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ECONOMIC AND SOCIAL POLICY
SYNTHESIS PROGRAMME :

COLOMBIA 2000 : A FRAMEWORK FOR POPULATION, EMPLOYMENT,
GROWTH, INCOME DISTRIBUTION AND ESSENTIAL
HUMAN NEEDS PLANNING

by

Harold Banguero
CEDE, University of Los Andes,
Bogota, Colombia

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October 1981

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PREFACE

This is the last paper in a series of four presenting case studies on the relationship between basic needs, economic development and trade.¹ A final report on the project as a whole will be published shortly. The present case study has been based on a slightly different model than the previous ones, while keeping the same general approach and some of the techniques of its predecessors. Harold Banguero, and the team of fellow professors and graduate students that have helped him for two years in developing this new model, have to be congratulated for their innovative effort. Michael Hopkins also spent some time in Colombia, working on employment in that country, and remained closely in touch with the team.

Like the other studies this paper has considered a number of scenarios coupled with basic needs policies. Interestingly enough, the major conclusions are similar. In Colombia, it is unlikely that the essential human needs (except for nutrition) of the population in the lowest income groups will be satisfied by the year 2000 even if existing trends (with relatively high growth rates) continue. However the study tentatively concludes that if a market for Colombia's exports

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¹ The previous papers covered India (J.G. Krishnayya, B. Joshi, V. Phaneedhrutu, S. Chatterji), Kenya (R. Van Der Hoeven), and Brazil (M.J. Hopkins). The case study for Colombia was financed under a grant to the ILO from the United Nation's Department of International and Economic Affairs. This grant was extended to the ILO to demonstrate how social factors could be included in large scale models. The country level modelling approach of the project was decided upon by the co-directors of the UN project Michael Hopkins and Rolph Van Der Hoeven.

(ii)

can be found, a strategy that concentrates on satisfying the essential needs of low income groups would produce the best results, since productivity gains from a better fed, clothed, housed, and healthy population permit the achievement of rates of growth that are as high as those obtained from conventional, growth-oriented, approaches. In addition, a distribution-oriented approach would of course enable the poor to benefit from growth earlier in the process than if one had to wait for benefits that may, or may not trickle down.

1.10.81

Jean Mouly

ACKNOWLEDGMENTS

Many people contributed to this research in the last two years. I would like to express my gratitude to Michael Hopkins and Rolph Van der Hoeven, from I.L.O., for their support in terms of ideas, funds, and encouragement. I would also like to extend my special thanks to all the members of the Colombia 2000 team at the University of Los Andes: Regina Méndez Heilman, Luis Ignacio Aguilar, Germán Ramírez Garzón, and Jorge Enrique Torres, Graduate Research Assistants, and Argemiro Morales, Computer Programmer, who spent many hours of their leisure time working in the project.

Making available data used to estimate the model, I would like to thank Evaristo Arrieta and others in the National Accounts Division of DANE.

I want to thank Augusto Cano and Edgar Revéiz, Dean of the School of Economics, and Director of CEDE, at the University of Los Andes, for their support to this work. I have a debt with all my colleagues at CEDE for their encouragement and ideas.

(iv)

My gratitude also is extended to Esperanza Dorantes de Ruiz for typing several versions of this report.

Finally, I want to dedicate this work to my father for teaching me that only death can prevent a man for doing the things he wants to do, and to the poor people of my country for being the great motivation of the study.

Errors that still remain are my own responsibility,

Harold Banguero

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INTRODUCTION

The main purpose of this work is to test the relative efficiency of external vis a vis domestic policies and strategies in meeting minimum standards of satisfaction of essential human needs in Colombia by the year 2000.

Examples of external policies considered are trade and capital inflows, while domestic policies include investment allocation, income distribution, and government budget distribution, among others.

The exercise required the building of an integrated and consistent theoretical and empirical framework for the analysis. The technique to be used for the testing of alternative policies and strategies is a long run dynamic non-linear simulation model consisting of demographic, economic, employment, income and consumption distribution, and essential human needs subsystems.

Long run simulation models built previously for Colombia include Thorbecke-Sengupta's model¹ and SERES².

The Thorbecke-Sengupta's model develops a consistency framework for analysis of employment, output, and income distribution policies. The model projects economic aggregates

to the year 1980 using a macroeconometric model built with information for the period 1950 to 1967, plus an input-output matrix for 1966 to obtain sectorial aggregates. Next, a mapping of the personal income distribution is obtained. The weakest part of the model appears to be the income distribution mapping because of the numerous assumptions made by the authors, in the absence of household-based information required to obtain income distribution by recipients .

The model was built to test the feasibility of the targets set by the 1970 I.L.O. Mission, concerning value added, employment, and labour productivity in Colombia³. The authors concluded that, except for labour productivity, the I.L.O Mission targets seemed to be too high to be obtained. An important merit of their work was the effort made by the authors to include income distribution, in spite of the scarcity of data.

The SERES* model belongs to the family of TEMPO models developed by Enke and others⁴, with the main purpose of testing the relative impact of family planning on per capita income, employment, savings, and other economic variables.

* Sistema para el Estudio de las Relaciones Económicas, Sociales y Demográficas.

Even though SERES and Colombia 2000 are both long run dynamic simulation models, they have structural differences given their different objectives and purposes. Among them, the following deserve to be pointed out : a) Colombia 2000 emphasizes distributional aspects of development, while preserving the elements of the more traditional economic growth approach, on which the SERES and TEMPO models are based. For this reason, Colombia 2000 has two submodels dealing with the distribution of income and consumption, and with levels of satisfaction of essential human needs for different social groups, in urban and rural areas of Colombia; b) Colombia 2000 emphasizes interrelations among sectors and variables rather than disaggregation of specific variables in each sector, while SERES is a much more disaggregated model, with less endogeneity than Colombia 2000; c) Colombia 2000 works under equilibrium or disequilibrium in the final product markets since the economic submodel has independent supply and demand subsystems. This feature permits the simulation of disequilibrium situations, typical of less developed countries. SERES is a demand led general equilibrium model and, therefore, assumes equilibrium in product markets; d) the demographic variables (fertility, mortality, rural to urban migration, and labour force participation rates) are endogenous

in Colombia 2000, and are functions of economic and social factors such as education, infant mortality, per capita income, and public and private expenditures on health and education. SERES assumes less endogeneity in some of these variables since they are policy variables in the model, given its purpose.

In spite of all the improvements made in Colombia 2000 over these two previous models, it still lacks a price subsystem. This is a task that should be undertaken in the future, since the relative impact of price changes on the distribution of income and welfare in less developed countries needs to be considered in the analysis.

Overall, Colombia 2000 is a major group effort aimed at developing a theoretical and empirical framework for the analysis of alternative policies and strategies for poverty alleviation in less developed countries. A general overview of the model is presented in Chapter I. Chapter II places the model in the Colombian setting, and Chapter III presents a detailed specification of the model and parameter estimation. Chapter IV discusses experimental results, and in the final part of the text some conclusions are derived. A statistical appendix completes this report.

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2. Corporación Centro Regional de Población. (CCRP), Modelo SERES, Vol. I, Descripción Técnica, Documento Técnico No. 5, Area Socioeconómica, Bogotá, Enero, 1975.
3. I.L.O. Towards Full Employment : A Programme for Colombia, prepared by an inter-agency team organized by the International Labour Office, Geneva, 1970.
4. A Summary of the TEMPO II version is presented in Stephen Enke, "Reducing Fertility to Accelerate Development", The Economic Journal, 84, 334, June, 1974.

CHAPTER I

A BRIEF OUTLINE OF COLOMBIA 2000*

A. CONCEPTUAL FRAMEWORK OF THE MODEL

Development is one of the most widely used concepts in the literature of the past and the present. However, with the dynamics of the world, its meaning has changed and will continue to change in the future, as facts show what is not development.

Initially, development was identified with economic growth (1), and the community welfare function was specified in terms of income per capita. But, Seer's remarks, among others, on the insufficiency of this indicator as a measure of well being for all groups in a society (2), and the 1960's development decade experience led to a reformulation of the welfare function, so that other indicators of development would be present (3).

(*) The Colombia 2000 research group was conformed by Harold Banguero, Project Director; Regina Méndez, Luis I. Aguilar, Germán Ramírez, Jorge Torres, Graduate Research Assistants; Argemiro Morales, Computer Programmer; and Michael Hopkins and Rolph Van der Hoeven, I.L.O. Advisers.

This initial experience, among other things, motivated the United Nations to create a world employment program in 1969 (I.L.O. World Employment Program), under the assumption that additional, more productive, and better paid jobs would lead to a considerable reduction in poverty. Although this assumption is valid, experience seems to indicate that this strategy will not be enough to solve the problem of poverty of specific groups in developing societies (4). Therefore, income distribution was incorporated in the analysis of development problems (5). Although it is recognized that income distribution is an important element in welfare distribution analysis, recent studies seem to show that income redistribution does not always imply an improvement in physical indicators of well being, such as nutrition, health, education and housing, for all groups in developing societies. Therefore, the 1976 World Employment Conference recommended the inclusion of indicators for the level of satisfaction of essential human needs in the welfare function (6).

All these experiences imply that development planning requires consideration of a welfare function of the form

$$W = f (YP, E, YD, (EHN)_i),$$

where

W represents a society welfare index, YP income per capita, E employment, YD income distribution, and $(EHN)_i$, a set of essential human needs, such as nutrition, health, education, housing, participation, freedom, and so forth.

The process of planning consists then in the designing of a series of strategies which would permit the achievement of given goals with respect to the variables considered in the welfare function, in a given period of time.

Decision making concerning the setting of goal levels, as well as policies aimed to achieve them, requires a theoretical-empirical framework in which all welfare determinants can be considered simultaneously. This is necessary for the evaluation of the feasibility of strategies to reach defined levels of the goals, since they are not necessarily complementary but sometimes contradictory, and a compromise solution is needed.

The Centro de Estudios sobre Desarrollo Económico-CEDE (Center for Studies on Economic Development), and the Employment and Development Division of the International Labour Office (I.L.O), have developed a theoretical-empirical framework which will permit analysis of development policies

and strategies within the above described conceptual framework, with emphasis on the satisfaction of essential human needs for all groups of the Colombian society. This effort implies the building of subsystems for population, demand-production, employment, income and consumption distribution, and essential human needs in a development planning model. A brief overview of the model is given in the rest of this chapter. A detailed discussion of it will be presented in chapter III.

B. THE MODEL (7) - A SUMMARY.

1. General Characteristics (8)

The model consists of five areas or subsystems: population, economy, employment, income-consumption distribution, and essential human needs. It is a dynamic nonlinear, recursive year to year simulation model, and its main objective is to project trends (under different assumptions) about the behavior of variables related to population, employment, growth, income and consumption distribution, and about the level of satisfaction of nutrition, health, housing, and educational needs for different groups of the Colombian society in a medium-long run horizon. (1970 - 2000) (9).

In this first version of the model all projections of economic flows are made in real terms (Colombian pesos of 1970). In future versions a price subsystem could be incorporated into the model.

Graph 1 presents the general structure of the model. It can be observed that the model closes two cycles: a) the economic cycle (final demand-production-factor payments-consumption-final demand), and b) the population-economy-welfare-population cycle. (see graph 1).

Graph 2 is the diagram of specific variables interrelationships in the model. It is important to point out the high level of endogeneity of most variables in the model (see graph 2).

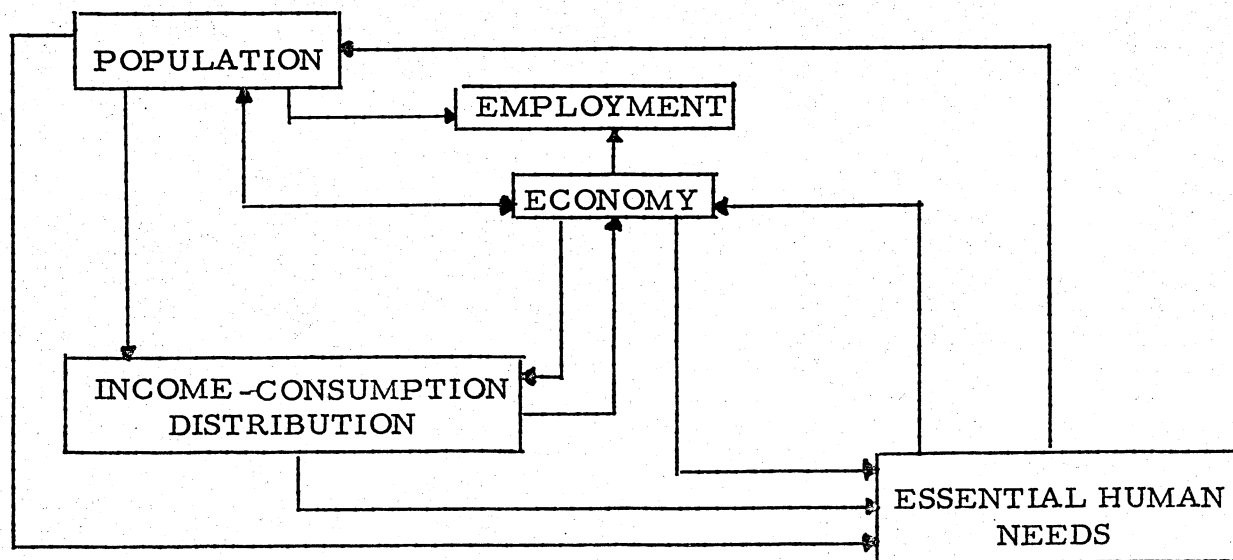
2. Disaggregation Levels

The income-consumption distribution and the essential needs subsystems disaggregate by socioeconomic groups in each area, as follows:

- Urban Capitalists
- Skilled Workers
(Professionals-Technicians)

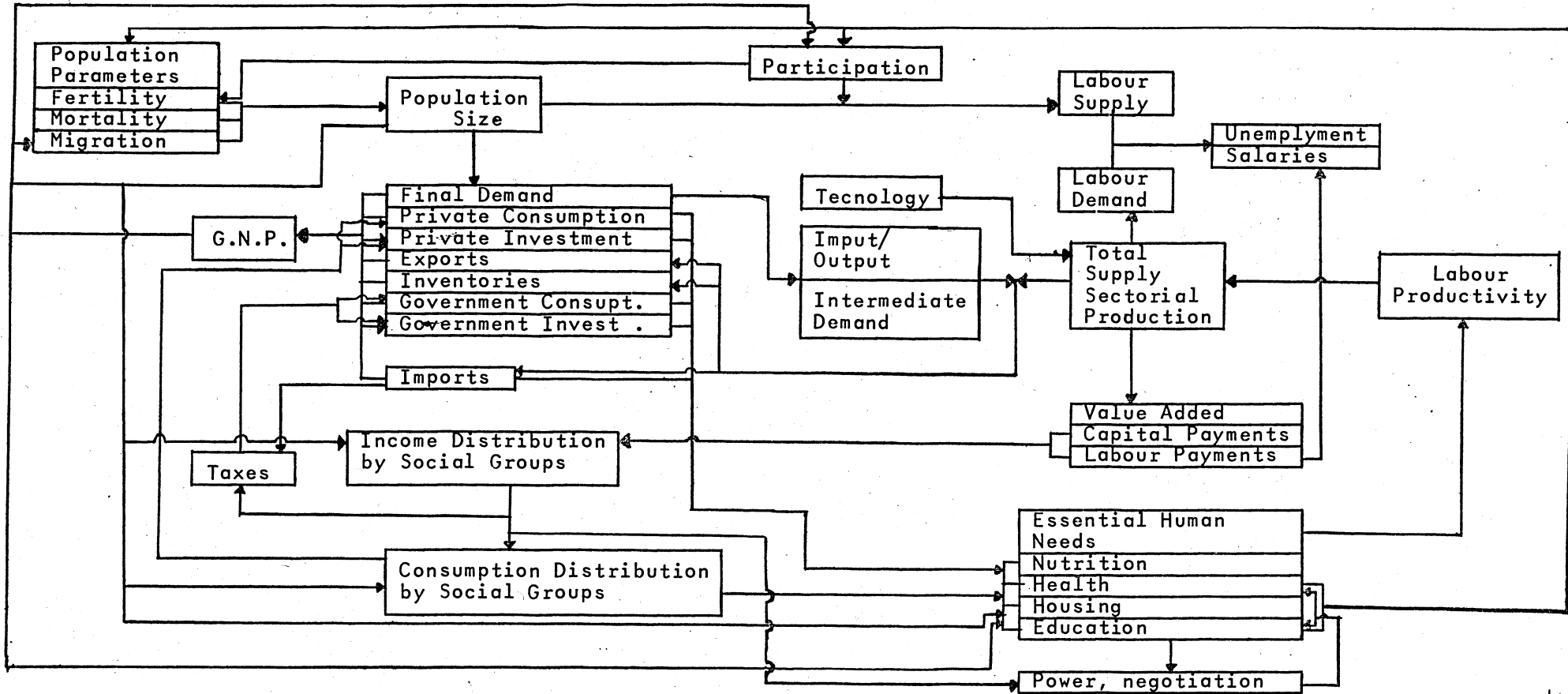
GRAPH 1

GENERAL STRUCTURE OF COLOMBIA 2000 MODEL



GRAPH 2.

