incidentally be performing as an instrument of income redistribution, a significantly higher rate of government investment financed from tax revenues than in the recent times, full utilization of the country's foreign credit capacity, both public and private, and policy of import substitution.

Under the present import structure and export prospects, it is mainly the balance of payments that provides an effective limit to growth. This conclusion is offered for comparison with a previous result obtained by the author (47) under different structural assumptions and export projections. To quote from the conclusions of cited paper:

"The first important conclusion to be drawn from inspection of the tables is that if it is possible from the standpoint of both demand conditions and technological capabilities to select for promotion of investment those sectors with an output-capital ratio such that their weighted average is as high as 0.30, it is likely that domestic resources will be available for even a more ambitious aggregate development rate. The balance of payments will present no problems. On the other hand, with an export rate of 7% and a reasonably modest output-capital ratio of 0.25, total
capital requirements* are likely to be somewhere between 12 and 9 billion soles. A balance of payments surplus appears in the process. Under more pessimistic assumptions, the foreign capital requirements necessary to support the 7% aggregate growth rate become staggering--50413 million soles or nearly 2 billion dollars for "balance-of-payments equilibrium or 47387 million soles to close the savings-investment gap."

Some tentative equilibrium values will be listed below along with the policy and structural specifications consistent with these values.

Table 30. Tentative equilibrium values

<table>
<thead>
<tr>
<th>Level</th>
<th>$\frac{1}{\theta} = 5$</th>
<th>Growth rate</th>
<th>Policy instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y_{1970}</td>
<td>106791</td>
<td>6.36%</td>
<td></td>
</tr>
<tr>
<td>C_{1970}</td>
<td>79640</td>
<td>6.5%</td>
<td></td>
</tr>
</tbody>
</table>
| C^G_{1970} | 14274 | 8.1% | $G$ $c = 0.667$
| C^G_{1970} | 65393 | 6.0% | |
| I_{1970} | 31625 | 11.1% | |
| E_{1970} | 23981 | 5.2% | |
| M_{1970} | 28455 | 7.7% | $m = 0.122$
| F_{1970} | 4474 | |
| S_{1970} | 20033 | 6.0% | $s = 0.30$

*For the whole period 1964-1970.
Table 30. (Continued)

<table>
<thead>
<tr>
<th>Level</th>
<th>$\frac{1}{\bar{p}} = 5$</th>
<th>Growth rate</th>
<th>Policy instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>T$_{1970}$</td>
<td>10680</td>
<td>15.1%</td>
<td>$\tau^d = 0.1844$</td>
</tr>
<tr>
<td>T$_{1970}^d$</td>
<td>10680</td>
<td>5.7%</td>
<td>$\tau^i = 0.0923$</td>
</tr>
</tbody>
</table>

Table 31. Tentative equilibrium values

<table>
<thead>
<tr>
<th>Level</th>
<th>$\frac{1}{\bar{p}} = 4.5$</th>
<th>Growth rate</th>
<th>Policy instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y$_{1970}$</td>
<td>16791</td>
<td>6.36%</td>
<td></td>
</tr>
<tr>
<td>C$_{1970}$</td>
<td>85027</td>
<td>7.55%</td>
<td>$c = 0.667$</td>
</tr>
<tr>
<td>CG$_{1970}$</td>
<td>14274</td>
<td>8.1%</td>
<td></td>
</tr>
<tr>
<td>CF$_{1970}$</td>
<td>70753</td>
<td>7.4%</td>
<td></td>
</tr>
<tr>
<td>I$_{1970}$</td>
<td>26238</td>
<td>7.7%</td>
<td></td>
</tr>
<tr>
<td>E$_{1970}$</td>
<td>23981</td>
<td>5.2%</td>
<td></td>
</tr>
<tr>
<td>M$_{1970}$</td>
<td>28455</td>
<td>7.7%</td>
<td>$m_c = 0.158$</td>
</tr>
<tr>
<td>F$_{1970}$</td>
<td>4474</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S$_{1970}$</td>
<td>14651</td>
<td>0%</td>
<td>$s = 0$</td>
</tr>
<tr>
<td>T$_{1970}^d$</td>
<td>10680</td>
<td>15.1%</td>
<td>$\tau^d = 0.1844$</td>
</tr>
<tr>
<td>T$_{1970}^i$</td>
<td>10680</td>
<td>5.7%</td>
<td>$\tau^i = 0.0923$</td>
</tr>
</tbody>
</table>
The comparison of the two alternative sets of projected national accounts underlines the conclusions drawn and suggests the areas for policy concern.

With unchanging import structure, a trade-off is possible between private domestic and public domestic savings, as in the second alternative equilibrium implies zero growth of the former. If import substitution takes place to a higher extent than presumed here, utilization of private domestic savings becomes possible as the financing counterpart of the growth of domestic production.
CHAPTER VII. STRUCTURAL ANALYSIS OF THE PERUVIAN ECONOMY: AN ECONOMETRIC MODEL

The development of the Peruvian economy over the recent past, the requirements for the maintenance of the pace of growth, and, if possible, of its acceleration in the future, will be studied in this part by means of a formal econometric model oriented towards effective demand (52). The main purposes of the model are to describe quantitatively the economic structure of Peru "normalized" to the historical experience 1950-1963; to project over the medium run (up to 1970) values of the major macroeconomic variables; and to analyze the effect of changes in the exogenous variables (both data and instrumental variables) on the set of endogenous variables within the model. Through such an analysis, the basic economic growth bottlenecks may be seen in a quantitative light and economic policy alternatives may be designed to overcome them.

The basic idea of the model is that the Peruvian economy is set in motion principally by the export sector. An increase in demand for exports, an improvement in the terms of trade, are thought to lead to further increases in income and to set the floor to the global growth rate, both directly and indirectly by way of influencing private investment demand.
The application of an effective demand-oriented model to an underdeveloped economy has well-known limitations. Primarily, it requires the existence of certain conditions without which the multiplier principle can only refer to monetary and not to real effects. In particular, it requires the existence of involuntary unemployment, a relatively elastic supply curve of output, excess capacity in consumption goods industries, and availability of complementary factors of production. Peru may be considered to meet most of these conditions with the exception, perhaps, of excess capacity in food industries.

Another limitation of the model is the absence of relationship to indicate the creation of additional capacity by net capital formation. This, although a critical limitation for long-run growth models, may not be as important when the analysis is confined to a five-year period and when the problem at hand is not the sectoral allocation of investment. At any rate, the results may be considered as representing the lower limit of the possible course of events.

Finally, the analysis assumes a given economic structure while it might be argued that the objective of economic development policy is to bring about changes in the structure which is taken here for given. Nevertheless, before a policy sets out to change a given structure, the latter's consequences must be known or evaluated.
The structural model

The variables appearing in the model are expressed in real terms (in billions of 1960 soles) and refer to annual observations. They are:

\[ Y_t = \text{Gross national income at market prices} \]
\[ C_t^P = \text{Private consumption} \]
\[ G_t = \text{Public consumption} \]
\[ I_t^P = \text{Private gross investment} \]
\[ G_t = \text{Public gross investment} \]
\[ I_t = \text{Imports of capital goods} \]
\[ M_t^C = \text{Imports of consumption goods} \]
\[ \text{RMS} = \text{Imports of raw materials and services} \]
\[ E_t = \text{Total exports} \]
\[ Z_t = \text{Terms-of-trade effect} \]
\[ T_t^d = \text{Direct tax receipts} \]
\[ I_t^i = \text{Indirect tax receipts} \]
\[ U_t = \text{Price index of imported consumption goods. The ratio of the price of imported consumption goods over that of domestically produced consumption goods.} \]
The structural relationships making up the economic system are:

\[(7.1) \quad C_t^P = C_t^P + s_P(Y_t - T_t)\]

\[(7.2) \quad I_t^P = i_0 + i_E E_{t-1} + i_Z Z_{t-1}\]

\[(7.3) \quad C_t^G = C_t^G + \sigma(T_t^d + T_t^i)\]

\[(7.4) \quad T_t^d = T_o^d + \tau_y t\]

\[(7.5) \quad T_t^i = T_o^i + \tau_1 (C_t^P - M_t^C) + \tau_2 M_t^C\]

\[(7.6) \quad M_t^I = m_I I_t + m_{I^G} G_t\]

\[(7.7) \quad M_t = m_{C^P} + m_{I^G} (C_t^P + C_t^G) + m_2 U_t\]

\[(7.8) \quad M_t^RMS = m_{RMS_o} + m_{RMS} Y_t\]

\[(7.9) \quad E_t = E_o (1 + e)^t\]

\[(7.10) \quad Z_t = Z_o (1 + z)^t\]

\[(7.11) \quad Y_t = C_t^P + C_t^G + I_t^P + I_t^G + E_t + Z_t - M_t\]

where

\[M_t = M_t^I + C_t^P + M_t^RMS\]

Equation (7.1) is the private consumption function. Private consumption expenditures are expressed as a linear function of national income net of direct taxes. The degree of misspecification for not including (the unavailable)
transfer payments in the argument is quite small given the size of the omitted term.

Equation (7.2) relates current gross private investment expenditures to the value of exports and the terms-of-trade effects*, both lagged one year. Many alternative investment demand functions were tried but none performed as well as the one included. It may be explained along the following lines: Peru's investing sector is mainly the one oriented towards exports. The lagged level of exports as an explanatory variable reflects the role played by demand for the products of the investing enterprises, while the terms-of-trade effect may be taken to some extent as a proxy for the profitability of investment given the high level of import requirements associated with capital formation in Peru.

Equation (7.3) relates public consumption expenditures to total tax receipts. The latter are the principal source of current public revenues. The exclusion of other sources of public revenues is the result of both inadequate data and relatively small magnitudes. However, the introduction of foreign public loans can take place in the course of the analysis when one discusses fiscal policy. The difference between total public expenditures and total tax receipts

*For definition of this concept (Z) see Chapter I.
may represent in any proportion a combination of deficit fi-
nancing and foreign public capital inflow.

Equations (7.4) and (7.5) are the direct and indirect
tax equations respectively. Direct tax receipts are simply
expressed as a function of national income, while the main
sources of indirect taxes are consumption of domestically
produced goods and import duties, each having a different
marginal rate.

Equations (7.6, 7.7 and 7.8) refer respectively to the
three categories exhausting total imports, namely, imports of
capital goods, imports of consumption goods and imports of
raw materials and services lumped together. Equation (7.6)
assumes that private and public investment each have differ-
ent import requirements. Equation (7.7) is a typical demand
equation where quantities demanded of imported consumption
goods are explained by total consumption expenditures and
relative prices. The relative price index, as it was con-
structed, assumes that domestically produced goods are sub-
stitutes for imported ones, an assumption which may not be
valid for all items classified under the relevant import
category. Finally, imported raw materials and services are
explained by the level of national income.

Equations (7.9) and (7.10) give the trends of exports
and the terms-of-trade effect and Equation (7.11) is the
GNI identity.
Diagram 4. Flow chart of econometric model
Of the variables included, $E_t, E_{t-1}, Z_t, Z_{t-1}, I_t, G_t$, and $U_t$ are the exogenous ones, namely, those not explained by the system. The last two ($I_t$ and $U_t$) may be considered instrument variables as they are controlled by the policymakers. ($U_t$ can be influenced by imposition or removal of import duties having the effect of increasing or decreasing the prices of imported goods relative to that of the domestic goods.)

The remaining nine endogenous variables are determined by the parametric structure of the system (of the nine structural equations) and the values of the exogenous variables. The exogenous paths of the latter determines over time a moving-equilibrium path for the system as a whole.

The working of the system is exhibited in a flow chart where the variables enclosed in rectangles are exogenous. Those in circles are endogenous. The arrows connecting any two variables indicate the functional relationship between them, leading from the independent to the dependent variables.

**The theoretical reduced form of the system**

By solution of the economic system is meant its expression in terms of the exogenous variables alone or equivalently, finding the inverse of the matrix of structural coefficients.
The reduced system is shown in a condensed way because of the complexity of the individual coefficients.

The following equations define the symbols appearing in the reduced system which are not immediately identified as structural coefficients.

\[ \lambda = \frac{1}{1 - c^P - c^\tau_1 c^P - \Theta c^G(\tau_2 - \tau_1) c^P - \Theta c^G(\tau_2 - \tau_1) m_1 c^\tau_1 c^P + m_{\text{RMS}}} \]

\[ + \Theta m_1 c^P + c^\tau_1 c^P m_1 \Theta + c^\tau + c^\tau + c^\tau_1 c^\tau \]

\[ \Theta = \frac{1}{1 - m_1 (\tau_2 - \tau_1) c^G} \]

\[ d = c^P + i_0 + c^G - m_{\text{RMS}} + \Theta c^d - c^\tau d - c^\tau_1 c^d - m_1 \Theta c^G(\tau_2 - \tau_1) \tau_0 \]

\[ + \Theta m_1 (\tau_2 - \tau_1) c^d - c^G(\tau_2 - \tau_1) m_1 \Theta c^d - m_1 c^d + m_{\text{RMS}} c^d \]

\[ + \Theta m_1 c^\tau d - \Theta c^\tau d + m_1 \lambda - \Theta m_1 c^P - \Theta m_1 c^P - \Theta m_1 c^G - \Theta m_1 c^G \]

\[ - \Theta m_1 c^\tau_1 c^P \]

\[ \beta = \Theta m_1 c^P + \Theta m_1 c^G + \Theta m_1 c^G + \Theta m_1 (1 + c^G \tau_1) \left[ c^P + c^P(\alpha \lambda - \tau_0 - \tau \alpha \lambda) \right] \]

\[ + m_1 \Theta c^G(\tau_0 + \tau \alpha \lambda) \]

\[ \beta_1 = \Theta m_1 (1 + c^G \tau_1) \lambda c^P(1 - \tau^d) + \Theta m_1 c^G \tau^d \lambda \]
(7.18) $\beta_1 = \theta m_1 (1 + c^G_\tau) c^P \lambda (1 - \tau^d) + \theta m_1 c^G \tau^d \lambda$

(7.19) $\beta_2 = \theta m_1 (1 + c^G_\tau) c^P \lambda (1 - \tau^d) (1 - m_I^P) i_E + \theta m_1 c^G \tau^d \lambda (1 - m_I^P) i_E$

(7.20) $\beta_3 = \theta m_1 (1 + c^G_\tau) c^P \lambda i_E (1 - \tau^d) (1 - m_I^P) + \theta m_1 c^G \tau^d \lambda i_E (1 - m_I^P)$

(7.21) $\beta_4 = \theta m_1 (1 + c^G_\tau) c^P \lambda (1 - m_I^G) (1 - \tau^d) + \theta m_1 c^G \tau^d \lambda (1 - m_I^P)$

(7.22) $\beta_5 = \theta m_2 - \theta m_1 (1 + c^G_\tau) c^P \lambda \theta (1 - \tau^d) m_2 - \theta m_1 c^G \tau^d \theta m_2$

(7.23) $\gamma_0 = \tau_0^i + \tau_1 c^P \theta + c^P (\alpha - \tau_0^d - \tau^d \alpha) + (\tau_2 - \tau_1) \beta_0$

(7.24) $\gamma_1 = \tau_1 c^P \lambda (1 - \tau^d) + (\tau_2 - \tau_1) \beta_1$

(7.25) $\gamma_2 = \tau_1 c^P \lambda i_E (1 - \tau^d) (1 - m_I^P) + (\tau_2 - \tau_1) \beta_2$

(7.26) $\gamma_3 = \tau_1 c^P \lambda i_E (1 - \tau^d) (1 - m_I^P) + (\tau_2 - \tau_1) \beta_3$

(7.27) $\gamma_4 = \tau_1 c^P \lambda (1 - m_I^G) (1 - \tau^d) + (\tau_2 - \tau_1) \beta_4$

(7.28) $\gamma_5 = (\tau_2 - \tau_1) \beta_5 - \tau_1 c^P \lambda \theta (1 - \tau^d) m_2$