DIAGRAM OF INTERRELATIONS IN COLOMBIA 2.000 MODEL



- Urban Area
 - Independent-Informal Sector
 - Urban Unskilled Workers
- Rural Area
 - Latifundists
 - Medium and Small Size Farmers
 - Rural Unskilled Workers

Criteria used to classify households in groups were income from capital, and head's educational and occupational status (10). (See table 3.5 in chapter III for detailed classification).

3. Description of the Subsystems

a. Demographic Subsystem

A demographic system, ideally, should try to integrate household behavior within the overall macroeconomic-social context of a country. The reason for it is the recognition that population parameters can not be considered as exogenously given, as only inputs in the system, but they are, in turn, determined by the social and economic conditions of a given society (11). In other words, the growth, structure and distribution of a population are function of a set of social and economic variables and, on the other hand, social and economic behavior is affected by the growth, structure and distribution of the population.

The demographic subsystem of Colombia 2 000 estimates: a) the total fertility rate for the country as a function of illiteracy rate, infant mortality rate, and women labor force participation rate (12); b) female and male life expectancy at birth as a function of G.N.P. per capita, and government expenditures on health; c) the rural-urban migration rate as a function of rural-urban G.N.P. per capita differential, and illiteracy rate; d) the female labour force participation rate as a function of G.N.P. per capita, and total fertility rate of the previous period. The male labor force participation rate is considered fairly stable and, therefore, is left fixed in the model. The international migration rate is an exogenous variable in this version.

The estimated parameters are then used to project the population by single ages, sex, and location (rural-urban). The labor force by location and skill level (skilled-unskilled) is obtained by using labor force participation and complete primary schooling completion rates.

The results from this subsystem are then used to determine unemployment rates, income distribution, consumption, G.N.P. per capita, and levels of satisfaction of essential human needs.

b. Economic Subsystem

The economic subsystem of the model is composed of three parts: i) demand side, ii) supply side, and iii) equilibrium rules.

i) Demand Side

Final demand components are determined as follows:

i) private consumption is endogenous in the overall model, and is equal to the sum of group specific consumption, estimated in the consumption subsystem; ii) government consumption is a function of G.N.P. of the previous period; iii) exports are partly exogenous and projected according to historical trends, and partly endogenous as function of excess supply in the given period; iv) total investment is assumed to equal total savings, according to the neoclassical postulate; household savings are endogenous, and estimated in the consumption subsystem; corporate as well as government savings are function of G.N.P. of the previous period; foreign aid for investment purposes is proportional to domestic investment. The sum of these four components equals total savings, and therefore, total investment.

Once final demand by sector is determined, an input-output matrix of the Colombian economy, for year 1970, is used to estimate total output required to meet intermediate

and final demands in fourteen sectors of the economy, that is: agriculture; mining; food, beverages, tobacco; textiles; paper, wood, leather; rubber and chemicals; non metallic products; metals and metallic products; machinery; other industry; electricity, gas, water; construction; transportation and communications; and services (13).

ii) Supply Side

Sectorial output produced is estimated by means of production functions in which value added is a function of capital, unskilled and skilled labour allocated to each sector using fixed coefficients, and neutral and labour embodied technical progress. Capital is updated year to year by subtracting depreciated capital and adding new investment. Then labor-capital ratios are used to update labour requirements. Labor productivity is a function of changes in levels of nutrition, health, housing, and education. Total output by sectors is obtained by using a fixed linear relationship between value added and total output.

iii) Equilibrium Rules

The economic subsystem can work under three different situations, depending on the behavior of the external sector. These situations are: i) free trade, i.e., no restrictions

on exports or imports. Under this situation, equilibrium is accomplished by exporting the surpluses and importing the deficits in those sectors with external trade, and by inventory changes in sectors with no external trade. In the last case, investment allocations in the next period are modified so that in the long run these sectors lurch towards equilibrium; ii) closed economy or no international trade. Excess supply or demand affect inventories in all sectors; inventories are used in scarcity periods to meet demand requirements; investment allocation in the next period is modified so as to drive the model towards equilibrium in the long run; there are no restrictions on imports, unless the equilibrium balance of payments option is used simultaneously; iii) forced equilibrium, i.e., demand led equilibrium; in this case, final supplies are adjusted so as to match total demands by sector.

Besides, the system has two options in public finance, i.e., a balanced public budget, in which case government consumption in the next period is adjusted to the availability of public funds; or an unbalanced public budget, so that deficits or surpluses in the current account might occur.

Finally, there are two options with respect to the behaviour of the balance of payments of the country, balanced and unbalanced. If the balanced option is selected, imports are adjusted so as to equal total exports in the same period.

The economic subsystem supplies total, urban and rural G.N.P. to the demographic subsystem, capital and labour payments to the income - consumption distribution subsystem, total investment and government consumption to the essential human needs subsystem, and labour demands to the employment subsystem.

c. Employment Subsystem

This subsystem receives labour supplies by area of residence and skill level from the demographic subsystem, and labour demands by area and skill level from the economic subsystem. The total number of unemployed in each category, the open unemployment rate, and average salary are then estimated. The last one is estimated by dividing total labour payments going to each category by the total number of employed workers in that category. Salaries are, therefore, more a result than a policy instrument in this version of the model.

d. Income Distribution- Consumption Subsystem

This subsystem distributes total capital and labour incomes among the social groups considered in the model by means of two (capital, labour) income distribution matrices, generated from household survey information obtained in 1971. (See section B of chapter III for more detail and matrix of coefficients).

Once total income accruing to each social group is determined, tax rates are applied to obtain disposable income for each social group which, jointly with family size (from the demographic subsystem), determine sectorial consumption for all groups, as well as household savings.

This subsystem provides information to the economic one concerning total consumption and savings. Besides, the following measures of income distribution are obtained: Gini concentration indexes before and after taxes, percentage of capital, labour, and total income received by each group, and per capita income for each group.

e. Essential Human Needs Subsystem

This subsystem plays an important role in the model since physical indicators of well being are obtained

as function of private and government consumption and investment. Measures for the level of satisfaction of four needs, considered essential for a human being (nutrition, health, housing, and education) (14), are estimated in this subsystem. An effort is made to measure levels of satisfaction (in terms of coverage and quality) of the needs for each one of the social groups. Besides indexes of power and bargaining are obtained in the subsystem. (See section E of chapter III for a discussion of this index).

Nutrition is expressed in terms of consumption of calories per capita per day, and is made a function of private expenditures on food.

Health is evaluated in its preventive aspects through female life expectancy at birth and the infant mortality rate; through the number of beds per 1.000 inhabitants, and the number of persons per physician, in the services provision (curative) aspects. These indicators are function of G.N.P. per capita, and private and public expenditures on health for each social group.

Education is evaluated through illiteracy, complete primary, and complete secondary rates. Besides, the number of students per teacher in primary school is

included as an indicator of quality of the education provided. These indicators are function of private and public expenditures on education for each social group.

Finally, housing is measured by the number of square meters available per person (quantity), and by the percentage of houses with piped water, and electricity as quality indicators. The number of square meters available per person is a function of housing stock, total investment in housing, and cost per square meter of housing. The proportion of houses with piped water, and electricity are a function of G.N.P. per capita, for each social group.

The subsystem supplies information on education and health status to the demographic subsystem, and to the economic submodel to determine labor productivity.

4. Use of the Model

Colombia 2.000 can be used, amongst other things, to evaluate the relative impact of:

1. Changes in population parameters on population size, labour force, unemployment, consumption, income distribution, and the level of satisfaction of the needs, as well as the impact of changes in G.N.P. per capita, and the level of satisfaction of the needs on population parameters.

2. Changes in final demand components on population, income distribution, consumption, savings, and, in turn, the impact of changes in these variables on final demand and the level of satisfaction of the essential needs in the following period.
3. National vs. international measures in meeting the essential human needs requirements of the social groups of the society in a reasonable period of time.

The main objective of the model, is to evaluate the relative impact of different policies or strategies aiming to affect welfare indicators. Although all parameters of the model were estimated with Colombian information, point forecasts, such as population size by year 2000, should be taken as estimates, subject to error margin present in any forecast.

CONCLUDING NOTE.

Colombia 2 000 provides a theoretical and empirical framework to analyze policies or strategies aimed to improve welfare levels of all groups in the Colombian society, through changes in population, employment, growth, income distribution, and levels of satisfaction of essential human needs, within an integrated and consistent framework, in a medium or long term horizon (15).

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1. This conception departed from neoclassical growth models developed by R.F. Harrod in "An Essay in Dynamic Theory", The Economic Journal, March, 1939, and R. Solow in "A Contribution to the Theory of Economic Growth". Quarterly Journal of Economics. Feb., 1956.
2. See Dudley Seers, "What Are We Trying to Measure?" The Journal of Development Studies, 8, 3, April, 1972.
3. Most developing countries reached and even surpassed the 5% G.N.P. growth rate defined by the U.N. for the decade, without making significant advances in poverty reduction for some groups of their populations. For a discussion of the objective and results of the First Development Decade (1960-1970) see G.Meier, "Toward the Second Development Decade", in Leading Issues in Economic Development, 2d. Ed. Oxford U. Press, 1970.
4. In I.L.O., "A Basic Needs Strategy for Development" Report of the General Director, in Employment, Growth and Basic Needs, I.L.O. Geneva, 1976, p. 32.
5. See Chenery et. al., Redistribution with Growth: An Approach to Policy. London, Oxford U. Press, 1974.
6. "The Main Approach which is now proposed to this conference is that development planning should include, as an explicit goal, the satisfaction of an absolute level of basic needs". In Employment, Growth, and Basic Needs: A One World Problem, Report of the I.L.O. Director, Geneva, 1976. See also: Glen Sheehan and Mike Hopkins. Basic Needs Performance. ILO, 1979.
7. The building of a mathematical model to examine poverty related issues might seem as a pure academic exercise to many. However, its use can be justified on the following grounds: a) although it is impossible to develop a quantitative framework containing all factors and interrelations, some key ones could be examined in a more rigorous, consistent, and integrated way by means of a mathematical specification of the relations; b) a model containing the most important interrelations of the variables related to poverty permits identification of the main restrictions (social, economic or institutional) determining the lack of access of specific population

groups to goods and services required for a decent living; c) the exercise permits the identification of theoretical and informational gaps, so that future research can be oriented to fill these gaps; d) it permits the integration of information that otherwise would remain disperse, thus allowing research and planners to undertake their own analysis using the collected information.

8. Colombia 2 000 has the structure of the model proposed by Mike Hopkins and Roph Van der Hoeven in "Economic and Social Factors in Development: A Socio-Economic Framework for Basic Needs Planning". (A Contribution to the U.N. 3rd. Development Decade). World Employment Programme Research, I.L.O. Working Paper 19, July, 1979. However, modifications were made to adapt it to the Colombian reality, and to the information available for estimation.
9. The set of essential human needs defined here is a subset of the commonly defined set of basic needs, which includes material (nutrition, housing) and non-material needs (participation, freedom). Although the importance of non-material needs is recognized, its analysis within a mathematical framework is not an easy task. A reference to this topic is Paul Streeten, "Distinctive Features of a Basic Needs Approach", International Development Review, 19,3, 1977, p 8-9.
10. This classification was made based on information supplied by 4.850 households in a DANE Household Survey (EH.4), in 1971.
11. For a discussion see G. Rodgers, M. Hopkins, and R. Wery, Population, Employment and Inequality - BACHUE - Philippines, Saxon House, Farnborough, U.K., 1978; and R. Anker, G. Farroq, "Population and Socio-Economic Development: the New Perspective" International Labour Review, 117,2, March-April, 1977.
12. Although the theoretical importance of income as a determinant of fertility is recognized, for multicollinearity reasons it was excluded from the equation, but its effect on fertility is captured in an indirect way through the variables infant mortality rate, women labor force participation, and illiteracy. An analysis of the determinants of fertility in Colombia can be found in H. Banguero, "The Social and Economic Determinants of Fertility in Colombia". Ph.D. Dissertation, U.N.C. Chapel Hill, 1977.

13. This input - output matrix is an aggregation of one containing 32 sectors, built by DANE for the year 1970. Aggregation criteria were selected according to the purpose of the model.
14. See I.L.O., "A Basic Need Strategy for Development" in Employment, Growth, and Basic Needs. Geneva, 1978, p. 32.
15. Colombia 2 000 is not designed to do analysis of specific detailed planning aspects. However, it is very efficient for analysing interrelations among different variables and sectors.

CHAPTER II
SETTING THE MODEL
COLOMBIA : CHARACTERISTICS AND DYNAMICS

A. GEOGRAPHICAL FEATURES

Colombia is located in the extreme northwest of South America. The total land area of the country is 1'138.914 square kilometers. Colombia is bounded on the north by the Caribbean Sea and on the west by the Pacific Ocean. Colombia's neighbors are Panama to the northwest, Venezuela and Brazil to the east, and Perú and Ecuador to the south. Colombia has large variations in topography with the Andes mountains traversing the country in a south north direction. Because of this topography, the climate also have extreme variations ranging from tropical to perpetual cold with snow (1). The country can be divided into five natural regions (2) :

1. The Caribbean region (12% of the land area) offers a very warm and dry climate all the year, and supports 19% of the country's population.
2. The Pacific region (6% of the land area) lies between the Pacific Ocean and the west branch of the Andes. This region, with 18% of the country's population is considered a great forest resource.

3. The Andean region (25% of the land area) is located between the west and the east branches of the Andes. This region supports 61% of the country's population and is the center of most economic and political activity. It offers adequate soils and climate for coffee plantations and includes the fertile Cauca and Magdalena valleys where modern agriculture is predominant. The three largest cities of the country (Bogotá, Medellín, Cali) are located in this region. In spite of the rugged terrain, a relatively good transportation network connects the three cities.
4. The Orinoquian region (28% of the land area) is located between the east branch of the Andes and the Venezuela border. The so-called "Llanos Orientales" offer ideal conditions for cattle raising. It is a sparsely populated region (1% of the country's population).
5. The Amazonian region covers the rest of the country. It consists mainly of Indian tribes, which speak their own dialects and preserve their own cultures. Only 1% of the country's population lives in this large (29% of the country's territory) region.

B. POLITICAL HISTORY

Explored and settled by spaniards at the beginning of the sixteenth century, the area remained a colony for the following three centuries. The country obtained its independence early in the nineteenth century and established a republic, ruled by descendants of the colonial elite (3).

Political instability dominated the new-born nation until 1885 when the Rionegro Constitution was adopted by the already existing political parties: Liberal and Conservative. These parties have dominated the political arena since, and only in recent years other parties have become important forces in the political life of the country.

C. SOCIAL STRUCTURE

The structure of Colombia society is deeply rooted in traditions inherited from spaniards with well defined class membership, status differences and little social mobility. This structure has been gradually changing due mainly to the urbanization process of the last three decades. The urban sector is characterized by a more mobile structure, and an emergent middle class is appearing between the small wealthy elite and the low class. In the rural sector, the

middle class is almost non-existent and there are only wealthy landowners and "campesinos". Criteria for class classification include family background, wealth, occupation and education. (4).

D. POPULATION DYNAMICS

The dynamics and structure of Colombia's population could be defined in terms of three patterns: a) rapid and increasing rate of population growth until 1964, and declining since then; b) rapid and increasing migration from rural areas since 1950; c) high rates of unemployment and underemployment in the last three decades. In the present century Colombia experienced a significant increase in its rate of population growth. Historical trends in population can be divided into four stages : a) stationary population until year 1825; b) low rate of population growth from 1825 to 1900; c) high and increasing rate of population growth from 1900 to 1964, as mortality declined; d) declining rate of population growth in the last decade, resulting from declining fertility. (5).

While in 1905 the country had only 4.4. million people, in 1938 it had 8.7 million, a doubling in 33 years. In 1964 the population was 17.5, a second doubling in this century that took only 26 years. In 1973 the population was

estimated to be 22.5 million people. (6).

Information from an advance sample of the 1973 census (7) and previous work done by Lopez (8) permits us to roughly trace the behaviour of fertility rates in the last 40 years. López estimated the crude birth rate to be 46.5 per thousand in the period 1938-1951, and 47.2 for the period 1951-1964. A gradual decline has occurred since 1964 and in 1978 this rate was estimated to be 29.0 per thousand. (9)

On the other hand, mortality rates had declined rapidly in the same period. DANE estimated a crude death rate of 17.3 per thousand in 1938, 14.2 in 1951, 10.0 in 1964, and 9.3 in 1967. (10)

As a result of changes in fertility and mortality rates, the annual rate of growth increased from 1.0% in 1938 to 3.2% by 1964 and has been declining since that time to about 2.2 by the year 1978. The age structure of the population has also undergone important changes. The dependency ratio reached a value of 106.5 by 1964 but, as a consequence of the decline in fertility in the last decade, the ratio decreased to an estimated 96.8 by 1973 (11)

The country has experienced such high rural to urban migration rates in the last 30 years that a country that was mainly rural in 1938, having only 29.1% of the population living in urban centers, became highly urbanized by 1973 with the urban centers containing 63.1% of the total population of the country. (12) Internal migration has resulted mainly in the expansion of the four largest cities of the country : Bogotá, Medellín, Cali, and Barranquilla.

The two factors, rapid population growth and migration from the country side to urban centers, have aggravated employment conditions. Open unemployment was estimated to be 9.5% in 1965, 13.9% in 1970, 15.3% in 1975, (13) and 8.6% in 1979. (14) However, the underemployment rate was 14.7% in 1979.

E. THE ECONOMY

1. GROWTH

The Colombian economy has maintained a medium level rate of growth of G.N.P. in the last 50 years, with an average annual rate of 4.8% for the period 1925-1974. However, G.N.P. per capita experienced considerable variations during the same period. Table 2.1 shows rates of growth of

G.N.P. and G.N.P. per capita, as well as levels of G.N.P. per capita in dollars of 1973. G.N.P. per capita increased from an estimate of US\$ 155 of 1925, to US\$ 460 in 1975.

The sectorial composition of G.N.P. has experienced a radical change in the last 50 years. In fact, the participation of the agricultural sector in total G.N.P. fell from 51.0% in 1925 to only 29.5 in 1973. The same trend was experienced by the mining sector falling from an estimated 9.0% participation to a rather small of 1.9% in 1973. On the other hand, the industrial sector increased its participation from 13.0% in 1925 to 18.1% in 1973, and commerce increased its participation from 15.7 in 1925 to 17.1 in 1973. (15) The country has, therefore, undergone a process of gradual industrialization and diversification in the last 40 years, with the primary sectors ~~losing~~ their relative importance in the economy.

The structural changes experienced by the Colombian economy in the present century have been closely related to the evolution of the external sector. Most economic historians agree that the coffee sector in Colombia played a crucial role in the creation of the economic conditions for the development of industry in Colombia in the last 50 years. (16) For the year

TABLE 2.1
 ANNUAL RATES OF GROWTH OF G.N.P. AND G.N.P. PER CAPITA, G.N.P.
 PER CAPITA (DOLLARS OF 1973). COLOMBIA 1925 - 1979

Period	G.N.P. %	G.N.P. PER CAPITA %	G.N.P. PER CAPITA US Dollars of 1973
1925-29	7.4	5.3	155 (1925)
1930-34	3.2	1.2	
1935-39	4.4	2.3	
1940-44	2.3	0	
1945-49	5.9	3.6	
1950-54	4.7	1.9	268 (1950)
1955-59	4.0	.7	
1960-69	5.1	1.8	
1970-74	6.7	3.3	440 (1973)
1975-79	5.4	-	460 (1975)
1925-74	4.8	2.1	

SOURCES : Miguel Urrutia. 50 Años de Desarrollo Económico Colombiano. Ed. La Carreta, Bogotá, 1979. p. 16. Tabla 4.

Banco de la República Cuentas Nacionales de Colombia 1970-1978.

1974, coffee amounted to one-third of total agricultural production and generated about two-thirds of Colombia's foreign exchange. Only in recent years other products such as cotton and textiles, emeralds, beef, sugar and bananas have been exported, but their participation in total exports is still small and fairly unstable. In recent times, drugs exports (marihuana and cocaine) have become an important source of foreign exchange in the country.

2. INCOME DISTRIBUTION

Even though the economy experienced relatively high rates of growth of G.N.P. in the last 50 years, the distribution of the benefits of growth has not been successful in providing acceptable income levels for an important proportion of the Colombian population. These groups present serious problems of malnutrition, infant mortality, illiteracy and housing.

According to Urrutia, income concentration for the year 1975 in Colombia was quite similar to the one observed in the 1930's with the poor 40% of the population receiving only 9% of total income, and the richest 20% of the population receiving 60% of total income. However, the degree of

concentration increased during the period 1934-1951, then decreased until the year 1964, and has remained constant since (17). (See Table 2.2).

F. SOCIAL WELFARE

As mentioned in the previous section, inequality in income distribution brings as a consequence problems of malnutrition, illiteracy, poor living conditions, and generalized poverty for large groups of the Colombian society. In 1969 it was estimated that about 15% of the population had per capita income below US\$ 50, and 27% an per capita income below US\$ 75. (18)

The rest of this section is devoted to the analysis of the evolution of specific social welfare indicators. (See Table 3.3.).

1. NUTRITION

The average number of daily per capita calories consumed by the Colombian population has remained fairly constant in the last 30 years, since it was estimated to be 2,278 calories in 1950 and 2,217 in 1975. However, for the years 1975 it has been estimated that approximately 30% of

TABLE 2.2.

GINI CONCENTRATION INDEXES ESTIMATED IN SEVERAL STUDIES.

COLOMBIA. 1953 - 1974

Study	Year	Urban	Rural	Total
Cepal	1953	-	-	.46
Berry	1960	-	.57	-
Taylor	1961	-	-	.51
McLure	1964	-	-	.54
Urrutia-Berry	1964	.54	.55	.57
Cepal	1965	-	-	-
CEDE (Presfam)	1967-68	.54	-	-
CEDE (Empleo)	1967	.75	-	-
CEDE (Empleo)	1968	.70	-	-
DANE	1971	.44	.47	.37
DANE	1972	.46	.48	.46
Coldatos Selowsky	1974	.52	.51	.40

SOURCE : Gustav Ranis. "Distribución del Ingreso y Crecimiento en Colombia", Desarrollo y Sociedad, Enero, 1980, Tables 1 and 2, pp. 82-83,86.

TABLE 2.3
EVOLUTION OF SOME WELFARE INDICATORS, COLOMBIA.
1951-1973

Indicator	Year		
	1951	1964	1973
<u>Nutrition</u>			
Calories per capita per day			
Urban ²	-	-	2236
Rural ²	-	-	1755
Total ²	2278	1947	2179
<u>Health</u>			
Female Life Expectancy at Birth ³	50.5	56.99	61.25
Infant Mortality Rate ⁴	135.8	85.6	64.6
Physicians per 10000 inhabitants ⁵	-	3.8	4.7
Beds per 1000 inhabitants ⁶	-	2.4	1.9
<u>Education</u>			
Illiteracy Rate			
Urban ⁷	-	-	10.7
Rural ⁷	-	-	36.5
Total ⁸	42.54	30.63	22.36
Complete Primary Schooling Rate ⁹	14.86	22.98	29.72
Complete Secondary Schooling Rate ¹⁰	1.76	2.89	3.93
<u>Housing</u>			
Proportion of houses with electricity			
Urban ¹¹	-	-	87.2
Rural ¹¹	-	-	13.1
Total ¹²	25.8	34.5	60.8

Cont

Continuation Table 2.3

Indicator	Year		
	1951	1964	1973
Proportion of houses with piped water			
Urban ¹³	-	-	72.9
Rural ¹³	-	-	10.9
Total ¹⁴	28.8	30.0	65.7

- SOURCES :
1. Jorge García, "Es Importante la Seguridad del Suministro de Alimentos en Colombia?". "Revista de Planeación y Desarrollo", XI, 3 Sep-Dic, 1979, Table 8. p. 145.
 2. Table A.18 of Appendix.
 3. Table A.1 of Appendix.
 4. Table A.19 of Appendix.
 5. D.N.P. Plan de Integración Nacional, Vol. II, Table 8. p. 392.
 6. Idem, Table 9, p. 393
 7. CEPAL, Proyecto sobre Estratificación Social y Movilidad Social en América Latina. Cuadros Básicos. Documento CEPAL/DS/ Versión Preliminar/167.
 8. Table A.23 of Appendix.
 9. Idem.
 10. Idem.
 11. Marcelo Selowsky. Who Benefits from Public Expenditures. World Bank, 1979.
 12. Table A.22 of Appendix.
 13. Selowsky, Op.Cit.
 14. Table A.22 of Appendix.

Colombian families were below the minimum national standard (1970 calories per capita per day). García has concluded the the problem of malnutrition in Colombia is a distribution problem rather than a food production problem (19).

2. HEALTH

Health conditions in the country have improved greatly in the present century. In fact, average life expectancy at birth increased from an estimate of 30.5 years in 1910 to 60.8 years in 1973 (20); and the infant mortality rate decreased from an estimated rate of 156.0 per thousand in 1938 to 61.2 per thousand in 1975 (21). However, these indicators hide very poor health conditions present in the population living in rural areas, where sanitary conditions are very poor and infant mortality rates are still well above the 100% mark. Furthermore, health services are limited (1.9 beds per 1,000 persons and 2,288 persons per physician in 1974) (22), and highly concentrated in urban centers. For the year 1965, 90.8% of Colombian physicians were living in urban areas. (22).

3. EDUCATION

Illiteracy rates have also declined considerably

in the present century in Colombia from an estimated rate of 74% in 1912 to a rate of 57% in 1938, (23) 43.1% in 1950, and 24.2% in 1976. (24) However, as in the case of health, the problem is basically one of highly uneven distribution of educational services between urban and rural areas, and among different groups in those areas. A second problem is the quality of the education received, since the government has been more concerned with the expansion of the existing educational system than its quality.

4. HOUSING

Housing problems have been aggravated in the last three decades by rural to urban migration. In the year 1951 the estimated number of houses in the urban centers required to meet the deficit was 111.345. This number in 1980 was 1.242.517, and will continue to grow if migration trends continue. (25).

Even though the quantitative deficit is serious, the main housing problems of the country are those related to the quality of housing in the peripheral areas of the urban centers and the rural area.

Overall, Colombia in the present century has experienced from moderate to high rates of growth of its national product, but the distribution of the product has been rather unequal. Therefore, the designing of specific policies and strategies aimed to accomplish a more equal distribution of the benefits of growth are important in order to reach minimum levels of satisfaction of essential human needs for all sectors of its population.

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8. Alvaro López Toro, Análisis Demográfico de los Censos Colombianos 1951-1964, Bogotá, 1968.
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11. D.N.P., Op. Cit., Table 9
12. DANE. Boletín Mensual de Estadística, August, 1975
13. D.N.P. El Empleo en Colombia, Doc. URT-DT-002, quoted in D.N.P., "La Población....", Op. Cit., p. 68
14. DANE. Colombia Estadística 1979, Special Publication, 1979, p. 79

15. Miguel Urrutia, 50 Años de Desarrollo Económico Colombiano, Ed. La Carreta, Bogotá, 1979, Table 6.
16. For a discussion see : Miguel Urrutia, Op. Cit., p. 44-74.
17. Urrutia, Op. Cit., p. 32
18. Hollis Chenery et al, Redistribution With Growth, Londres, 1974, p. 12.
19. Jorge García García. "Es Importante la Seguridad del Suministro de Alimentos en Colombia? Revista de Planeación y Desarrollo, Vol. IX, 3, 1979, p. 158-160.
20. Urrutia, Op. Cit., Table 11, p. 35
21. DANE. "Estimaciones de Mortalidad Infantil" Boletín Mensual de Estadística, 305, Dec. 1976, Table 1, p, 41
22. DANE. "La Salud en Colombia". Boletín Mensual de Estadística, 244, Nov. 1971, p. 106.
23. Urrutia, Op.Cit., p. 146
24. D.N.P. "La Economía Colombiana 1950-1975" Revista de Planeación y Desarrollo, Vol. IX, 3, Oct. Dec, 1977, p. 69.
25. I.C.T. Vivienda y Desarrollo Urbano en Colombia. Bogotá, 1979, Table 4.

CHAPTER III

MODEL SPECIFICATION AND ESTIMATION

A. Demographic Subsystem

This subsystem is concerned with tracking the population in each period by age, rural-urban location, and labour force participation. The model treats endogenously for each period female life expectancy at birth, the overall total fertility rate, the rural-urban migration rate, and the female labour force participation rate. The international migration rate is treated exogenously, and the male labour force participation rate as a fixed coefficient.

1. Mortality

Mortality is handled by endogenously computing female life expectancy at birth, and then, using a matrix of survival rates derived from model life tables, age and sex-specific survival rates are derived.

Female life expectancy is estimated in the essential human needs subsystem using an equation of the form:

$$(1) \quad (FLE_{t+1}) = a_2 + b_2 \ln (YP_t) + c_2 \ln (SALPE_{t+1}),$$

where

FLE = female life expectancy at birth,

YP = G.N.P. per capita (pesos of 1970),

SALPE = government health expenditures (pesos of 1970),

a_2, b_2, c_2 = coefficients,

\ln = natural logarithm,

t = time period (1).

The estimated equation is (2)

$$(1.a) \quad (FLE_{t+1}) = 30.6627 + 12.4134 \ln (YP) + 0.7191 \ln (SALPE_{t+1})$$

$(5.1287) \quad (2.1936) \quad (.8619)$

$$R^2 = .9895 \quad D-W = 1.0855. \quad \text{Observations} = 10.$$

(See table A-1 of appendix for data and sources).