(7.29) $\delta_0 = \tau^d \alpha \lambda + \tau_0^d$

(7.30) $\delta_1 = \tau^d \lambda$

(7.30') $\delta_2 = \tau^d \lambda i_E (1 - m_I^P)$
Table 32. Coefficient of the reduced form matrix

<table>
<thead>
<tr>
<th>Endogenous Variables</th>
<th>( E + Z )</th>
<th>( E - 1 )</th>
<th>( Z - 1 )</th>
<th>( I )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_t )</td>
<td>( c^P \lambda (1 - \tau^d) )</td>
<td>( c^P \lambda \mathbf{E} (1 - m^P_1) (1 - \tau^d) )</td>
<td>( c^P \lambda \mathbf{E} (1 - \tau^d) (1 - m^P_1) )</td>
<td>( c^P \lambda (1 - m^G_1) (1 - \tau^d) )</td>
</tr>
<tr>
<td>( \Gamma_t )</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( C_t^G )</td>
<td>( c^G (\gamma_1 + \delta_1) )</td>
<td>( c^G (\gamma_2 + \delta_2) )</td>
<td>( c^G (\gamma_3 + \delta_3) )</td>
<td>( c^G (\gamma_4 + \delta_4) )</td>
</tr>
<tr>
<td>( T_t^d )</td>
<td>( \tau^d \lambda )</td>
<td>( \tau^d \lambda \mathbf{E} (1 - m^P_1) )</td>
<td>( \tau^d \lambda \mathbf{Z} (1 - m^P_1) )</td>
<td>( \tau^d \lambda (1 - m^G_1) )</td>
</tr>
<tr>
<td>( T_t^d )</td>
<td>( \tau_t c^P \lambda (1 - \tau^d) + (\tau_2 - \tau_1) \beta_1 )</td>
<td>( \tau_t c^P \lambda \mathbf{E} (1 - m^P_1) (1 - \tau^d) )</td>
<td>( \tau_t c^P \lambda \mathbf{Z} (1 - m^P_1) (1 - \tau^d) )</td>
<td>( \tau_t c^P \lambda (1 - m^G_1) (1 - \tau^d) )</td>
</tr>
<tr>
<td>( M_t^I )</td>
<td>0</td>
<td>( m^P_1 \mathbf{E} )</td>
<td>( m^P_1 \mathbf{Z} )</td>
<td>( m^G_1 )</td>
</tr>
<tr>
<td>( M_t^C )</td>
<td>( \beta_1 )</td>
<td>( \beta_2 )</td>
<td>( \beta_3 )</td>
<td>( \beta_4 )</td>
</tr>
<tr>
<td>( M_t^{RMS} )</td>
<td>( m^{RMS} \lambda )</td>
<td>( m^{RMS} \lambda \mathbf{E} (1 - m^P_1) )</td>
<td>( m^{RMS} \lambda \mathbf{Z} (1 - m^P_1) )</td>
<td>( m^{RMS} \lambda (1 - m^G_1) )</td>
</tr>
<tr>
<td>( Y_t )</td>
<td>( \lambda )</td>
<td>( \lambda \mathbf{E} (1 - m^P_1) )</td>
<td>( \lambda \mathbf{Z} (1 - m^P_1) )</td>
<td>( \lambda (1 - m^G_1) )</td>
</tr>
</tbody>
</table>
Table 32. (Continued)

<table>
<thead>
<tr>
<th>Endogenous Variables</th>
<th>Constant Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>( c^P \lambda \theta (1-\tau^d)m_2 )</td>
<td>( c_0 + c^P(\alpha \lambda - \tau^d_0 - \tau^d_{\theta_0}) )</td>
</tr>
<tr>
<td>0</td>
<td>( i_0 )</td>
</tr>
<tr>
<td>( c^G(\gamma_5+\delta_5) )</td>
<td>( c_0^G + c^G(\delta_0 + \gamma_0) )</td>
</tr>
<tr>
<td>(- \tau^d \gamma \theta m_2 )</td>
<td>( \tau^d_0 + \tau^d \alpha \lambda )</td>
</tr>
<tr>
<td>((\tau_{2-1})^{-3}_5 - \tau^d c^P \lambda \theta (1-\tau^d)m_2 )</td>
<td>( \tau^i_0 + \tau^i_1 c^P_0 + c^P(\alpha \lambda - \tau^d_0 - \tau^d \alpha \lambda) + (\tau_{2-1})_5 \beta_0 )</td>
</tr>
<tr>
<td>( \beta_5 )</td>
<td>( m_{\tau^i_0} )</td>
</tr>
<tr>
<td>(-m_{\text{RMS}} \lambda \theta m_2 )</td>
<td>( m_{\text{RMS}} + m_{\text{RMS}} \alpha )</td>
</tr>
<tr>
<td>(-\lambda \theta m_2 )</td>
<td>( \alpha \lambda )</td>
</tr>
</tbody>
</table>
(7.31) \( \delta_3 = r^d \lambda_i z (1-m^P) \)

(7.32) \( \delta_4 = r^d \lambda (1-m^G) \)

(7.33) \( \delta_5 = -r^d \lambda \theta m_2 \)

Each composite coefficient of the exogenous system is a total multiplier with respect to the exogenous variable to which it is attached in the sense that it accounts for all changes in the system due to the simultaneity of the structural relations.

The empirical model

The annual data used for the statistical estimation of the structural parameters of the model are based on the INP publications for the period 1950-1963.

Two statistical procedures were used; Classical Least Squares and Two-Stage Least Squares. The results are as follows:

**TSLS - estimated structural model**

\[
(7.34) C_t^P = 5260 + 0.626 (Y_t - T_t^d) \\
\quad (1843) \quad (0.037) \quad 0.96 \quad 271 \quad 0.84
\]

\[
(7.35) I_t^P = 2361 + 0.6044 E_{t-1} \\
\quad (1301) \quad (0.0967) \quad 0.81 \quad 24 \quad 2.32
\]

\[
+ 0.968 Z_{t-1} \\
\quad (0.374)
\]
(7.36) \[ C_t = -590 + 0.722 (T^d_t + T^1_t) \]
\[ R^2 = 0.97, \quad F = 373, \quad D.W. = 1.25 \]

(7.37) \[ T^d_t = -2091 + 0.098 Y_t \]
\[ R^2 = 0.97, \quad F = 368, \quad D.W. = 2.42 \]

(7.38) \[ T^1_t = -4262 + 0.205 (C^P_t + C^G_t) \]
\[ R^2 = 0.96, \quad F = 160, \quad D.W. = 2.49 \]

(7.39) \[ M_t = 0.443 I^P_t + 0.389 I^G_t \]
\[ R^2 = 0.99, \quad F = 737, \quad D.W. = 1.11 \]

(7.40) \[ C_t = 6531 + 0.005 (C^P_t + C^G_t) \]
\[ R^2 = 0.84, \quad F = 27, \quad D.W. = 1.14 \]

(7.41) \[ RMS_t = -1251 + 0.090 Y_t \]
\[ R^2 = 0.93, \quad F = 148, \quad D.W. = 0.75 \]

(7.42) \[ Y_t = \frac{C^P_t}{t} + \frac{I^P_t}{t} + \frac{C^G_t}{t} + \frac{I^G_t}{t} + E_t + \frac{Z_t}{t} - \frac{M_t}{t} \]
As usual, the standard errors of the coefficients are listed in parentheses below each coefficient. $R^2$ denotes the value of the coefficient of multiple determination corrected for degrees of freedom. In addition, the Durbin-Watson
(D. W.) test for serial correlation in the residuals is also given. With the sample size used and a single independent variable a value of the DW statistic below .81 indicates significant autocorrelation; a value above 1.07 indicates serial independence, while a value between .81 and 1.07 is inconclusive. For two independent variables the corresponding limits are .70 and 1.25.

In general, the structural estimates obtained by the two procedures are very close. The sole exception is Equation (7.49). The statistical problems involved and the merits and shortcomings of each method are discussed among others in References 48, 49 and 50. The case at hand confirms the prevalent opinion that the results of the two methods are not expected to differ significantly. The analysis will be based subsequently on the CLS - estimated model.