Then, a model life table is used to obtain age specific survival rates for females and males. Survival rates are obtained by linear interpolation of the value of female life expectancy (e_0), given by equation (1.a), in the matrix of survival rates of the model, so that:

$$(2) \quad SM_{t+1, k} = f (FLE_{t+1}, MLT), \text{ and}$$

$$(3) \quad SH_{t+1, k} = f (FLE_{t+1}, MLT),$$

where

SM_k = female survival rate, age k,

SH_k = male survival rate, age k,

$k = 0, \dots, \dots, 65 + ,$

MLT = model life table.

The same set of survival rates is used for urban and rural areas in the population projection. (3) (See table A.10 of appendix for estimated survival rates).

2. Female Labour Force Participation

The equation for the estimation of the overall female labour force participation is

$$(4) \quad \ln (LFPR_{t+1}) = a_4 - b_4 \ln (YPINV_t) - c_4 \ln (FR_{t-1})$$

where

LFPR = female labour force participation rate,

YPINV = inverse of G.N.P. per capita,

FR = total fertility rate, so that

$$(5) \quad (LFPR_{t+1}) = \text{EXP} (\ln (LFPR_{t+1})).$$

The estimated equation is

$$(4.a) \quad \ln (\text{LFPR}_{t+1}) = 6.2368 - .05526 \ln (1/\text{YP}_t) - .6389^{**} \ln (\text{FR}_{t-1})$$

(.0399)
(.1265)
(.1035)

$$R^2 = .9970 \quad D-W = 1.5602 \quad \text{Observations} = 15$$

(See Tables A-2 and A-3 of appendix for data and sources).

3. Fertility

An overall fertility rate, defined as

$$(6) \quad (\text{FR})_t = (\text{Births})_t / (\text{Female Population})_{15-49, t}$$

is estimated with the following equation

$$(7) \quad (\text{FR}_{t+1}) = a_1 + b_1 \ln (\text{ILLIT}_t) - c_1 \ln (\text{LFPR}_t) + d_1 \ln (\text{MORIN}_t),$$

where

ILLIT = illiteracy rate,

MORIN = infant mortality rate.

The estimated equation is

$$(7.a) \quad (\text{FR}_{t+1}) = -12.1617 + 4.0906^{**} \ln (\text{ILLIT}_t) - 0.0844$$

(9.2469)
(.9556)
(1.1993)

$$\ln (\text{LFPR}_t) + 1.0407^{**} \ln (\text{MORIN}_t).$$

(.3594)

$$R^2 = .9996 \quad D-W = 1.9355 \quad \text{Observations} = 15$$

(See Tables A-4 and A-5 of the appendix for data and sources).

The overall fertility rate is disaggregated into urban and rural assuming a constant ratio (4) of rural to urban fertility rate

$$(8) \quad R = \text{FRR} / \text{FRU},$$

where

R = constant ratio,

FRR = rural total fertility rate,

FRU = urban total fertility rate,

and hence

$$(9) \quad (\text{FR}_t) = \text{FRR} \left[\frac{\text{HR}_t + \text{MR}_t}{\text{RPOP} + \text{UPOP}} \right] + \text{FRU} \left[\frac{\text{HU}_t + \text{MU}_t}{\text{RPOP} + \text{UPOP}} \right]$$

where

HR = total rural male population,

MR = total rural female population,

HU = total urban male population,

MU = total urban female population,

RPOP = total rural population,

UPOP = total urban population.

By calling

$$\frac{HR_t + MR_t}{RPOP + UPOP} = Q_{1t}, \text{ and}$$

$$\frac{HU_t + MU_t}{RPOP + UPOP} = Q_{2t},$$

and using R from equation, (8) equation (9) can be solved for FRR, so that:

$$(10) \quad (FRR_t) = \frac{(FR_t/Q_{1t})}{1 + \left[\frac{1/R}{Q_{1t}} \right] Q_{2t}},$$

and then, using equation (8) again we obtain

$$(11) \quad (FRU_t) = \frac{(FRR_t)}{R}.$$

4. Rural to Urban Migration

The overall rural migration rate, defined as

$$(12) \quad (RUM_t) = (MIGR)_t / RPOP_t,$$

where

RUM = rural to urban migration rate,

MIGR = total number of migrants in period t, and

RPOP = total rural population at time t, is estimated with the equation

$$(13) \quad (RUM_{t+1}) = a_3 + b_3 (ILLIT_t) + c_3 (YARPOP_t),$$

where

$$(14) \quad YARPOP = (YNA/UPOP) - (YA/RPOP) / (YA/RPOP),$$

being

YNA, YA = urban and rural G.N.P., respectively. (5)

The estimated equation is

$$(14.a) \quad (RUM_{t+1}) = \begin{matrix} .0412 \\ (.0059) \end{matrix} - \begin{matrix} .009947^{**} \\ (.0004) \end{matrix} (ILLIT_t) + \begin{matrix} .0021 \\ (.0075) \end{matrix} (YARPOP_t),$$

$R^2 = .9420$ $D-W = 1.1310$ Observations = 15

(See tables A-6 and A-7 of Appendix for data and sources).

Then the annual flow of migrants is computed as

$$(15) \quad (MIGR_{t+1}) = (RUM_{t+1}) (RPOP_{t+1}).$$

This overall flow is further disaggregated by age, using fixed proportions for each age, so that

$$(16) \quad (MIGR_{t+1, k}) = (MIGR_{t+1}) \cdot (\% k),$$

being

(% k) the proportion of migrants corresponding to age group k.

(See table A-9 of Appendix for these proportions).

5. International Migration

An overall annual international migration rate is provided exogenously to the system.

Then, the total number of international migrants is calculated as

$$(17) \quad (IMIGR_t) = (TMIGRI_t) (POP_t),$$

where:

IMIGR = annual flow of international migrants,

TMIGRI = international migration rate,

POP = total population.

This flow is further disaggregated by age, sex, and location using fixed coefficients. (See table A.9 of Appendix for these coefficients).

6. Population Projection⁽⁶⁾

Starting with an initial population by age, sex and location, the model uses the estimated parameters to project the population year by year, as follows (see table A-8 of Appendix for the initial population).

Age 0

$$(18) \quad UPOP_{k=0}^{t+1} = \frac{(FRU)_t / 35 \sum_{k=15}^{45} MU_t}{1 + RSN} + MIGRM_{t,k=0} - IMIGRUM_{t,k=0},$$

$$(19) \quad UPOPH_{k=0}^{t+1} = (FRU)_t / 35 \sum_{k=15}^{49} MU_t \left[1 - \frac{1}{1 + RSN} \right] + MIGRH_{t,k=0} - IMIGRUH_{t,k=0},$$

$$(20) \quad RPOPM_{k=0}^{t+1} = \frac{(FRR)_t / 35 \sum_{k=15}^{49} MU_t}{1 + RSN} - MIGRM_{t,k=0} - IMIGRRM_{t,k=0},$$

$$(21) \quad RPOH_{k=0}^{t+1} = (FRR)_t / 35 \sum_{k=15}^{49} MR_t \left[1 - \frac{1}{1 + RSN} \right] - MIGRH_{t,k=0} - IMIGRRH_{t,k=0},$$

being

RSN = sex ratio at birth, ⁽⁷⁾

UOPM, UOPH, ROPM, ROPH, the corresponding populations for females urban, males urban, females rural and males rural; MIGRM, MIGRH, the number of female and male migrants (rural to urban); and IMIGRUM, IMIGRUH, IMIGRRM, IMIGRRH, the corresponding number of international migrants for urban females, urban males, rural females and rural males;

Ages 1 - 64

$$(22) \quad \begin{matrix} \text{UOPM}_{t+1} \\ k=1, \dots, 64 \end{matrix} = \begin{matrix} \text{MU}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} + \begin{matrix} \text{MIGRM}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix}$$

$$\left[\text{SM}_{t, k=0, \dots, 63} \right] - \text{IMIGRUM}_{t, k=0, \dots, 63}$$

$$(23) \quad \begin{matrix} \text{UOPH}_{t+1} \\ k=1, \dots, 64 \end{matrix} = \begin{matrix} \text{HU}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} + \begin{matrix} \text{MIGRH}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix}$$

$$\left[\text{SH}_{t, k=0, \dots, 63} \right] - \text{IMIGRUH}_{t, k=0, \dots, 63}$$

$$(24) \quad \begin{matrix} \text{RPOP}_{t+1} \\ k=1, \dots, 64 \end{matrix} = \begin{matrix} \text{MR}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} \left[\begin{matrix} \text{SM}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} \right]$$

$$- \text{MIGRM}_{t, k=0, \dots, 63} - \text{IMIGRRM}_{t, k=0, \dots, 63}$$

$$(25) \quad \begin{matrix} \text{RPOP}_{t+1} \\ k=1, \dots, 64 \end{matrix} = \begin{matrix} \text{HR}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} \left[\begin{matrix} \text{SH}_{t, k=0, \dots, 63} \\ k=1, \dots, 64 \end{matrix} \right]$$

$$- \text{MIGRH}_{t, k=0, \dots, 63} - \text{IMIGRRH}_{t, k=0, \dots, 63}$$

being SM, SH, the corresponding survival rates for females and males.

Age 65 + (open ended interval)

$$(26) \quad \text{UPOP}_{t+1} = \text{MU}_{t,k=64} + \text{MIGRM}_{t,k=64} \left[\text{SM}_{t,k=64} \right]$$

k=65 +

$$+ \text{MU}_{t,k=65+} + \text{MIGR}_{t,k=65+} \left[\text{SM}_{t,k=65+} \right]$$

$$- \text{IMIGRUM}_{t,k=64, 65+},$$

$$(27) \quad \text{UPOP}_{t+1} = \text{HU}_{t,k=64} + \text{MIGRH}_{t,k=64} \left[\text{SH}_{t,k=64} \right]$$

k=65 +

$$+ \text{HU}_{t,k=65+} + \text{MIGRH}_{t,k=65+}$$

$$\left[\text{SH}_{t,k=65+} \right] - \text{IMIGRUH}_{t,k=65+}$$

$$(28) \quad \text{RPOP}_{t+1} = \text{MR}_{t,k=64} \left[\text{SM}_{t,k=64} \right] +$$

k=65+

$$\text{MR}_{t,k=65+} \left[\text{SM}_{t,k=65+} \right]$$

$$- \text{MIGRM}_{t,k=64, 65+} - \text{IMIGRRM}_{t,k=64, 65+},$$

$$\begin{aligned}
 (29) \quad RPOP_{t,k=65+} &= HR_{t,k=64} [SH_{t,k=64}] \\
 &+ HR_{t,k=65+} [SH_{t,k=65+}] \\
 &-MIGRH_{t,k=64,65+} \quad -IMIGRH_{t,k=64,65+}.
 \end{aligned}$$

7. Labour Supply

Using female labour force participation rates estimated with equation (4.a) in this chapter and the fixed coefficient for male labour force participation (8), labour supplies by area of residence and sex are derived in the model as:

$$(30) \quad (LSFU)_t = (LFPR)_t \sum_{k=10}^{64} (UOPM)_t,$$

$$(31) \quad (LSFR)_t = (LFPR)_t \sum_{k=10}^{64} (RPOP)_t,$$

$$(32) \quad (LSHU)_t = (LFPH)_t \sum_{k=10}^{64} (UOPH)_t,$$

$$(33) \quad (LSHR)_t = (LFPH)_t \sum_{k=10}^{64} (RPOP)_t,$$

being

LSFU, LSFR, LSHU, and LSHR the corresponding labour supplies for urban females, rural females, urban males and rural males, respectively, and LFPR, LFPH labour force participation rates for females and males.

In a second step labour supplies by area of residence and skill level are obtained as

$$(34) \quad (LSUC)_t = (LSFU + LSHU)_t (PRIMACU)_t,$$

$$(35) \quad (LSRC)_t = (LSFR + LSHR)_t (PRIMACR)_t,$$

$$(36) \quad (LSUN)_t = (LSFU + LSHU)_t (1 - PRIMACU)_t,$$

$$(37) \quad (LSRN)_t = (LSFR + LSHR)_t (1 - PRIMACR)_t,$$

where

LSUC, LSRC, LSUN, LSRN are the corresponding labour supplies for urban skilled, rural skilled, urban unskilled, and rural unskilled, and PRIMACU and PRIMACR are complete primary schooling rates for the urban and the rural areas.

Besides, the following aggregates are obtained

$$(38) \quad (LSC)_t = (LSUC)_t + (LSRC)_t,$$

$$(39) \quad (\text{LSN})_t = (\text{LSUN})_t + (\text{LSRN})_t,$$

$$(40) \quad (\text{LSU})_t = (\text{LSUC})_t + (\text{LSUN})_t,$$

$$(41) \quad (\text{LSR})_t = (\text{LSRC})_t + (\text{LSRN})_t,$$

$$(42) \quad (\text{LST})_t = (\text{LSU})_t + (\text{LSR})_t,$$

where

- (LSC) = total skilled labour supply,
- (LSN) = total unskilled labour supply,
- (LSU) = total urban labour supply,
- (LSR) = total rural labour supply,
- (LST) = total country labour supply.

This aggregates are used in the employment subsystem to estimate unemployment rates.

8. Demographic Indicators.

a. Crude Birth Rates

The total number of births in the urban and the rural areas are obtained in the model as

$$(43) \quad (\text{NU})_t = \frac{(\text{FR2})_t}{35} (F_a) \sum_{k=15}^{49} \text{UPOPM}_t,$$

and

$$(44) \quad (NR)_t = \frac{(FR1)_t}{35} (F_a) \sum_{k=15}^{49} RPOP_t,$$

where

$(NU)_t$ = total number of births in the urban area,

$(NR)_t$ = total number of births in the rural area,

FR2, FR1 = total fertility rates for the urban and rural areas, estimated with equations (10) and (11),

F_a = adjustment factor for fertility schedule, and, therefore

$$(45) \quad (NT)_t = (NU)_t + (NR)_t,$$

being (NT) = total number of births in the country. Crude Birth Rates are then obtained as

$$(46) \quad (CBRU)_t = \frac{(NU)_t}{((UPOP)_t + (UPOP)_{t+1})/2} \times 1.000,$$

$$(47) \quad (CBRR)_t = \frac{(NR)_t}{((RPOP)_t + (RPOP)_{t+1})/2} \times 1.000,$$

$$(48) \quad (CBRT) = \frac{(NT)_t}{((POP)_t + (POP)_{t+1})/2} \times 1,000,$$

where

CBRU, CBRR, and CBRT = crude birth rates for the urban area, the rural area, and the country; UPOP, RPOP, and POP = population in the urban and the rural areas, and the country.

b. Rural to Urban Migrants.

The total number of rural to urban migrants is obtained as

$$(49) \quad (MIGRAN)_t = (RUM)_t (RPOP)_t,$$

where

(MIGRAN) = total number of rural to urban migrants,

(RUM) = rural to urban migration rate estimated with equation (13.a),

(RPOP) = rural population.

c. International Migrants.

International migrants from urban and rural areas are estimated as

$$(50) \quad (\text{MIGINU}) = (\text{TMIGIN})_t (\text{UPOP})_t,$$

$$(51) \quad (\text{MIGINR}) = (\text{TMIGIN})_t (\text{RPOP})_t,$$

where

MIGINU, MIGINR = international migrants coming from
the urban and rural areas, respectively,
TMIGIN = exogenous international migration rate.