The values of the structural parameters reveal important features of the Peruvian economy. The private consumption function indicates a nearly proportional relation between disposable income and private consumption expenditures. Yet the marginal propensity to consume is quite low for a country of Peru's per capita income level. This reflects the unequal distribution of income and the fact that additions to national income, originating mainly in the export sector, leave substantial savings margins for capital formation. Private investment is shown to depend very strongly on lagged exports and the terms-of-trade effect.
Although it is true that the greatest part of private investment is channeled into the export sector, Equation (7.44) may reflect more than that. The sensitivity of private investment in underdeveloped economies to the "social climate" is well-established. It may be said with some confidence that few other factors affect the "mood" of the Peruvian economy more than developments in the country's export trade.

Public consumption is shown to be a nearly proportional function of total tax revenues. The public sector's marginal propensity to consume is higher than that of the private sector so that direct taxes reduce national income via private consumption by less than they increase it via public consumption expenditures for relatively small transfers between the two sectors.

The structural requirements for capital-goods imports and for imports of raw materials and services are seen to be high. The marginal propensity to import raw materials and services is substantially greater than the average propensity indicating a demand elasticity greater than unity. On the other hand, imports of consumption goods appear to be very sensitive to relative price changes so that it may be concluded that this (negative) component of national income can be manipulated easily through import-duty policies. However, as is evident from Equation (7.5), there is a cost attached to a reduction of consumption-goods imports. Total
indirect tax receipts depend heavily on the level of such imports so that a given amount of decrease in the latter leads to a decline of indirect taxes and thereby to a decline of public expenditures.

The empirical reduced form system

The empirical reduced form system associated with the CLS-estimated model is presented in Table 33.

Before making use of the reduced form system, the descriptive and forecasting power of the above model over the sample period can be tested. Evaluating first the forecasting quality of the system involves a comparison of predicted values with actual values of the endogenous variables which lie outside the sample period together with criteria to judge the differences between the two sets of values. Until such actual values become available no definitive conclusion can be drawn. The following observations indicate what can be expected of the model's forecasting power. Inspection of the reduced form matrix in Table 33 shows that forecasts of the endogenous variables depend very heavily on the assumptions about the exogenous variables, $E_t$, $Z_t$, $E_{t-1}$ and $Z_{t-1}$. Whereas it appears possible to project the volume of total exports fairly accurately over the five to seven year period, the same cannot be claimed with respect to the terms-of-trade effect. The latter is a volatile component depending on both volume of exports and export and import prices. Not much can be done to improve the forecasts of
Table 33. Reduced form matrix

<table>
<thead>
<tr>
<th>Equations</th>
<th>$E + Z$</th>
<th>$E_{-1}$</th>
<th>$Z_{-1}$</th>
<th>$I^G$</th>
<th>$V$</th>
<th>Constant term</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C^P$</td>
<td>1.3528</td>
<td>0.4554</td>
<td>0.7294</td>
<td>0.8265</td>
<td>22.9095</td>
<td>10464</td>
</tr>
<tr>
<td>$I^P$</td>
<td>0</td>
<td>0.6044</td>
<td>0.9680</td>
<td>0</td>
<td>0</td>
<td>2361</td>
</tr>
<tr>
<td>$C^G$</td>
<td>0.3694</td>
<td>0.1243</td>
<td>0.1991</td>
<td>0.2257</td>
<td>-0.8012</td>
<td>-1754</td>
</tr>
<tr>
<td>$T^d$</td>
<td>0.2121</td>
<td>0.0714</td>
<td>0.1144</td>
<td>0.1296</td>
<td>3.5598</td>
<td>-1393</td>
</tr>
<tr>
<td>$T^i$</td>
<td>0.3110</td>
<td>0.1050</td>
<td>0.1680</td>
<td>0.1900</td>
<td>-4.7410</td>
<td>-402</td>
</tr>
<tr>
<td>$M^T$</td>
<td>0</td>
<td>0.2677</td>
<td>0.4288</td>
<td>0.3890</td>
<td>0</td>
<td>1045</td>
</tr>
<tr>
<td>$M^C$</td>
<td>0.0693</td>
<td>0.0233</td>
<td>0.0374</td>
<td>0.0423</td>
<td>-22.8522</td>
<td>3698</td>
</tr>
<tr>
<td>$M^{RMS}$</td>
<td>0.2848</td>
<td>0.0959</td>
<td>0.1535</td>
<td>0.1740</td>
<td>4.8319</td>
<td>-608</td>
</tr>
<tr>
<td>$Y$</td>
<td>2.3680</td>
<td>0.7973</td>
<td>1.2768</td>
<td>1.4468</td>
<td>40.1657</td>
<td>7006</td>
</tr>
</tbody>
</table>
these latter factors. The Peruvian economy is primarily export oriented and will continue to be exposed to the vagaries of international markets so that no aggregate economic model can afford to minimize the role of these variables without a severe loss of descriptive and predictive value.

The other exogenous variables, $G$ and $U$, can be considered instruments of economic policy. Forecasting the values of policy instruments is, of course, possible in case the government formulates plans—even informal ones. Projections of policy instruments incorporating public policy intentions are, generally, the rule. On the other hand, in case a formal planning model is used, policy instruments are the unknowns to be solved for in a specified context of objectives and constraints. In general, the projections of the endogenous variables which will be attempted here are conditional upon both exogenous trends in the foreign-trade variables (adopted by the INP) and alternative fiscal and trade policies.

Accurate forecasting of the exogenous variables is one basic requirement for good results in predicting the endogenous variables. The other basic condition is a good approximation of the structure of a given economy in terms of its descriptive validity over the sample upon which the model is based.

A usual test consists in examining the residual of each individual estimated equation using only the observed values
of the explanatory variables appearing in it. The test which will be applied here differs from the above in that the set of the endogenous variables generated by the model's mechanism will be compared with the actually observed values of the same variables during the sample period. In other words, the internal "predictions" will be based on the reduced-form equations. This procedure provides a more stringent test of the model's performance inasmuch as it tends to reveal systematic biases which may arise because of the cumulative effects of estimation errors due to the simultaneous structure of the relationships.

The results are given in the first part of Table 33 and graphically reproduced in the charts.

In general, the actual observations are satisfactorily approximated by the values generated by the system.

In the second part of Table 33 certain inequality measures are presented as tests of the model's "goodness of fit".

A digression on their meaning is in order. Theil developed in (27) some interesting tools for the analysis of forecasting accuracy. The same concepts can be applied in the evaluation of the closeness with which a given model reproduces observed values on the basis of which the model was constructed.
The basic measure is the inequality coefficient defined as

\[ U = \frac{\sqrt{\frac{1}{N} \sum (P_i - A_i)^2}}{\sqrt{\frac{1}{N} \sum P_i^2} + \sqrt{\frac{1}{N} \sum A_i^2}} \]

where \( P_1, \ldots, P_N \) are the predicted values and \( A_1, \ldots, A_N \) the corresponding actual outcomes. The coefficient \( U \) is confined to the closed interval \((0, 1)\). \( U = 0 \) corresponds to perfect forecasting, that is, \( P_i = A_i \) for all \( i \)'s.

\( U = 1 \), the maximum of inequality, corresponds to the case of the existence of a non-positive proportionality between the \( P \)'s and the \( A \)'s.

The numerator of \( U \) is the square root of the second moment of the forecasting errors. The latter can be decomposed as follows:

\[ (\bar{P} - \bar{A})^2 + (S_P - S_A)^2 + \sqrt{2(1-r)S_P S_A} \]

where \( \bar{P}, \bar{A}, S_P, S_A \) and \( r \) are the means, the standard deviations and the correlation coefficient of the two series.

Writing

\[ D = \sqrt{\frac{1}{N} \sum P_i^2} + \sqrt{\frac{1}{N} \sum A_i^2} \]

\[ U_M = \frac{\bar{P} - \bar{A}}{D} \]

\[ U_S = \frac{S_P - S_A}{D} \]
one derives
\[
U_c = \frac{\sqrt{2(1-r)SS^*}}{D}
\]

\[
\frac{U^2_M + U^2_S + U^2_c}{U^2} = U^2
\]

\(U_M, U_S\) and \(U_c\) may be termed the partial coefficients of inequality due to unequal central tendency, unequal variation and imperfect covariation, respectively.