Therefore, the total number of international
migrants

$$(52) \quad (\text{MIGINT})_t = (\text{MIGINU})_t + (\text{MIGINR})_t.$$

d. Crude Death Rates

The total number of deaths in the urban and the
rural areas is obtained as

$$(53) \quad (\text{DU})_t = (\text{UPOP})_t - (\text{UPOP})_{t+1} + (\text{NU})_t + (\text{MIGRAN})_t - (\text{MIGINU})_t,$$

$$(54) \quad (\text{DR})_t = (\text{RPOP})_t - (\text{RPOP})_{t+1} + (\text{NR})_t + (\text{MIGRAN})_t - (\text{MIGINR})_t,$$

where

DU, DR = total deaths in the urban and the rural areas,

and UPOP, RPOP, NU, NR, MIGRAN, MIGINU, MIGINR were defined previously.

Therefore, the total number of deaths in the country

$$(55) \quad (DT)_t = (DU)_t + (DR)_t.$$

Crude Death Rates are then obtained as

$$(56) \quad (CDRU)_t = \frac{(DU)_t}{((UPOP)_t + (UPOP)_{t+1})/2} \times 1.000,$$

$$(57) \quad (CDRR)_t = \frac{(DR)_t}{((RPOP)_t + (RPOP)_{t+1})/2} \times 1.000,$$

$$(58) \quad (CDRT)_t = \frac{(DT)_t}{((POP)_t + (POP)_{t+1})/2} \times 1.000,$$

being CDRU, CDRR, CDRT the corresponding crude death rates for the urban and the rural areas, and the country, respectively.

e. Growth Rates.

Rates of Natural Increase are obtained as

$$(59) \quad (RNIU)_t = (CBRU)_t - (CDRU)_t,$$

$$(60) \quad (RNIR)_t = (CBRR)_t - (CDRR)_t,$$

$$(61) \quad (RNIT)_t = (CBRT)_t - (CDRT)_t,$$

where

RNIU, RNIR, and RNIT = rates of natural increase for the urban and rural areas, and the country, respectively,

CBRU, CBRR, CBRT = crude birth rates already defined, CDRU, CDRR, CDRT = crude death rates previously defined.

Total Rates of Growth are defined as

$$(62) \quad (RGU)_t = \frac{(UPOP)_{t+1} - (UPOP)_t}{((UPOP)_t + (UPOP)_{t+1})/2},$$

$$(63) \quad (RGR)_t = \frac{(RPOP)_t - (RPOP)_{t+1}}{((RPOP)_t + (RPOP)_{t+1})/2},$$

$$(64) \quad (RGT)_t = \frac{(POP)_t - (POP)_{t+1}}{((POP)_t + (POP)_{t+1})/2},$$

where

RGU, RGR, RGT = total growth rates for the urban and the rural areas, and the country, respectively, and UPOP, RPOP, POP= population for the urban, the rural, and country respectively.

f. Dependency Rates.

Dependency rates for the urban (DRU) and the rural (DRR) areas, and the country (DRT) are defined in the model as

$$(65) \quad (DRU)_t = \frac{\sum_{k=0}^{14} (UPOP_{k,t}) + UPOP_{k=65+,t}}{\sum_{k=15}^{64} (UPOP_{k,t})} \times 100,$$

$$(66) \quad (DRR)_t = \frac{\sum_{k=0}^{14} (RPOP_{k,t}) + RPOP_{k=65+,t}}{\sum_{k=15}^{64} (RPOP_{k,t})}$$

$$(67) \quad (DRT)_t = \frac{\sum_{k=0}^{14} (POP_{k,t}) + POP_{k=65+,t}}{\sum_{k=15}^{64} (POP_{k,t})} \times 100,$$

g. Population Structure.

Proportions of population for specific age groups are also obtained as

$$(68) \quad \begin{array}{l} \% \text{ UPOP} \\ <15 \text{ years} \end{array} = \frac{\sum_{k=0}^{14} (\text{UPOP})_{k,t}}{(\text{UPOP})_t} \times 100,$$

$$(69) \quad \begin{array}{l} \% \text{ RPOP} \\ <15 \text{ years} \end{array} = \frac{\sum_{k=0}^{14} (\text{RPOP})_{k,t}}{(\text{RPOP})_t} \times 100,$$

$$(70) \quad \begin{array}{l} \% \text{ POP} \\ <15 \text{ years} \end{array} = \frac{\sum_{k=0}^{14} (\text{POP})_{k,t}}{(\text{POP})_t} \times 100,$$

$$(71) \quad \% \text{ UPOP}_{k=65+,t} = \text{UPOP}_{k=65+,t} / (\text{UPOP})_t \times 100,$$

$$(72) \quad \% \text{ RPOP}_{k=65+,t} = \text{RPOP}_{k=65+,t} / (\text{RPOP})_t \times 100,$$

$$(73) \quad \% \text{ POP}_{k=65+,t} = \text{POP}_{k=65+,t} / (\text{POP})_t \times 100,$$

$$(74) \quad \% \text{ Econ. Active} = \frac{\sum_{k=15}^{64} \text{UPOP}_{k,t}}{(\text{UPOP})_t} \times 100,$$

(UPOP)

$$(75) \quad \% \text{ Econ. Active} = \frac{\sum_{k=15}^{64} \text{RPOP}_{k,t}}{(\text{RPOP})} \times 100,$$

(RPOP)

$$(76) \quad \% \text{ Econ. Active} = \frac{\sum_{k=15}^{64} \text{POP}_{k,t}}{(\text{POP})} \times 100,$$

(POP)

giving the proportions of young, aging, and economically active populations for the urban and the rural areas, and the country, respectively.

The subsystem provides the urban, rural, and total populations to the income distribution and essential needs submodels, and total fertility rates to the consumption one. Besides, it provides the labor supply to the employment subsystem disaggregated by area and skill level.

B. Economic Subsystem

This subsystem is concerned with the behavior of the economy in its demand and supply components.

1. Demand

The final demand equation is specified as:

$$(77) \quad DF_{j,t} = CP_{j,t} + IT_{j,t} + CG_{j,t} + E_{j,t} - M_{j,t}$$

where

$DF_{j,t}$ = total final demand for products of sector j(9), in period t,

CP_{jt} = total private consumption of products of sector j, in period t,

$IT_{j,t}$ = total investment demand for products of sector j, in period t (includes private and government investment),

$CG_{j,t}$ = total government consumption of products of sector j, in period t,

$E_{j,t}$ = total exports of products of sector j, in period t,

$M_{j,t}$ = total imports of products of sector j , in period t .

The model divides the structure of the economy in 14 sectors, ($j=1, \dots, 14$), i.e.: agriculture; mining; food and beverages; textiles; paper, wood and leather; rubber and chemical products; non metals; metals and metals products; machinery and equipment; other industry; electricity, gas, water; construction; transportation and communication; and services.

The components of the final demand equation are determined as follows:

a. Private Consumption is endogenous, and is supplied to this subsystem by the consumption system.

b. Government Consumption is a function of G.N.P. in the previous period, i.e.:

$$(78) \quad (CG_t) = a_0 + b_0 (GNP_{t-1}),$$

being

(CG) = total aggregate government consumption.

The estimated equation is:

$$(78.a) \quad (CG_t) = 3539.6211 + .1086^{**} (GNP_{t-1}).$$

(2639.0408) (.0218)

$$R^2 = .9636 \quad D-W = 1.3423 \quad \text{Observations} = 19$$

(See table A-12 of appendix for data and sources).

c. Exports

Exports are partly endogenous and partly exogenous in the model.

The historical trend has been used to obtain exogenous exports as:

$$(79) \quad E_t = a_0 + a_1 (t).$$

The estimated equation is

$$(79.a) \quad E_t = -869543.9007 + 450.3579^{**}(t),$$

(54708.8320) (27.9125)

$$R^2 = .9320 \quad D-W = 1.2336 \quad \text{observations} = 21$$

(See table A-12 of appendix for data and sources).

A vector of coefficients (b_j) is then used to obtain exports by sector as

$$(80) \quad E_{j,t} = b_j (E_t).$$

The endogenous component is a function of excess supply in product markets.

Exports are considered in the model an important policy variable, and will be used as a control variable in experiments.

d. Investment is determined in a neoclassical fashion by total savings. Once total savings are determined in the model, a vector of distributional coefficients is used to obtain sectorial investment, so that

$$(81) \quad IT_{j,t} = c_j (S_t),$$

where

(S_t) = total savings.

(See table 3.1 for investment destination in year 1970).

e. Total Savings

Total savings and, therefore, total investment, is the sum of household, institutional, government and external savings. The identity is

$$(82) \quad S_t = (SF_t) + (SR_t) + (SG_t) + (IE_t),$$

where

SF = household savings,
SR = institutional savings,
SG = government savings,
IE = external savings

- i: Household Savings are endogenous in the model and are determined in the consumption subsystem, which supplies the aggregate to this subsystem.
- ii: Institutional and Government Savings were specified in the model as a function of G.N.P. of the previous period, under the assumption that this component of total savings grows as total G.N.P. grows. Therefore,

$$(83) \quad SR_{(t)} = f (GNP_{t-1}), \text{ and}$$

$$(84) \quad SG = f (GNP_{t-1}),$$

where

$(G.N.P._{t-1})$ = GNP. of the previous period.

The estimated equations are

$$(83.a) \quad SR_t = 5059.3984 + .07127^* (PIB_{t-1}),$$

(3176.3244) (.03225)

$$R^2 = .9047$$

$$D- W = 1.8208$$

$$Obs = 19$$

$$(84.a) \quad SG_t = 1051.4435 + .06741^{**} (PIB_{t-1}).$$

(2163.6120) (.02357)

$$R^2 = .7484 \quad D- W = 1.8249 \quad Obs = 19$$

(See table A-12 of appendix for data and sources).

iii. External Savings are proportional in the model to domestic savings (10).

Once all the components of the final demand are determined, output required to satisfy final and intermediate demands is obtained for each sector via an input-output matrix (fixed technical coefficients) (11), representing the structure of the economy, so that

$$(85) \quad DT_{j,t} = (1-A)^{-1} DF_{j,t},$$

where

$DT_{j,t}$ = total demand of products of sector j , in period t ,

$(1-A)^{-1}$ = matrix of technical coefficients.

The matrix of coefficients of sectorial distribution of demand components are shown in table 3.1. Input-output coefficients are shown in table 3.2. (See table A-11 of appendix for the input-output matrix in value terms).

2. Supply

a. Production

Combining available production factors (capital, skilled and unskilled labor, and given the state of technology, output is estimated in each sector by means of a Cobb-Douglas production function(12). The dependent variable in the production function represents gross value added of each sector. Using the input-output table a link between gross value added and gross output is established for each sector, by assuming a linear relationship between them,

$$(86) \quad (OT)_j = (VAB)_j (COEF)_j,$$

$(OT)_j$ = gross output of the sector j , defined in value terms,

TABLE 3.1

MATRIX OF COEFFICIENTS OF SECTORIAL DISTRIBUTION OF FINAL DEMAND COMPONENTS

COLOMBIA 1970

Sector	Private Consumption ¹	Total Investment ²	Government Consumption	Exports	Imports ³	Margin ⁴
1. Agriculture	.1503	.0454	0	.1281	.0204	.1710
2. Mining	0	0	0	.0767	.0084	0
3. Food, Bev, Tobacco	.2626	0	0	.5475	.0250	.1494
4. Textiles	.0886	0	0	.0490	.0188	.2720
5. Paper, Wood, L.	.0304	.0084	0	.0094	.1495	.3487
6. Rubber, Chemicals	.0672	0	0	.0254	.2202	.4727
7. Non Metallic P.	.0041	.0001	0	.0094	.0675	.7158
8. Metallic P.	.0064	.0628	0	.0079	.3067	.4349
9. Machinery	.0136	.1946	0	.0049	.5500	.0820
10. Other Industry	.0243	.1463	0	.0026	.4713	.2270
11. Electricity, Gas, Water	.0136	0	0	0	0	0
12. Construction	0	.5424	0	0	0	0

Cont....

Continuation Table 3.1

Sector	Private Consumption ¹	Total Investment ²	Government Consumption	Exports	Imports ³	Margin ⁴
13. Transp-Comm.	.0801	0	0	.1151	.0970	0
14. Services	.2588	0	100.0	.0280	.0186	0
TOTAL	100.0	100.0	100.0	100.0		

SOURCE : Table A-11 of the Appendix.

1. These values are not used in the model since private consumption is endogenous in it and estimated sectorially in the consumption subsystem.
2. These coefficients were estimated by adding private plus public investment in Table A-11 of the Appendix, to obtain the proportion of total investment in each sector. They can be modified exogenously, or endogenously by the functioning of equilibrium rules in the final products market.
3. Coefficients obtained by dividing the sectorial value of imports by total output value of the sector in Table A-11 of the Appendix.
4. Coefficients obtained by dividing the sectorial value of margin by the total value of final demand for each sector in Table A-11 of the Appendix.

TABLE 3.2
 INPUT OUTPUT COEFFICIENT MATRIX - $(1-A)^{-1}$ MATRIX). COLOMBIA 1970¹

Sectors	Agric.	Mining	Food Bev.,Tob.	Textiles	Paper,W.,L.	Rubber,Ch.	Non Metallic
1. Agriculture	1.04379 ^a	0.00505	0.58758	0.18488	0.08648	0.03922	0.01309
2. Mining	0.00538	1.00671	0.00650	0.01583	0.01327	0.10736	0.13060
3. Food, Bev, Tob.	0.04403	0.00608	1.12470	0.07907	0.02876	0.05382	0.00994
4. Textiles	0.01313	0.00216	0.01348	1.47827	0.02369	0.04142	0.00738
5. Paper, Wood, Leather	0.00555	0.00613	0.02010	0.02166	1.35860	0.07295	0.04307
6. Rubber and Chemic.	0.05091	0.03910	0.05849	0.17645	0.11995	1.27900	0.12099
7. Non Metallic P.	0.00180	0.00384	0.00668	0.00296	0.00482	0.01065	1.07655
8. Metallic Products	0.00351	0.01123	0.01849	0.01398	0.02726	0.02417	0.04317
9. Machinery	0.00358	0.03132	0.01127	0.02923	0.02965	0.02228	0.05016
10. Other Industry	0.00188	0.01302	0.00594	0.02222	0.00977	0.00777	0.00997
11. Electricity	0.00205	0.04645	0.00773	0.02317	0.01858	0.02461	1.04168
12. Construction	0.00076	0.00552	0.00147	0.00307	0.00455	0.00269	0.00306
13. Transp-Communication	0.01453	0.11540	0.04639	0.05538	0.07861	0.04835	0.06105
14. Services	1.01780	0.05036	0.03126	0.05328	0.10409	0.06367	0.04782

Cont....

Continuation Table 3.2

Sectors	Metals	Machinery	Other Industry	Elect.	Const.	Transp. Communic.	Services
1. Agriculture	0.00895	0.00536	0.00695	0.00665	0.01027	0.01054	0.08680
2. Mining	0.05998	0.01081	0.01326	0.02331	0.04019	0.01331	0.00687
3. Food, Bev., Tob.	0.00970	0.00557	0.00653	0.00945	0.00945	0.01152	0.10847
4. Textiles	0.00845	0.00337	0.01498	0.00490	0.00507	0.00665	0.01519
5. Paper, Wood, Leather	0.02332	0.02151	0.02128	0.01221	0.03869	0.01610	0.04042
6. Rubber and Chemic.	0.06044	0.04577	0.06125	0.08847	0.08690	0.14603	0.06007
7. Non Metallic P.	0.00402	0.00587	0.00336	0.00324	0.16502	0.0021	0.00667
8. Metallic Products	1.29436	0.13713	0.08681	0.04141	0.17551	0.01156	0.01554
9. Machinery	0.03671	1.05919	0.01897	0.07370	0.02230	0.01310	0.01143
10. Other Industry	0.01081	0.00544	1.15375	0.01423	0.00790	0.03598	0.02761
11. Electricity	0.01922	0.00621	0.00495	1.02483	0.01295	0.00705	0.01443
12. Construction	0.00329	0.00111	0.00137	0.00718	1.00199	0.00364	0.02407
							Const....

Continuation Table 3.2

Sectors	Metals	Machinery	Other Industry	Elect.	Const.	Communic.	Services
13. Transp-Communic.	0.06185	0.02436	0.02854	0.02279	0.04127	1.11046	0.13499
14. Services	0.07476	0.03933	0.03807	0.05108	0.06204	0.06465	1.17363

1. SOURCE : Table A-11 of the Appendix.

- a. Coefficients are obtained by dividing the sectorial value of inputs of the j sector from the i sector by total output of the j sector, to obtain the A matrix. These coefficients are then subtracted from one, and the resulting matrix is inverted to obtain the $(1-A)^{-1}$ matrix.

$(VAB)_j$ = gross value added of sector j , defined in value terms, and

$(COEF)$ = matrix of transformation coefficients defined by the input-output table, so

$$(87) \quad OT = \sum_{j=1}^{14} (OT)_j, \text{ defines total output of the economy.}$$

Production functions used to estimate gross value added are homogeneous of degree one, and have the form

$$(88) \quad (VAB)_{jt} = W_j \left[K_{jt} \left[e^{r_{jt}} (LC_{jt})^{b_j} (LNC_{jt})^{d_j} \right] T_{jt}^{d_j} \right],$$

for

$j = 1$, i.e., the agricultural sector,

where

K_{jt} = total capital stock of sector j , in period t ,

LC_{jt} = total skilled labour used in sector j , in period t ,

LNC_{jt} = total unskilled labour used in sector j , in period t ,

T_{jt} = total land (hectares) used in the agricultural sector, in period t ,

W_j = scale parameter,

r_j = rate of total labour productivity in sector j , in period t (these rate is estimated endogenously as a function of changes in nutrition, health, education, and housing),

a, b, c, d = coefficients expressing the relative contribution of each one of the inputs to gross value added, and

$$(89) \quad (VAB)_{jt} = W_j \left[K_{jt}^{aj} \left[e^{r_{jt}} (LC_{jt})^{bj} (LNC_{jt})^{cj} \right] \right]$$

for

$j = 2, \dots, 14$, i.e., all sectors except agriculture.

Sectorial inputs and estimated coefficients are shown in tables 3.3 and 3.4 respectively.

Total gross value added is therefore

$$(90) \quad (VAB)_t = \sum_{j=1}^{14} (VAB)_{j,t}$$

TABLE 3.3.
 SECTORIAL DISTRIBUTION OF CAPITAL, SKILLED AND UNSKILLED LABOUR, AND GROSS VALUE ADDED
 COLOMBIA - 1970

Sector	Capital ^{1,2}	Skilled Labour ³	Unskilled Labour ³	Gross Value Added ^{1,4}
1. Agriculture	97996.9	209133	1448015	33161
2. Mining	15241.5	1533	54842	2543
3. Food, Bev, Tob.	12344.1	21933	64217	11962
4. Textiles	12155.1	19796	111566	4490
5. Paper, Wood , Leather	4282.6	7189	28101	3240
6. Rubber-Chemicals	9289.6	18248	31406	7652
7. Non Metallic Products	4744.0	7589	39401	1760
8. Metallic Product	6235.0	7457	31543	4224
9. Machinery	2834.1	7589	21423	6237
10. Other Industry	3180.5	8728	33601	5428
11. Electricity, Gas, Water	4503.1	7016	15087	2104

Cont.....

Continuation Table 3.3

Sector	Capital ^{1,2}	Skilled Labour ³	Unskilled Labour ³	Gross Value Added ^{1,4}
12. Construction	22735.8	10958	480441	8771
13. Transportation-Communication	36811.8	9411	255688	13571
14. Services	82535.3	325206	2261953	26671
TOTAL	314900.1	661786	4878214	131814

1. Millions of Colombian pesos of 1970.

2. Values obtained by using the estimate of total capital stock given in "La Economía Colombiana 1950-1975" Revista de Planeación y Desarrollo, Vol. IX, 3, Oct-Dec, 1977, Table 2.29, p. 84. This estimate is 314900.1 millions of pesos of 1970. Then the sectorial values for capital stock were obtained by applying the distribution given by Jaime de Melo in "a Multi-Sector, Price Endogenous Trade Model Applied to Colombia", Ph.D. Dissertation, John Hopkins University, 1975, Table A-4, p. 203, to total value of capital stock.

3. These values were obtained as follows :

- i. An overall value for total labour occupied in the economy in year 1970 was obtained by linear interpolation between the values given for years 1965 and 1975 in "La Economía Colombiana, 1950-1975", Op. Cit., Table 2-29, p. 84.
- ii. A value of labour occupied in the primary, secondary and tertiary sectors was obtained by applying the sectorial distribution given in "La Economía Colombiana", Op. Cit., Table 3.33, p. 139, for year 1973, to 1970 value of total occupied labour in the economy.

Cont

Continuation Table 3.3

- iii. Labour occupied in the agriculture and mining sectors was obtained by applying the distribution given by Jaime de Melo, Op. Cit., Table A-4, p.203 to the total value of labour occupied in the primary sector obtained in ii. Labour occupied in the sectors 3 to 10, was obtained by applying distributional coefficients given by Melo, Op. Cit. to the total value of labour occupied in the secondary sector obtained in ii. Values for total labour occupied in sectors 11 to 14 were obtained in a similar way using the total value of labour occupied in the tertiary sector obtained in ii.
 - iv. Finally, total labour in each sector was disaggregated into skilled and unskilled using the percent distribution given in de Melo, Op. Cit., Table A-4, p. 203.
4. SOURCE : DANE, Input-Output Matrix, 1970. Table A-11 of the Appendix.

TABLE 3.4
ESTIMATED PRODUCTION FUNCTIONS COEFFICIENTS AND LABOUR/CAPITAL RATIOS
COLOMBIA 1970

Sectors	Capital (Aj) 1,2	Skilled Labour(Bj) ²	Unskilled Labour (Cj) ²	Scale Parameter (Wj) ³	Skilled Labour/ Capital ⁴	Unskilled Labour/Capital ⁴
1. Agriculture	.3085	.0220	.2696	2.0615	.002130	.014776
2. Mining	.7401	.0677	.1922	.9095	.000101	.003598
3. Food, Bev, Tobacco	.6383	.1467	.2150	7.5327	.001777	.005202
4. Textiles	.3969	.1628	.4403	8.2130	.001629	.009179
5. Paper, Wood, Leather	.5198	.1750	.3052	10.6372	.001679	.006562
6. Rubber, Chemicals	.5325	.2666	.2009	13.4877	.001964	.003381
7. Non Metallic P.	.5617	.1192	.3198	3.6216	.001596	.008286
8. Metallic Products	.3383	.2044	.4573	29.8017	.001196	.005059
9. Machinery	.4652	.2127	.3221	37.0791	.007678	.007559
10. Other Industry	.5535	.1268	.3197	15.3048	.002744	.010565
11. Electricity, Gas, Water	.5386	.2046	.2568	7.3984	.001558	.003550

Cont

Continuation Table 3-4

Sectors	Capital (Aj) ^{1,2}	Skilled Labour(Bj) ²	Unskilled Labour (Cj) ²	Scale Parameter (Wj) ³	Skilled Labour/ Capital ⁴	Unskilled Labour/Capital ⁴
12. Construction	.1511	.1678	.6811	19.0512	.000482	.021131
13. Transp-Communic.	.5668	.1278	.3054	4.7983	.000256	.006946
14. Services	.4974	.2452	.2574	3.1419	.003940	.027406

1. Land Coefficient (Dj) = .3999.

2. These coefficients were obtained as follows :

i. Capital and labour shares were estimated using the 1970 DANE input-output Table (Tables A-11 and A-15 of Appendix).

ii. Coefficients for skilled and unskilled labour were then obtained by multiplying the total labour share of value given by the DANE input-output table by the percent distribution given by Jaime de Melo in "A Multi-Sector, Price Endogenous Trade Model Applied to Colombia", Ph.D. Dissertation, John Hopkins University, 1975, Table A-3, p. 202, for each sector. A similar procedure was followed for disaggregating the capital share of value added in the agricultural sector between land and other capital.

3. The sectorial value of this parameter was derived by dividing the estimated value added given by the evaluation of the production function by the actual value given in the input-output matrix for year 1970.

4. These ratios are the inverse of capital/labour ratios for each sector

b. Capital

Capital stock is updated year to year by adding investment and subtracting depreciated capital during the period, so that

$$(91) \quad (K_{j,t+1}) = K_{j,t}(1-h) + IT_{jt},$$

being

h = annual rate of capital depreciation, and

IT_{jt} = investment in sector j between t and $t + 1$.

Therefore,

$$(92) \quad (K)_{t+1} = \sum_{j=1}^{14} K_{j,t+1},$$

is total capital stock of the economy in the period $t + 1$.

c. Labour Demands

Labour demands are estimated by using labour to capital ratios (See table 3.4 for the values) for each skilled and unskilled category, so that

$$(93) \quad (LC)_{j,t+1} = K_{j,t+1} (LC_j/K_j), \quad \text{and}$$

$$(94) \quad (LNC)_{j,t+1} = K_{j,t+1} (LNC_{j/K_j}),$$

where:

(LC_{j/K_j}) = skilled labour to capital ratio (estimated with information for the base year), for sector j , and

(LNC_{j/K_j}) = unskilled labour to capital ratio for sector j , and therefore,

$$(95) \quad (LT)_{j,t+1} = (LC)_{j,t+1} + (LNC)_{j,t+1},$$

where

$(LT)_{j,t+1}$ = total labour demanded by sector j , in period $t + 1$.

The following aggregates are then obtained

$$(96) \quad (DLCU)_{t+1} = \sum_{j=3}^{14} (LC)_{j,t+1},$$

$$(97) \quad (DLCR)_{t+1} = \sum_{j=1}^2 (LC)_{j,t+1},$$

$$(98) \quad (\text{DLNCU})_{t+1} = \sum_{j=3}^{14} (\text{LNC})_{j,t+1},$$

$$(99) \quad (\text{DLNCR})_{t+1} = \sum_{j=1}^2 (\text{LNC})_{j,t+1},$$

where:

DLCU, DLCR, represent labour demand for skilled workers in the urban and the rural areas, and DLNCU, DLNCR, are the corresponding labour demands for unskilled workers in the same areas. This information is supplied to the employment subsystem to estimate unemployment rates, and wages.

d. Factor Payments

Net value added is obtained by defining a ratio between gross value added and net value (factor payments) in each sector in the input-output table in the base year, so that

$$(100) \quad (\text{VAN})_{j,t} = (\text{VAB})_{j,t} (\text{RVANB})_j,$$

where

$(VAN)_{j,t}$ = net value added of sector j, in period t,

$(VAB)_{j,t}$ = gross value added of sector j, in period t,

$(RVANB)_j$ = ratio of net to gross value added in sector j. (See table A-13 of the appendix for ratio values).

Capital payments and labour payments are obtained multiplying net value added for each sector by the corresponding factor defined by the coefficients of the production functions, to obtain

(101) $(CAPI)_{j,t} = (VAN)_{j,t} (a_j + d_j)$, for $j = 1$ = the agricultural sector,

(102) $(CAPI)_{j,t} = (VAN)_{j,t} (a_j)$, for $j = 2, \dots, 14$ = all sectors except agriculture, and

(103) $(SALA)_{j,t} = (VAN)_{j,t} (b_j + c_j)$ for $j = 1, \dots, 14$,

where:

$(CAPI)_{j,t}$ = capital payments to sector j, in period t, and

$(SALA)_{j,t}$ = labour payments to sector j , in period t .

Total capital and labour payments in period t are, therefore,

$$(104) \quad (CAPI)_t = \sum_{j=1}^{14} (CAPI)_{j,t}, \quad \text{and}$$

$$(105) \quad (SALA)_t = \sum_{j=1}^{14} (SALA)_{j,t}.$$

In addition, the following values for labour payments are obtained

$$(106) \quad (SALAC)_{j,t} = (VAN)_{j,t} (b_j), \quad \text{and}$$

$$(107) \quad (SALANC)_{j,t} = (VAN)_{j,t} (c_j),$$

being

$SALAC$ and $SALANC$ the corresponding total payments to skilled and unskilled labour in sector j , in period t .

The following aggregates are then calculated

$$(108) \quad (\text{SALACU})_t = \sum_{j=3}^{14} (\text{SALAC})_{j,t} ,$$

$$(109) \quad (\text{SALACR})_t = \sum_{j=1}^2 (\text{SALAC})_{j,t} ,$$

$$(110) \quad (\text{SALANCU})_t = \sum_{j=3}^{14} (\text{SALANC})_{j,t} ,$$

$$(111) \quad (\text{SALANCR})_t = \sum_{j=1}^2 (\text{SALANC})_{j,t} ,$$

being SALACU and SALACR the corresponding payments to skilled labour in the urban and rural areas, and SALANCU, SALANCR payments to unskilled labour in the same areas. These values are supplied to the employment subsystem to estimate average wage paid to each labour category in period t.

e. Imports

Imports in the model are related to total demand of each sector. Therefore, to obtain imports by sector a vector relating imports to total demand is used, so that

$$(112) \quad M_{j,t} = m_j (DT)_{j,t} ,$$

where:

$M_{j,t}$ = total imports of sector j , in period t ,

m_j = import coefficient (ratio of imports required by the sector, to total demand of each sector in period t .

(See table A-13 of appendix for coefficient values).

If there is excess demand in the product markets, imports are increased on top of the gross domestic output determined amount, assuming that the model is working under the option of disequilibrium in the balance of payments. Otherwise, imports will be subject to a foreign exchange availability constraint.

Import taxes are obtained in the model as

$$(113) \quad (IMP)_{j,t} = M_{j,t} (VIMP)_j ,$$

being VIMP a vector of tax rates on imports of each sector. (See table A-13 of appendix for rate values) Therefore, total imports and total import taxes are defined as

$$(114) \quad M_t = \sum_{j=1}^{14} M_{j,t}, \text{ and}$$

$$(115) \quad (\text{IMP})_t = \sum_{j=1}^{14} (\text{IMP})_{j,t}$$

in the model.

f. Gross National Product

G.N.P. in the model is defined as

$$(116) \quad (\text{G.N.P.})_t = \sum_{j=1}^{14} (\text{VAB})_{j,t}$$

The following aggregates are also calculated

$$(117) \quad (\text{YNA})_t = \sum_{j=3}^{14} (\text{VAB})_{j,t}, \text{ and}$$

$$(118) \quad (YA)_t = \sum_{j=1}^2 (VAB)_{j,t},$$

being

YNA and YA values of G.N.P. for the urban and rural areas, respectively. These values are supplied to the demographic subsystem to estimate rural to urban migration rates.

g. Labour Productivity

A rate of change in labour productivity in each period is estimated in the model as a function of changes in the levels of nutrition, health, housing, and education (supplied by the essential human needs subsystem).