By defining
\[
U^2_M = \frac{U^2_M}{U^2}, \quad U^2_S = \frac{U^2_S}{U^2}, \quad U^2_c = \frac{U^2_c}{U^2}
\]

one has
\[
U^2_M + U^2_S + U^2_c = 1,
\]

\(U_M, U_S\) and \(U_c\) being the proportion of inequality due to the mentioned sources.

Since in practice no perfect forecasting is possible in most cases, the significance of each source of error must be assessed separately.

Inequality of central tendency, or bias, may be called a systematic error. Similarly, unequal variation of the two series reveals a systematic error in the sense that factors making for fluctuations in one series are not accounted for in the other. Imperfect covariation, however, indicates an unsystematic sort of error since it implies that the differences between predictions and outcomes do not follow a
Table 348. Generated values and differences from actual values of the 
Endogenous variables

<table>
<thead>
<tr>
<th>Years</th>
<th>( \hat{Y} )</th>
<th>( \hat{Y} - Y )</th>
<th>( \hat{\Delta} P )</th>
<th>( \hat{\Delta} P )</th>
<th>( \hat{\Delta} G )</th>
<th>( \hat{\Delta} G )</th>
<th>( \hat{\Delta} I )</th>
<th>( \hat{\Delta} I )</th>
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<tr>
<td>1951</td>
<td>40159</td>
<td>950</td>
<td>29393</td>
<td>342</td>
<td>3605</td>
<td>424</td>
<td>7998</td>
<td>106</td>
</tr>
<tr>
<td>1952</td>
<td>41984</td>
<td>1938</td>
<td>30439</td>
<td>2355</td>
<td>2669</td>
<td>276</td>
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<td>1953</td>
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<td>211</td>
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<td>-212</td>
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<td>-171</td>
<td>3048</td>
<td>241</td>
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<td>232</td>
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<td>1316</td>
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<td>473</td>
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<td>554</td>
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<td>8454</td>
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<td>-654</td>
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<td>1961</td>
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<td>959</td>
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<td>9</td>
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Inequality Coefficients

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<th></th>
<th>( u )</th>
<th>( u_M )</th>
<th>( u_S )</th>
<th>( u_C )</th>
<th>( u_M )</th>
<th>( u_S )</th>
<th>( u_C )</th>
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<td>.0653</td>
<td>.0457</td>
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<td>- .0013</td>
<td>- .0009</td>
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<td>- .0013</td>
<td>- .0009</td>
<td>- .0007</td>
<td>- .0004</td>
<td>- .0066</td>
<td>- .0226</td>
</tr>
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<td>- .0226</td>
<td>- .0140</td>
<td>.0155</td>
<td>.0239</td>
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<tr>
<td>( u_C )</td>
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<td>.00019</td>
<td>.0002</td>
<td>.0007</td>
<td>.0709</td>
<td>.0698</td>
</tr>
<tr>
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<td>.9263</td>
<td>.8800</td>
<td>.9047</td>
<td>.9688</td>
<td>.9263</td>
<td>.8800</td>
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Table 34a. (Continued)

<table>
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<th>Year</th>
<th>$\Delta d$</th>
<th>$\Delta d - T^d$</th>
<th>$\Delta I$</th>
<th>$\Delta I - T^I$</th>
<th>$\Delta I$</th>
<th>$\Delta I \cdot T$</th>
<th>$\Delta C$</th>
<th>$\Delta C - T^C$</th>
<th>$\Delta RMS$</th>
<th>$\Delta RMS - T^M$</th>
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<tr>
<td>1951</td>
<td>1604</td>
<td>2</td>
<td>2809</td>
<td>86</td>
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<td>116.0</td>
<td>1929</td>
<td>-101.1</td>
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<td>510.0</td>
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<td>1645</td>
<td>15</td>
<td>3021</td>
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<td>4595</td>
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<td>1910</td>
<td>-88.1</td>
<td>3599.6</td>
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<td>269</td>
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<td>1954</td>
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<td>3143</td>
<td>-213</td>
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<td>17</td>
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<td>-74.4</td>
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<td>702</td>
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<td>-342.0</td>
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<td>1959</td>
<td>2055</td>
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<td>3567</td>
<td>-520</td>
<td>4045</td>
<td>337.0</td>
<td>2206</td>
<td>255.0</td>
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<td>1960</td>
<td>2739</td>
<td>-518</td>
<td>4663</td>
<td>-101</td>
<td>4208</td>
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<td>193.0</td>
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<td>3385</td>
<td>165.0</td>
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<td>349.0</td>
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<tr>
<td>1963</td>
<td>3741</td>
<td>-471</td>
<td>6281</td>
<td>-899</td>
<td>6711</td>
<td>240.0</td>
<td>3449</td>
<td>-340.0</td>
<td>6762.0</td>
<td>-1.0</td>
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</table>

Inequality Coefficients

<table>
<thead>
<tr>
<th>$U$</th>
<th>0.0474</th>
<th>0.0449</th>
<th>0.0606</th>
<th>0.0433</th>
<th>0.0346</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_M$</td>
<td>-0.0015</td>
<td>0.0014</td>
<td>-0.0006</td>
<td>-0.0059</td>
<td>0.0057</td>
</tr>
<tr>
<td>$U_S$</td>
<td>-0.0155</td>
<td>-0.0053</td>
<td>-0.0318</td>
<td>-0.0059</td>
<td>-0.0060</td>
</tr>
<tr>
<td>$U_C$</td>
<td>0.0449</td>
<td>0.0423</td>
<td>0.0515</td>
<td>0.0425</td>
<td>0.0336</td>
</tr>
<tr>
<td>$U_M$</td>
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<td>0.0009</td>
<td>0.0001</td>
<td>0.0191</td>
<td>0.0284</td>
</tr>
<tr>
<td>$U_S$</td>
<td>0.1071</td>
<td>0.1161</td>
<td>0.2761</td>
<td>0.0185</td>
<td>0.0299</td>
</tr>
<tr>
<td>$U_C$</td>
<td>0.8919</td>
<td>0.8830</td>
<td>0.7238</td>
<td>0.9624</td>
<td>0.9417</td>
</tr>
</tbody>
</table>
pattern. It follows that in any given situation of imperfect forecasting the desirable distribution of the sources of error is $U^M = U^S = 0$ and $U^C = 1$.

Turning now to the data of Table 33 it is seen that the basic inequality coefficients are small for all series and very satisfactory for national income and private consumption. Similarly, the distribution of error over the three sources approximates quite closely the desired pattern with the exception of $M^I$. It is remarkable that in general, the bias is very close to zero for most series. This particular characteristic is a desired one for projections over a number of years as interest lies not only in year to year changes but in the cumulative aspect of development and its requirements over the planning horizon.

The series with significant proportion of error due to unequal variation, are the two tax series and the capital goods imports. This means that an improvement in specification is called for on the relevant relationships. This, however, may not be possible without additional data. For instance, the case may be that direct tax receipts depend much more closely on the level of profits than that of national income. The standard deviation of profits is believed to be greater than that of income, whence a possible explanation of the unequal variation in the relevant two series.
Diagram 5. Predicted and actual income path
Diagram 6. Predicted and actual private consumption path
Diagram 7. Predicted and actual private investment path
Diagram 8. Predicted and actual public consumption path
Diagram 9. Predicted and actual direct tax path
Diagram 10. Predicted and actual indirect tax path
Diagram 11. Predicted and actual path of capital goods imports
Diagram 12. Predicted and actual path of consumption goods imports
Diagram 13. Predicted and actual path of raw materials imports
equilibrium in the balance of trade and a specified rate of
growth of national income in the year 1970 (the other exo-
genous variables being determined as stipulated previously).
These conditions imply that values of \( I_{1970}^G \) and \( U_{1970} \)
must be sought which satisfy simultaneously the equations

\[
(E + Z)_{1970} - M_{1970} - M_{1970} - M_{RMS} = 0
\]

\[\frac{Y_{1970}}{Y_{1964}} (1 + r_y)^6\]

where \( r_y \) is the specified rate of growth of \( Y \).