The equation expressing this relation is

$$(119) \quad (Dr)_{t,t+1} = a_1 \left[\frac{\text{METROS}_{t,t+1}}{\text{METROS}_t} \right] + a_2 \left[\frac{\text{CALCA}_{t,t+1}}{\text{CALCA}_t} \right] \\ + a_3 \left[\frac{\text{FLE}_{t,t+1}}{\text{FLE}_t} \right] + a_4 \left[\frac{\text{PRIMAC}_{t,t+1}}{\text{PRIMAC}_t} \right],$$

where

Dr = change in rate of labour productivity,
METROS = number of squares meters per person,
CALCA = per capita calories consumed per day,
FLE = female life expectancy at birth,
PRIMAC = complete primary schooling rate,
 a_1, a_2, a_3, a_4 = coefficients of response of the
rate of labour productivity to changes in the level
of satisfaction of housing, nutrition, health, and
education needs. (13)

A value of Dr is estimated for the urban and rural
areas. The value for the urban area is used for
all sectors, except agriculture and mining where the
value for the rural area is used.

The rate of labour productivity is then obtained as

$$(120) \quad (r)_{j,t+1} = (r)_t + (Dr)_{t,t+1}$$

which is the rate used in the production functions
in the next period.

Given the asymptotic character of the functions used to estimate values for housing, nutrition, health, and education, the rate of labour productivity also reaches an upper asymptotic value in the long run.

3. Equilibrium

a. Product Market

The economic subsystem can work under three different situations depending on the behaviour of the external sector and inventory management as equilibrating mechanisms in the product market.

i) Free trade - Open economy

This situation assumes no restrictions on exports or imports, so that any excess supply can be exported and any excess demand can be imported in the same period. If this situation is combined with the option of equilibrium in the balance of payments, then imports are constrained by foreign exchange availability. For those sectors with no external trade, inventories are increased if there is excess supply, and decreased if there is excess demand, if the sector has enough inventories accumulated; otherwise, the excess is imported.

Besides, in the non-trade sectors investment allocations in the next period are modified so that in the long run these sectors lurch towards equilibrium (14).

ii) No trade-Closed economy

Any excess supply in this situation goes to inventories, any excess demand is solved by using inventories or by importing in those sectors where there is not enough inventory to meet demand requirements. Besides, investment allocations in the next period are modified so as to drive markets towards equilibrium in the long run.

iii) Forced Equilibrium

Under this situation, supply is adjusted to demand,

under the assumption that there is unutilized capacity or imports to cover any excess demand, or that any excess supply is consumed in the same period in addition to normal consumption, or exported.

b. Public Finances

The model has two options concerning the behaviour of the public account: a) a deficit- superavit, and b) a balanced account. In the first case, deficits or superavits are allowed and government expenditures are determined exclusively by the behaviour of G.N.P. in the previous period. When the balanced option is adopted, then government investment and government consumption are adjusted in the next period to the amount allowed by government revenue in the present period.

c. Balance of Payments

Two options can be used concerning the behaviour of the balance of payments of the nation: a) a disequilibrium one, in which deficit or superavit is allowed, and b) an equilibrium one, in which no deficit is permitted.

If any deficit occurs, imports are decreased by the same amount of the deficit.

c. Employment Subsystem

This subsystem estimates unemployment rates and average wages by area of residence and skill level, based on the information supplied by the demographic and economic subsystems. The total number of unemployed in each category are defined as

$$(121) \quad (UNEUC)_t = (LSUC)_t - (LDUC)_t ,$$

$$(122) \quad (UNEUNC)_t = (LSUNC)_t - (LDUNC)_t ,$$

$$(123) \quad (UNERC)_t = (LSRC)_t - (LDRC)_t ,$$

$$(124) \quad (UNERNC)_t = (LSRNC)_t - (LDRNC)_t ,$$

where UNEUC, UNEUNC, UNERC, UNERNC are the total number of unemployed in each labour category, LSUC, LSUNC, LSRC, LSRNC are labour supplies by category, and LDUC, LDUNC, LDRC, LDRNC are labour demands by category. Therefore, unemployment rates are obtained as

$$(125) \quad (URUC)_t = (UNEUC)_t / (LSUC)_t \times 100 ,$$

$$(126) \quad (URUNC)_t = (UNEUNC)_t / (LSUNC)_t \times 100 ,$$

$$(127) \quad (\text{URRC})_t = (\text{UNERC})_t / (\text{LSRC})_t \times 100,$$

$$(128) \quad (\text{URRNC})_t = (\text{UNERNCR})_t / (\text{LSRNC})_t \times 100,$$

being URUC, URUNC, URRC, and URRNC rates for urban-skilled, urban-unskilled, rural-skilled and rural-unskilled categories, respectively.

Finally, the average wage by category of labour is obtained as

$$(129) \quad (\text{SALUC})_t = (\text{SALUCU})_t / (\text{LDUC})_t,$$

$$(130) \quad (\text{SALUNC})_t = (\text{SALUNCU})_t / (\text{LDUNC})_t,$$

$$(131) \quad (\text{SALRC})_t = (\text{SALACR})_t / (\text{LDURC})_t,$$

$$(132) \quad (\text{SALRNC})_t = (\text{SALANCR})_t / (\text{LDRNC})_t,$$

being SALUC, SALUNC, SALRC, SALRNC average wages for urban-skilled, urban-unskilled, rural-skilled, and rural-unskilled categories, and SALACU, SALANCU, SALACR, SALANCR, total labour payments to the same categories of

labour, which are determined in the supply side of the economic subsystem.

Labour demands are adjusted in each period by a factor equal to the inverse of the rate of change in labour productivity due to increases in nutrition, health, education, and housing levels of the population.

D. Income Distribution - Consumption Subsystem

This subsystem distributes capital and labor income among seven social groups, and then estimates sectorial consumption for each one of the social groups as a function of disposable income and family size. It also estimates household savings for each one the groups as a function of the same variables.

1. Social Groups

Social groups by area of location are defined based on capital income of the household and occupational status

of the head of the household. According to the above criteria, seven social groups are defined in the model as follows (See table 3-5 for criteria definition)

Urban Area

1. Capitalists - Owners of large enterprises (domestic and foreign profit earners).
2. Skilled Workers - Professionals and Technicians.
3. Self - Employed in small enterprises - Independent workers.
4. Unskilled urban workers - Low wage earners.

Rural Area

5. Latifundists - Large scale farmers.
6. Medium and small size farmers.
7. Agricultural wage earners and unpaid family workers.

2. Income Distribution

The subsystem receives vectors of capital and labour payments by sector from the economic subsystem.

TABLE 3.5
 CRITERIA FOR SOCIOECONOMIC CLASSIFICATION OF COLOMBIAN FAMILIES. DANE SURVEY.
 EH4. 1970

Socioeconomic Group.	Area	Income From Capital (Colombian Pesos of 1970)	Occupational Status of Head.	% of Families in Group
1. Capitalists.	Urban	20.000	1,2,3,4,5.	.013
2. Professionals-Technicians.	Urban	1- 20.000	1,2,3,4,5.	.154
3. Independent Workers (Informal Sector).	Urban	0	0,6,7.	.198
4. Wage Earners.	Urban	0	0,1,2,3,4,5.	.165
5. Latifundists.	Rural	5.000	1,2,3,4,5.	.003
6. Medium-Small Farmers.	Rural	0	0,6,7.	.249
7. Wage Earners.	Rural	0	0,1,2,3,4,5.	.218
Total Number of Families				4.850

1. Status Definitions
 0 = No Information
 1 = White Collar Worker-Private.
 2. Blue Collar Worker-Private
 3. White Collar Worker-Public.
 4. Blue Collar Worker - Public

- 5 = Chiefs and Administrators.
 6 = Independent Workers
 7 = Family Workers.

i Capital Income Distribution among groups is obtained by means of a capital income distribution matrix, so that

$$(133) \quad \text{CAP}_{i,t} = (C) \quad (\text{CAP I})_{j,t},$$

$\text{CAP}_{i,t}$ = capital income received by group i (15),

C_{ij} = (C) = matrix of capital income distribution by group (i), and sector (j)

$(\text{CAP I})_{j,t}$ = vector of capital payments by sector (profit share of value added).

The estimated C matrix is shown in table 3-6.

ii Labour Income Distribution among groups is obtained by means of a labour income distribution matrix, so that

$$(134) \quad \text{SAL}_{i,t} = (S) \quad (\text{SAL A})_{j,t},$$

where:

$\text{SAL}_{i,t}$ = labour income received by social group i, (16).

TABLE 3.6
MATRIX OF DISTRIBUTIONAL COEFFICIENTS OF CAPITAL INCOME BY SECTOR AND GROUP.
COLOMBIA - 1970

Socioeconomic Group.	1	2	3	4	5	6	7
1. Capitalists.	0.1169	.2451	.2744	0.0863	0.1681	0.1272	0.1042
2. Professionals-Technicians.	0.1555	.5370	.4967	0.2625	0.3733	0.2961	0.2456
3. Independent Workers (Informal Sector) - Urban.	0.2728	.1605	.1935	0.6512	0.3880	0.5306	0.5412
4. Wage Earners-Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Latifundists.	0.0228	0.0	.0112	0.0	0.0291	0.0030	0.0095
6. Medium-Small Farmers.	0.4320	0.0574	.0242	0.0	0.0415	0.0431	0.09995
7. Wage Earners-Rural	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1. Agriculture	(1 in table 3.4)						
2. Mining.	(2 in table 3.4)						
3. Manufacture	(3+4+5+6+7+8+9+10 in table 3.4).						
4. Electricity.	(11 in table 3.4)						
5. Construction.	(12 in table 3.4).						
6. Transportation	(13 in table 3.4)						
7. Services	(14 in table 3.4).						

SOURCE : DANE Household Survey, EH. 4. 1970 (See table 1.14 of the Appendix for values in pesos of 1970).

S_{ij} = (S) = matrix of labour income distribution by group (i), and sector (j).

$(SAL A)_{j,t}$ = vector of labour payments by sector.

The estimated S matrix is shown in table 3-7.

iii Total Income Distribution among groups is then obtained by adding their corresponding capital and labour incomes, ie:

$$(135) \quad TOT_{i,t} = CAP_{i,t} + SAL_{i,t},$$

where

$TOT_{i,t}$ = total income received by group i, in period t. (17)

iv Disposable Income by social group is equal to total income minus taxes imposed to each type of income.

Therefore

$$(136) \quad (ID)_{i,t} = TOT_{i,t} - CTAX_{i,t} - STAX_{i,t},$$

TABLE 3.7
MATRIX OF DISTRIBUTIONAL COEFFICIENTS OF LABOUR INCOME BY SECTOR AND GROUP
COLOMBIA - 1970

Socioeconomic Group.	1	2	3	4	5	6	7
1. Capitalists.	0.0364	0.0684	0.1068	0.0411	0.0754	0.0465	0.0749
2. Professionals-Technicians.	0.0604	0.2381	0.3430	0.3009	0.2955	0.2287	0.2282
3. Independent Workers (Informal Sector) - Urban.	0.1684	0.0613	0.1483	0.4120	0.3209	0.3835	0.2274
4. Wage Earners-Urban	0.0294	0.2499	0.2313	0.1612	0.1555	0.2486	0.3514
5. Latifundists.	0.0038	0.0	0.0070	0.0	0.0068	0.0015	0.0053
6. Medium-Small Farmers.	0.3972	0.0536	0.0535	0.0	0.0477	0.0593	0.0595
7. Wage Earners-Rural	0.3044	0.3286	0.1101	0.0847	0.0981	0.0319	0.0533

1 = Agriculture (1 in table 3.4)
 2 = Mining (2 in table 3.4)
 3 = Manufacture (3+4+5+6+7+8+9+10 in table 3.4)
 4 = Electricity (11 in table 3.4)
 5 = Construction (12 in table 3.4)
 6 = Transportation (13 in table 3.4)
 7 = Services (14 in table 3.4)

SOURCE : DANE Household Survey, EH. 4, 1970 (See table A15 of the Appendix for values in pesos of 1970).

where

$(ID)_{i,t}$ = disposable income corresponding to group i,

$CTAX_{i,t}$ = amount paid as taxes imposed to capital
income of group i, $STAX_{i,t}$ = amount paid as
taxes imposed to labour income of group i.

v Income Concentration indexes are calculated
before taxes for capital, labour and total income,
and after taxes for disposable income by means of
the formula:

$$(137) \quad GIC = \sum_{i=1}^7 (\%P)_i (\%Y)_{i+1} - \sum_{i=1}^7 (\%P)_{i+1} (\%Y)_i,$$

being

GIC = Gini's concentration index, (15).

$(\%Y)$ = cumulative proportion of income up to
group i,

$(\%P)_i$ = cumulative proportion of population up to
group i,

3. Consumption

Once disposable income by social group is obtained, it is possible to estimate consumption and savings functions. Consumption functions used have the form:

$$(138) \quad (\text{CONS})_{i,j,t} = a_{i,j} + b_{i,j}(\text{ID})_{i,t} + c_{ij} (\text{TF}_{i,t}),$$

$$i = 1, \dots, 7$$

$$j = 1, \dots, 14$$

where

$(\text{CONS})_{i,j,t}$ = consumption of products of sector j ,
by group i , in period t ,

$(\text{TF}_{i,t})$ = average family size for group i (determined endogenously as a function of total fertility rates for urban and rural areas estimated in the demographic subsystem) (19).

$$(139) \quad (\text{SF})_{i,t} = a_i + b_i (\text{ID}_{i,t}) + c_i (\text{TF}_{i,t}),$$

$$i = 1, \dots, 7$$

where

$(SF)_{i,t}$ = household savings of group i , in period t .

Estimated consumption and savings functions are shown in table 3-8. (See tables A-16 and A-17 of appendix for values used to estimate the functions and adjustment factors used to make them consistent with national accounts).

A disposable income constraint is imposed to these savings functions so that there are positive savings only at a given level of average disposable income. Otherwise savings are zero (20).

Total consumption by sector is obtained

as

$$(140) \quad CP_{j,t} = \sum_{i=1}^7 (CONS)_{i,j,t}$$

$j = 1, \dots, 14$,

being

$CP_{j,t}$ = total consumption of products of sector j .

TABLE 3.8

ESTIMATED CONSUMPTION FUNCTIONS BY SOCIOECONOMIC GROUP AND SECTOR, COLOMBIA . 1970

THE ESTIMATED LINEAR MODEL IS $(CONSUM)_1 = a_0 + a_1 (TOTAL EXPENDITURES) + a_2 (FAMILY SIZE) + e$
 GROUP 1 AND .5- CAPITALISTS AND LATIFUNDISTS.

Sector ¹	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	18.997	.021 (.047) ^a	1.009 (1.197)	.991	552.654 **
Textiles	.717	.109** (.016)	.026 (.397)	.999	13804.780 **
Non Metallic Products.	-4.664	.051** (.010)	.202 (.260)	.999	11974.095 **
Metalic Products.	3.838	.0302** (.009)	-.738** (.249)	.616	8.0187*
Other Industry	-2.792	.059** (.015)	-.019 (.0372)	.999	5 294.292 **
Electricity, Gas, Water	1.543	.020 (.009)	.1126 (.235)	.835	25.319 **
Construction	22.356	.054 (.071)	-1.249 (1.801)	.258	1.740
Services	20.278	.083 (.044)	-1.890 (1.109)	.705	11.950 **
					Cont. . .

Continuation Table 3.8

Sector ¹	Intercept	Total Expenditures	Family Size	R ²	F
Transportation	7.977	.044 (.024)	-1.099 (.599)	.266	1.812
Savings	15.132	.178** (.063)	-2.678 (1.597)	.989	440,812

* Coefficient Significant at the 5% Level.

** Coefficient Significant at the 1% Level.

a Standard Error of the Coefficient.

Continuation Table 3.8

GROUP 2 . PROFESSIONALS AND TECHNICIANS.