The above equations can be rewritten in the following
form*.

\[
\begin{pmatrix}
1.4468 & 40.1657 \\
0.6053 & -18.0203
\end{pmatrix}
\begin{pmatrix}
I_{1970}^G \\
U_{1970}
\end{pmatrix}
= \begin{pmatrix}
Y_{1970} - 94221 \\
F_{1970} + 2733
\end{pmatrix}
\]

where \( F_{1970} \) is the level of total net foreign capital inflow
and \( Y_{1970} \) the desired level of national income corresponding
to a specified \( r_y \).

---

*The derivation is as follows: The first equation in
matrix form corresponds to the last equation in Table 32
where all known terms have been calculated with the exception
of \( I^G \) and \( U \) components. Similarly, the second equation in
matrix form is derived by equating the sum of \( M_{RMS}, M^C \) and \( M^I \)
where all components have been calculated except those
corresponding to \( I^G \) and \( U \).
Before the determination of the path of the endogenous variables can be derived the future annual values for \( I \) and \( Z \) have to be specified. Considering that both these variables are subject to policy control within relatively wide limits, values may be sought which are consistent with predetermined policy goals. In the absence of an explicit welfare function, the thing which can be achieved in the present context is to present a set of policy alternatives together with their side effects inasmuch as the latter may have relevance for the final choice by the policymakers.

In the system the two policy degrees of freedom available make it possible, in principle, for two policy targets to be selected for simultaneous realization.

From the analysis of the previous chapter, it will be remembered that under several assumptions about final year values of instrument variables and the path of exports and the terms-of-trade effect, the trade balance showed a substantial deficit of nearly 167 million dollars in the equilibrium solution temporarily accepted. (A balanced government budget was, however, imposed.)

Several alternatives can be investigated here relating to the balance of trade, the growth rate of national income and the state of the public budget. For example, let us examine the consequences on required \( I^G \), and \( U \), and the state of the public budget of a policy designed to attain
of foreign prices to the Peruvian consumer over that of domestically produced consumer goods \(2.31 \ (U_{1963} = 231)\) as compared to the prevailing one in 1963 \(U_{1963} = 85\).

**Projections and economic policy alternatives**

As explained earlier, the INF revised downward its projections of exports and the terms of trade to a rate of growth of 5.4% annually for the former and 5.2% for the latter. On the basis then of the trends

\[
E_t = 17692 \ (1.054)^t \quad t = 1, \ldots, 6
\]

\[
Z_t = 2497 \ (1.052)^t
\]

the following values are obtained.

**Table 34b. Values of E and Z in millions of 1960 soles**

<table>
<thead>
<tr>
<th>Years</th>
<th>E</th>
<th>Z</th>
<th>E + Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>17692</td>
<td>2487</td>
<td>21344</td>
</tr>
<tr>
<td>1965</td>
<td>18612</td>
<td>2632</td>
<td>21344</td>
</tr>
<tr>
<td>1966</td>
<td>19580</td>
<td>2774</td>
<td>22354</td>
</tr>
<tr>
<td>1967</td>
<td>20958</td>
<td>2524</td>
<td>23522</td>
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<tr>
<td>1968</td>
<td>21669</td>
<td>3082</td>
<td>24751</td>
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<td>1969</td>
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<td>26044</td>
</tr>
<tr>
<td>1970</td>
<td>23981</td>
<td>3423</td>
<td>27404</td>
</tr>
</tbody>
</table>
\[
\frac{\Delta y_t}{\Delta \pi_t} = 2.3680 (1-m_{1P})
\]

indicates by how much the income generating power of private investment can be increased by lowering the structural coefficient and similarly, for all coefficients of the reduced-form matrix in which the term \( m_{1P} \) is involved.

The influence, e.g., of the past level of exports on private consumption expressed as a function of \( m_{1P} \),

\[
\varphi P P \frac{C_t}{E_{t-1}^P} = c_P \lambda \frac{t}{P}(1-t^P)(1-m_{1P}) = 0.8178(1-m_{1P})
\]

is shown to depend substantially on what goes on with respect to import substitution of capital goods.

There is considerable scope in manipulating \( U_t \) for a number of policy goals. The cumulative effect of raising \( U_t \) via import duties on national income can amount to a considerable percentage of the latter's level. Given the reduction of consumer-goods imports which accompany a substantial raise of \( U_t \) and the corresponding increase in private consumption, it must be assumed that domestic consumption-good industries will be able to meet the increase in demand so as to allow the multiplier mechanism to work itself out without monetary complications. There is, however, an obvious limit above which \( U_t \) cannot be raised and this is the point of \( M_t^c = 0 \).
The empirical reduced system: discussion of some coefficients

The reduced-form equations (Table 7.32) show clearly the extreme dependence of the Peruvian economy on exports and the terms of trade in view of the absolute magnitudes of both coefficients and arguments involved. The export, or terms-of-trade effect multiplier is 2.3680, which means that an addition to income originating on the export sector induces further increments until the equilibrium output has increased by approximately two and one-third times the initial change. The coefficients of lagged variables can be used to obtain the private investment multiplier on any of the endogenous variables. For example, the private investment multiplier on national income, \( \frac{\Delta Y_t}{\Delta I_t} \), is obtained by observing that

\[
\Delta Y_t = \frac{\partial Y_t}{\partial E_{t-1}} = \frac{\partial Y_t}{\partial z_{t-1}} = 1.319.
\]

It is noticed that the investment expenditure multipliers are substantially lower than the export and terms-of-trade effect multipliers. This is, of course, due to the fact that both types of investment require relatively high amounts of imported capital goods. If in the process of capital formation import requirements are reduced, nearly the whole structural picture changes. For instance, the private investment multiplier expressed as a function of \( m^P_I \)
The following results are obtained with $F_{1970} = 0$ and $r_y = 0.07, 0.065, 0.06$, respectively.

Table 35. Policy requirements

<table>
<thead>
<tr>
<th>$F_{1970} = 0$</th>
<th>$r_y/0.07$</th>
<th>$0.065$</th>
<th>$0.06$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I^G_{1970}$</td>
<td>8800</td>
<td>7479</td>
<td>6186</td>
</tr>
<tr>
<td>$U_{1970}$</td>
<td>93.412</td>
<td>64.6</td>
<td>36.5</td>
</tr>
<tr>
<td>Budget Deficit $_{1970}$</td>
<td>3955</td>
<td>720</td>
<td>-8</td>
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</tbody>
</table>

The results in the first column of Table 35 suggest a non-feasible policy program. Although neither $I^G$ is excessively higher than the projected value of the INP (7979), nor does $U = 93.412$ suggest a trade policy vis-a-vis consumer-goods imports reaching prohibitive levels (by comparison with pre-existing levels), the side effect of such a policy on the public budget is a great deficit which may not be covered by domestic debt, while the tax revenues implied are even higher than the INP projections.

The results of the second column show a striking sensitivity of both the instrument and the side variables to a relatively slight reduction in the aggregate growth rate. A manageable budget deficit emerges, a level of public investment within proclaimed government intentions and even a
more liberal import policy. Whether by reduction or even elimination of import duties a price ratio such as derived is possible, can be determined only by detailed analysis of Peruvian tariffs not available to the author.

The above results are not really at variance with those derived with the supply-oriented model of the previous chapter where the terms-of-trade effects were not taken into account. The resulting heavy requirements for foreign capital in the previous model can be traced directly to this fact, reflecting again Peru's basic dependence on its foreign sector. To illustrate this point with a further example, the figures of projected $Z_{1969}$ and $Z_{1970}$ in (52) are taken (they are lower by about 764 million 1960 soles than the corresponding projections incorporated in this chapter) and for policy requirements $I_G^{1970}$, and $U^{1970}$ are computed with $F_{1970} = 0$, $r_y = 0.07$, and alternatively $r_y = 0.065$. Corresponding to $r_y = 0.07$, $I_G^{1970} = 8723$ (which is somewhat lower than in Table 35) but $U_{1970} = 165.6$ (comparing with 93.412 in Table 35). The derived value for $U_{1970}$ may well imply prohibitive tariffs on consumer goods. Corresponding to $r_y = 0.065$, one derives $I_G^{1970} = 7681$ and $U_{1970} = 128.9$. The last figure is also very high in comparison with the historically observed and indicates severe import restrictions of consumer goods. The government budget is affected adversely by about 183 million 1960 soles.
If the terms-of-trade effect has not been accurately forecast, in particular, if the experts have been optimistic in their forecasts, foreign capital will be required to sustain the 0.065 growth rate which appears feasible within the present framework of analysis. It should be noted, however, that given the structure of the model, extrapolation into the indefinite future will imply a widening balance-of-trade gap and consequently increasing foreign capital requirements to sustain a given rate of aggregate growth. Nevertheless, the present model would be inappropriate if extended beyond the medium run as in the long run the capacity effect of capital formation, and the import substitution made possible by the widening scope of domestic production cannot be ignored. If properly taken into account, they would imply significant changes in the structure of the economy and invalidate conclusions drawn on the basis of the present structural picture.

What emerges then can be stated as follows: With unchanging economic structure (with the parameters remaining approximately at the estimated levels) the economy of Peru, foreign-demand oriented as it is, will most likely not progress at a slower pace than that exhibited by its foreign sector. For significantly higher aggregate performance, there must take place either foreign capital inflow reaching relatively high levels by 1970 in order to preserve a
balanced budget or develop a great budgetary deficit, if equilibrium in the balance of trade is pursued. Otherwise, import substitution remains imperative.

The final empirical step will be to derive the path of the endogenous variables over the planning period; in other words, to present a table of national accounts for the period 1965-1970 based on the following assumptions:

1) The Peruvian economic structure as pictured by the model will remain substantially unchanged over the indicated period of time.

2) The trade policy with respect to consumer-goods imports will result in a ratio of foreign to domestic prices yielding \( U = 0.93 \) for all years.

3) Total exports and the terms-of-trade effects will be growing annually at the rates of 5.2% and 5.4% respectively.

4) Public investment will be growing at the rate of 10.5% annually. This is an approximation to the implicit rate of growth of \( I^G \) so as to result to the level by 1970 which was found to correspond along with \( U = 93 \), to an acceptable global growth rate, a manageable public budget deficit and equilibrium in the balance of trade.

These specifications lead to a growth rate of the national economy of about 6.5% annually. The equilibrium in the balance of trade is maintained effectively but a widening tax gap develops. Over the planning period it remains within manageable proportions, but the government will need
Table 36. Projections of endogenous variables 1965-1970 in millions of soles

<table>
<thead>
<tr>
<th>Year</th>
<th>( Y )</th>
<th>( \Delta P )</th>
<th>( \Delta G )</th>
<th>( Y' )</th>
<th>( \Delta G' )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>84846</td>
<td>54928</td>
<td>9730</td>
<td>15471</td>
<td>4496</td>
</tr>
<tr>
<td>1966</td>
<td>89063</td>
<td>57337</td>
<td>10387</td>
<td>16159</td>
<td>4968</td>
</tr>
<tr>
<td>1967</td>
<td>93537</td>
<td>59893</td>
<td>11085</td>
<td>16880</td>
<td>5490</td>
</tr>
<tr>
<td>1968</td>
<td>98571</td>
<td>62769</td>
<td>11870</td>
<td>17858</td>
<td>6066</td>
</tr>
<tr>
<td>1969</td>
<td>103323</td>
<td>65483</td>
<td>12612</td>
<td>18441</td>
<td>6703</td>
</tr>
<tr>
<td>1970</td>
<td>108402</td>
<td>68539</td>
<td>13446</td>
<td>19283</td>
<td>7407</td>
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</tbody>
</table>
### Table 36. (Continued)

<table>
<thead>
<tr>
<th>Year</th>
<th>$\Delta d$</th>
<th>$\Delta i$</th>
<th>$\Delta I$</th>
<th>$\Delta C$</th>
<th>$\Delta RMS$</th>
<th>Budget Deficit</th>
<th>Balance-of-trade Surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>5575</td>
<td>8895</td>
<td>8601</td>
<td>3733</td>
<td>8754</td>
<td>-248</td>
<td>-156</td>
</tr>
<tr>
<td>1966</td>
<td>5655</td>
<td>9449</td>
<td>9089</td>
<td>3864</td>
<td>9266</td>
<td>201</td>
<td>-135</td>
</tr>
<tr>
<td>1967</td>
<td>6056</td>
<td>10037</td>
<td>9612</td>
<td>3995</td>
<td>9804</td>
<td>481</td>
<td>-111</td>
</tr>
<tr>
<td>1968</td>
<td>6507</td>
<td>10699</td>
<td>10269</td>
<td>4143</td>
<td>10434</td>
<td>770</td>
<td>-85</td>
</tr>
<tr>
<td>1969</td>
<td>6932</td>
<td>11323</td>
<td>10775</td>
<td>4282</td>
<td>10981</td>
<td>1060</td>
<td>-6</td>
</tr>
<tr>
<td>1970</td>
<td>7411</td>
<td>12026</td>
<td>11422</td>
<td>4438</td>
<td>11624</td>
<td>1416</td>
<td>80</td>
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</table>
to increase its domestic debt to the private sector to the extent that inflationary pressures are to avoided as a consequence of the proposed fiscal policy.

If one discards the differences caused by the introduction of the terms-of-trade effects, differences which are, by themselves, quite important since they show what a credit strain the Peruvian economy will be subjected to in case of deterioration of the former, the following comparisons can be made between the 1970 state of the economy envisaged on the present model as opposed to that derived in accordance with the model of Chapter V.

The aggregate growth rate in both situations is approximately the same. With a capital-output ratio equal to 5, total gross investment required exceeds significantly the level of the investment demand as specified here. If, however, the capital-output ratio is 4.5, the two levels are quite similar. Total import projections are lower by one billion soles in the present model. With a capital-output ratio of 4.5, private consumption is projected at a higher level by the supply-oriented model. With a capital-output ratio of 5, the demand-oriented model yields a higher estimate.

The tax composition of the two situations is different. In the previous model taxes were considered instrument variables and their values sought in agreement with the
specified targets. The ratios were
\[ \frac{T_i^{1970}}{y^{1970}} = \frac{T_d^{1970}}{y^{1970}} = 0.10 \]

In the demand-oriented model, the projection of the past structure yields
\[ \frac{T_d^{1970}}{y^{1970}} = 0.0684 \text{ and } \frac{T_i^{1970}}{y^{1970}} = 0.111 \]

and the difference between the total tax receipts is a little greater than the budget deficit in the present model.

If the terms-of-trade effects incorporated in the demand model are taken into account in the supply model, the former presents the alternative of a given assumed growth rate with equilibrium in the balance of trade and a deficit in the budget to be compared with the alternative of the same growth rate, a balanced-budget and a manageable balance-of-trade deficit, derived with the supply model.

A note on capacity-generating effects of capital formation in effective-demand macro-models

It has already been observed that the present model does not yield results valid in the long run because of the capacity-generating effects of progressive capital formation and the structural changes implicit in the process.

In order to take into account their effects within any time period (as long as it consists in a number of basic time units for which the variables are defined), the usual thing is to add a function relating in some customarily simple way capital or its rate of change with income and
derive through the savings-investment identity an equilibrium path for income. It is well known that a number of different interpretations and uses of this basic procedure fall in the class of what is called Harrod-Domar growth models. One of the interpretations, as for instance in Hicks's (51), is to consider the fundamental growth equation as showing the equilibrium path of income that will be followed if certain expectational conditions are satisfied, if the initial capital is balanced, and if, in the initial period, it is fully used. Another way of using the fundamental equation of growth is to start by interpreting the income-capital (or income-increment-rate of investment) relation as a rudimentary production function, or technical relation indicating the increase in productive capacity in general as a consequence of a given rate of investment and proceed through the savings-investment identity to obtain the equilibrium path of full-capacity output or income. In such a formulation, investment is determined entirely by the identity and no freedom exists to specify it at less than the full-capacity level. The derived income path is in this sense as conditional as the one under the first kind of interpretation. The above model cannot handle a situation in which investment, or at least part of it, is determined by factors such as exports and other exogenous variables which may result in less than full capacity utilization. In that case the capacity-path can be expected to be different
from that specified by the effective-demand income solution, since the latter consists of its usual behavioral and definitional equations sufficient in number to form a determinate mathematical system.

So, then a comparison can be made of the income path generated by the demand model with that given by the capacity equation.

Assume that over time a gap develops such that excess capacity prevails at an increasing rate. Then it may be thought that the investment demand equation will not be valid after some excess-capacity level. Or it may be the case that only private investment is determined by the given equation involving exogenous factors and that public investment may be used as an instrument by economic policy to bridge the gap.

Suppose the capacity equation to be of the form

\[ Y^*_{t+1} = Y^*_t + \beta(I^B_t + I^G_t) \]

where an asterisk denotes capacity level as opposed to actual level. Also suppose the private investment function to be similar to that fitted empirically for Peru in this chapter:

\[ I^P_t = I^0_o + I^E_t - 1 \]

Write also

\[ Y_t = \lambda_o + \lambda_1 I^G_t - \lambda_2 E_t + \lambda_3 E_{t-1} \]
for the income reduced-form equation of the demand model.

Then

\[ Y^*_{t+1} - Y^*_t = \beta_1 E_{t-1} + \beta_{1i} G + \beta_{1i} c \]

and

\[ Y_{t+1} - Y_t = \lambda_1 I^G_{t+1} - \lambda_1 I_t + \lambda_2 E_{t+1} - \lambda_2 E_t + \lambda_3 E_t - \lambda_3 E_{t-1} \]

and by equating the above right-hand side (in other words equating demand and supply where the variable is \( I^G_t \)) one obtains

\[ I^G_{t+1} = \frac{\lambda_1 + \beta}{\lambda_1} I^G_t - \frac{\lambda_2}{\lambda_1} E_{t+1} + \frac{\lambda_3 - \beta_1}{\lambda_1} E_t + \frac{\lambda_3}{\lambda_1} E_{t-1} + \beta_{1i} / \lambda_1 \]

and

\[ I^G_t = \frac{\lambda_1 + \beta}{\lambda_1} I^G_t - \frac{\lambda_2}{\lambda_1} E_0 (1+e)^{t+1} + \frac{\lambda_3 + \lambda_1}{\lambda_1} E_t (1+e)^t \]

\[ + \frac{\lambda_3 - \beta_1}{\lambda_1} E_0 (1+e)^{t+1} + \beta_{1i} / \lambda_1 \]

Rewrite last equation as

\[ x(t+1) = \phi_1 x(t) - \phi_2 y^{t+1} + \phi_3 y^t + \phi_4 y^{t-1} + \phi_5 \]

The solution is given by

\[ x(t) = \left[ x(0) - 1 \right] \phi_1^t + \phi_1 - \phi_2 y + \phi_3 + \frac{\phi_4}{\lambda_1} + \phi_5 \]

and in terms of the original equation

\[ I^G_t = \left[ I_0 - 1 \right] \left( \frac{\lambda_1 + \beta}{\lambda_1} \right)^t \left[ \frac{\lambda_1 + \beta}{\lambda_1} \right] - \frac{\lambda_2}{\lambda_1} E_0 (1+e)^t + \frac{\lambda_3 + \lambda_1}{\lambda_2} \frac{\lambda_3 - \beta_1}{\lambda_1} \]

This last equation specifies a decision rule by which public investment is called to bridge an excess capacity gap. If excess capacity existed at the beginning of the period, the final solution would differ from the above expression by the constant term \( Y^*_o - Y^*_o \) which would be
incorporated in the last parenthesis additively. An alternative would be to introduce a flexible accelerator depending on the gap between actual and capacity output.

The matter will not be pursued further. The purpose of this note was to indicate briefly how a problem of overdeterminacy of some importance in practical work with macroeconomic models may be overcome by its conversion into a policy framework with the particular goal of stabilization of the growth path in case the structure of the parameters allows meaningful solutions for the selected instrumental variable.
CHAPTER VIII: CONCLUSIONS

The challenge offered by Peru to economic development theory and policy is great. The major problems and objectives of development policy were sketched in Chapter III. Of the many particular policy goals which correspond to actual, acutely felt needs of the country, three may be selected as most important for medium-run economic planning: satisfactory growth rate of national income, unemployment absorption and more equitable income distribution.

It is not possible to ascertain a priori the degree of compatibility among these objectives especially as regards aggregate growth and employment. The experience of Peru and other developing countries in Latin America and elsewhere has been that the growth rate of the leading sectors by far exceeds that of employment opportunities within them (53, 54, 55). Moreover, it is believed that the observed expansion might not have taken place without recourse to capital-intensive techniques, and consequently, that the "surplus-labor" theories of economic development depict a more flexible world than actually prevails. In Peru the leading sectors may be identified as the export industries. Their growth has not provided adequate additional employment so as to absorb the existing unemployment and the natural increase in the labor force. Deeply-rooted reasons are expected to operate in favor of capital-intensive production techniques
wherever substitution of capital for labor can take place. The whole area of appropriate choice of technique is one of the most difficult problems of the theory of economic development. It appears to the author that much empirical research is needed before the question of choice can be answered with the alternative economic consequences in mind.

The process of more equitable income redistribution through agrarian reform and its concomitant measures (mainly marketing reforms) may provide an adequate basis for growth of the internal market. The effects of the size of the latter on industrial expansion have been discussed in the literature with substantial agreement since the times of Adam Smith. Much will depend, however, on the elasticity of supply of agricultural output which will be affected favorably if the government realizes that effective agrarian reform begins with legislative action but is brought into function only through persistent administrative assistance to the new producers.

The quantitative models of the Peruvian economy in this study bring to focus a few important aspects of development alternatives in the medium run. The outstanding conclusion is the high degree of dependence of the Peruvian economy on foreign trade. With the present size of production for domestic use the relative weight of exports in direct and indirect effects is overwhelming. Although Peruvian exports are diversified to a considerable extent, the terms-of-trade
effect is a component of profits over which the exporters have no control (as it depends on international prices). An adverse movement of the terms of trade makes the set 7% global growth target unattainable. With a relatively high incremental capital-output ratio (consequence of infrastructure-oriented development) a 6.36% rate of growth is attainable under considerable policy changes (such as 0.20 private savings-income ratio, a significantly higher rate of public investment and full utilization of the country's foreign credit capacity.

A "disequilibrium" analysis was presented in Chapter VI in order to identify the growth limiting aspects of the Peruvian economic structure under alternative conditions. Although the available data did not permit a fuller investigation, it was concluded that serious unemployment will continue to prevail until 1970 and, most likely, beyond. Under the assumption of balanced public budget, a substantial amount of annual net foreign capital inflow was required to sustain an acceptable global rate of growth. The foreign capital requirements emerging from the balance-of-trade gap exceeded significantly those due to insufficient domestic savings. In conclusion, a policy of import substitution was recommended to close the trade gap by 1970.

Finally, a larger effective-demand econometric model was constructed summarizing the main trends of the Peruvian economy in the period 1950-1963.
The investment and foreign trade multipliers were seen to be high, indicating a fairly elastic supply of output. This fact permits the use of this type of model for forecasting the values of the endogenous variables in the medium run. Special features substantiated quantitatively were the relatively low marginal propensity to consume of the private sector, and the responsiveness of private investment to foreign demand.

The model was used to predict the path of the main endogenous variables over the period 1964-1970 under alternative conditions with respect to import and public investment policies and to measure the side effects on the public budget and the balance of trade. Tax reforms and a policy of import substitution appeared to be two obvious directions for policy concern.

The work presented here offers only some general lines for quantitative economic policy. It appears clear that a considerable increase in the stock of statistical information is required before more elaborate attempts can be completed successfully.
BIBLIOGRAPHY


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