Sector	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	2.075	.229** (.053)	.677 (.707)	.644	15.364**
Textiles	-.278	.108** (.019)	-.096 (.225)	.711	20.901**
Non Metallic Products.	-.035	.020** (.007)	-.034 (.091)	.363	4.853*
Metalic Products.	-1.316	.054** (.023)	.121 (.303)	.339	4.357
Other Industry.	-.589	.019** (.007)	.996 (.090)	.475	7.692*
Electricity, Gas, Water	-.377	.025* (.010)	.990 (.130)	.415	6.928*
Construction	-.955	.211** (.051)	-.045 (.688)	.560	10.801**
Services	-6.284	.159 (.037)	.574 (.493)	.654	16.939**
Transportation	6.759	.175 (.103)	-1.482 (1.377)	.149	1.489

Cont...

Continuation Table 3.8

GROUP 3. INDEPENDENT WORKERS - SELF EMPLOYED URBAN.

Sector	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	.544	.270** (.028)	.745 (.477)	.868	55.649 **
Textiles	-1.922	.810** (.010)	.399* (.170)	.836	43.385 **
Non Metallic Products.	-.349	.012** (.003)	.051 (.057)	.505	8.670 **
Metalic Products.	.879	.019* (.008)	-.124 (.137)	.257	2.942
Other Industry	-.081	.022** (.002)	-.003 (.040)	.840	44.630**
Electricity, Gas, Water.	-.152	.036** (.004)	.038 (.064)	.858	51.485 **
Construction.	5.147	.303** (.028)	-1.355** (.480)	.872	57.981 **
Services	-2.468	.197** (.013)	.078 (.221)	.936	125.023 **
Transportation.	-1.598	.061** (.010)	.172 (.173)	.718	21.676 **
					Cont...

Continuation Table 3.8

WAGE EARNERS - URBAN

Sector	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	-1.855	.326** (.061)	1.034* (.491)	.803	34.654**
Textiles	.362	.119** (.015)	-.142 (.120)	.828	40.968**
NonMetalic Products.	-.092	.020** (.007)	-.023 (.053)	.416	6.966*
Metalic Products.	.879	.019* (.008)	-.124 (.137)	.257	2.942
Other Industry.	-.081	.022** (.002)	-.003 (.040)	.840	44.630**
Electricity, Gas, Water.	-.152	.036** (.004)	.038 (.064)	.858	51.485**
Construction	1.126	.177** (.037)	-.263 (.297)	.627	14.284**
Services.	-.248	.131** (.029)	-.108 (.233)	.617	13.665**
Transportation.	-.219	.083** (.032)	-.140 (.267)	.317	3.951

Cont...

Continuation Table 3.8

GROUP 6 : MEDIUM AND SMALL FARMERS.

Sector	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	-2.638	.393 ** (.056)	1.056** (.399)	.847	46.949 **
Textiles	-1.171	.056** (.021)	.268 (.147)	.533	9.705 **
Non Metallic Products	- .045	.008 (.008)	.007 (.029)	.227	2.495
Metalic Products	.022	.023 (.032)	.003 (.004)	.036	.321
Other Industry	- .381	.016** (.005)	.052 (.038)	.536	9.827 **
Electricity, Gas, Water	1.142	.054** (.010)	-.262** (.074)	.531	14.536 **
Construction	3.696	.236** (.072)	-.880 (.511)	.391	5.449 *
Services	-1.546	.108** (.031)	.147 (.220)	.528	9.320 **
Transportation	.920	.132** (.031)	-.411 (.222)	.516	9.049 **
					Cont...

Continuation Table 3.8

GROUP 7 : WAGE EARNERS - RURAL

Sector	Intercept	Total Expenditures	Family Size	R ²	F
Agriculture	-.870	.482** (.055)	.561 (.339)	.831	41.667 **
Textiles	-.850	.102** (.019)	.120 (.117)	.649	15.713 **
Non Metallic Products	-.081	.011** (.004)	.008 (.023)	.331	4.203
Metalic Products	.576	.008 (.008)	-.081 (.050)	.161	1.634
Other Industry	.084	.026** (.006)	-.009 (.034)	.569	11.213 **
Electricity, Gas, Water	.274	.028** (.008)	-.065 (.038)	.564	10.976 **
Construction	.738	.128** (.033)	-.207 (.209)	.479	7.807 *
Services	.146	.112** (.027)	-.147 (.166)	.502	8.553 **
Transportation	.211	.103** (.034)	-.0181 (.209)	.354	4.657 *
					Cont....

Continuation Table 3.8

1. Expenditure items in each category (sector)* are:

Agriculture	= Cereals, roots, sugars, tubers, grains, vegetables, fruits, meat, eggs, fish, milk, oils, alcoholic beverages, non-alcoholic beverages, spices, tobacco, hot beverages, food from employer, own-consumption, meals out.
Textiles	= Adult and children clothing, clothing care.
Non Metallic Products	= Most minor durables.
Metalic Products	= Most major durables
Other Industry	= Cleaning articles, personal hygiene, others.
Electricity, Gas, Water	= Public utilities.
Construction	= Rent, housing payments, housing maintenance, property taxes.
Services	= Domestic service, recreation, tourism, funerals, health expenses, taxes, cultural expenses, educational expenses, other expenses.
Transportation	= Vehicle operation, public transportation, communications, vehicle payments, vehicle taxes.
Savings	= Were estimated as a residual by subtracting total expenditures from total income of the household.

* Expenditure items were assigned to sectors according to the dominant input. For example : housing payments were assigned to the construction sector, although a house has wood, glass, and other components.

Total private consumption is then

$$(141) \quad CP_t = \sum_{j=1}^{14} CP_{j,t} ,$$

being

CP_t = total private consumption.

Total household savings are defined as

$$(142) \quad SF_t = \sum_{i=1}^7 (SF)_{i,t} .$$

This subsystem provides total consumption by sector and total household savings to the economic subsystem.

The subsystem also derives a set of indicators of income distribution such as per capita income before and after taxes by social group, the percentage of capital, labor and total income going to each social group before taxes, and the percentage of disposable income going to each social group. Also total consumption by social group.

E. Essential Human Needs Subsystem

This subsystem is concerned with the estimation of physical indicators of welfare for each of the social groups. The set of essential human needs considered includes nutrition, health, housing and education. Indicators for measuring the degree of satisfaction of each need (in quantitative and qualitative terms) by social group are estimated as function of G.N.P. per capita, private and government expenditures, and private and public investment.

In addition, an index of power and bargaining is included. This index is a function of per capita income.

1. Nutrition

Nutrition status is measured in terms of per capita daily consumption of calories by each social group.

The equation used has the form.

$$(143) \quad (\text{CALCA})_{i,t} = a_i + b_i \ln (\text{GAPEDI})_{i,t}$$

where

$(CALCA)_{i,t}$ = per capita daily consumption of calories
by social group i , in period t ,

$(GAPEDI)_{i,t}$ = private expenditures on
food, in period t , by group i .

The estimated equation for the country is (22).

$$(134.a) \quad (CALCA)_t = -267.3130 + 490.8510^* \ln (GAPEDI)_t ,$$

(1131.5100) (218.158)

$$R^2 = .8769 \quad D-W = 2.8114 \quad Obs = 11$$

(See table A-18 of appendix for data and sources).

2. Health

Four indicators for health are estimated, two of them are indicators of general environmental conditions, (female life expectancy and infant mortality), and two indicators of access to services (beds per thousand inhabitants and number of persons per physician).

a. Female Life Expectancy

(See equations 1 and 1.a in the demographic subsystem).

b. Infant Mortality

$$(144) \quad (\text{MORIN})_{i,t} = a_i - b_i (1/Y_{i,t})$$
$$i=1,\dots,7$$

$(\text{MORIN})_{i,t}$ = infant mortality rate for group i , in period t ,

$(Y_{i,t})$ = G.N.P. of group i , in period t .

The estimated equation for the country is

$$(144.a) \quad (\text{MORIN})_t = 1129.4000 - 120.4660^{**} (1/Y)$$
$$(121.9950) \quad (13.9977)$$

$$R^2 = .8707 \quad D-W = .1242 \quad \text{Obs} = 13$$

(See Table A-19 of appendix for data and sources).

c. Beds per Thousand Inhabitants

$$(145) \quad (\text{CAM})_{i,t} = a_i + b_i \ln (\text{GASPED})_{i,t} + c_i \ln (\text{SALPE})_{i,t},$$

$$i = 1,2$$

where

d. Persons per Physician

$$(147) \quad (\text{MED})_{i,t} = a_i + b_i (\text{GAEPED})_{i,t} + c_i (\text{EDUPE})_{i,t},$$

where

$(\text{MED})_{i,t}$ = total number of physicians available in the country and the urban area in period t,

$(\text{GAEPED})_{i,t}$ = private expenditures on education for group i, in period t,

$(\text{EDUPE})_{i,t}$ = government expenditures on education for group i, in period t.

Therefore,

$$(148) \quad (\text{HAB}/\text{MED})_{i,t}^{(P)} = \frac{(\text{P})_{i,t}}{(\text{MED})_{i,t}}$$

is the equation for the number of persons per physician in the country and the urban area (i=1= country; i=2 urban).

The estimated equation for physicians is

$$(147.a.) \quad (\text{MED})_t = 4830.3800 + 433.2530 * (\text{GAEPED})_t + .0980 (\text{EDUPE})_t$$

(1198.9000) (220.699) (.5362)

$$R^2 = .9734 \quad D-W = .9204 \quad \text{Obs} = 12$$

(See table A-21 of appendix for data and sources).

3. Housing

Housing is measured in quantitative terms by the number of square meters available per person, and in qualitative terms by the proportion of houses having electricity and piped water, in each social group. The equations are

a. Square Meters per Person

$$(149) \quad (\text{MET})_{i,t+1} = \frac{(1-d) (\text{STOCK})_{i,t}}{(\text{P})_{i,t}} + \frac{(\text{INV})_{i,t}}{\text{COME}} \Big/ (\text{P})_{i,t} ,$$

for the first year of the projection and

$$(149.a) \quad (\text{MET})_{i,t+1} = \frac{(1-d) ((\text{MET})_{i,t} (\text{P})_{i,t})}{(\text{P})_{i,t}} +$$

$$\frac{(\text{INV})_{i,t}}{\text{COME}} \Big/ (\text{P})_{i,t} ,$$

for the rest of the years of the projection,

being

$(\text{MET})_{i,t+1}$ = number of square meters per person in group i, in period t+1,

d = depreciation rate,
 $(\text{STOCK})_{i,t}$ = stock of square meters of housing
available for group i , (base year),
 $(\text{INV})_{i,t}$ = total investment in housing (private +
public) by group i , in period t ,

COME = cost per square meter of housing (base year).
(See table A-22 of appendix for data, sources, and
methodology).

b. Electricity

$$(150) \quad (\text{LUZ})_{i,t} = a_i - b_i (1/\text{YP})_{i,t},$$

where

$(\text{LUZ})_{i,t}$ = proportion of houses in group i having
electricity, in period t ,

$(1/\text{YP})_{i,t}$ = inverse of G.N.P. per capita for group i ,
in period t .

The estimated equation for the country is

$$(150.a) \quad (\text{LUZ})_t = 1.2989 - 5021.7382^{**} (1/\text{YP})_t \\ (.0596) \quad (330.6486)$$

$$R^2 = .9831 \quad D-W = 1.8235 \quad \text{Obs} = 22$$

(See table A-22 of appendix for data and sources).

c. Piped water

$$(151) \quad (AGUA)_{i,t} = a_i - b_i (1/YP)_{i,t}$$

where

$(AGUA)_{i,t}$ = proportion of houses in group i having
piped water service, in period t .

The estimated equation for the country is

$$(151.a) \quad (AGUA)_t = 1.4519 - 5947.4882^{**} (1/YP)_t \\ (.1183) \quad (677.7802)$$

$$R^2 = .9732 \quad D-W = 1.6049 \quad \text{Obs} = 22$$

(See table A-22 of appendix for data and sources).

4. Education

Education is measured in terms of coverage and completion by illiteracy rate, complete primary and secondary schooling rates. Besides, the students per teacher ratio in primary schooling is used as an indicator of quality of education.

Equations used are

a. Illiteracy

$$(152) \quad (\text{ILLIT})_{i,t} = a_i - b_i \ln (\text{GAEPED})_{i,t} - c_i \ln (\text{EDUPE})_{i,t},$$

where

$(\text{ILLIT})_{i,t}$ = illiteracy rate (proportion of persons over age six who do not read or write) in group i , in period t .

$(\text{GAEPED})_{i,t}$ = private expenditures on education by group i , in period t ,

$(\text{EDUPE})_{i,t}$ = government expenditures on education for group i , in period t .

The estimated equation for the country is

$$(152.a) \quad (\text{ILLIT})_t = \frac{42.0065}{(4.9753)} - \frac{2.7623^*}{1.3638} \ln (\text{GAEPED})_t - \frac{1.94638^*}{(.8067)} \ln (\text{EDUPE})_t$$

$$R^2 = .9989 \quad D-W = 1.451 \quad \text{Obs} = 24$$

(See table A-23 of appendix for data and sources).

b. Complete Primary

$$(153) \quad (\text{PRIMAC})_{i,t} = a_i + b_i (\text{GAEPED})_{i,t} + c_i (\text{EDUPE})_{i,t},$$

The estimated equation for the country is

$$(\text{SECUNC})_t = 3.0124 + .04391^* (\text{GAEPED})_t + .0002^{**} (\text{EDUPE})_t \\ (.1700) \quad (.0188) \quad .00005$$

$$R^2 = .9989 \quad D-W = 1.0849 \quad \text{Obs} = 24$$

(See table A-23 of appendix for data and sources).

d. Students per Teacher Ratio

$$(155) \quad (\text{A/T})_{i,t} = a_i - b_i (\text{GAEPED})_{i,t} - c_i (\text{EDUPE})_{i,t},$$

where

$(\text{A/T})_{i,t}$ = students per teacher ratio in primary school for group i , in period t .

The estimated equation for the country is

$$(155.a) \quad (\text{A/T})_t = 39.6101 - .196823^* (\text{GAEPED})_t - .0008 (\text{EDUPE})_t \\ (.4414) \quad (.905) \quad (.0002)$$

$$R^2 = .9943 \quad D-W = 1.0147 \quad \text{Obs} = 11$$

(See table A-23 of appendix for data and sources).

Disposable income, private expenditures on food, health, housing, and education by social group are supplied by the income-consumption distribution subsystem. Public expenditures on health, education and housing are derived by means of government budget distributional coefficients. (See table A-24 for initial values of these coefficients).

This subsystem provides indicators of education, and life expectancy to the demographic subsystem, and of education, health, nutrition and housing to the economic subsystem to determine labor productivity.

The subsystem produces a matrix of indicators of the level of satisfaction of education, health, nutrition and housing for each one of the social groups, as well, as aggregates for the rural and urban areas, and the country.

5. Power and Bargaining

Two options are included in the model concerning power and bargaining among different social groups: a) no bargaining, and therefore constant power for each one of the social groups through time, and b) government expenditures on health and education allocated among social groups as a

function of the relative power of the group. The power index for each group is defined as

$$(156) \quad (\text{POWER})_{i,t} = \frac{(\text{YP})_{i,t}}{(\text{YP})_t}$$

where

$(\text{YP})_{i,t}$ = per capita disposable income of group i ,
in period t , and

$$(\text{YP})_t = \sum_{i=1}^7 (\text{YP})_{i,t}$$

Coefficients defining group participation in government expenditures on health and education are modified in the next period if the relative power changes so that those groups gaining power have a greater share and those loosing it have a smaller share in the next period.

REFERENCES-CHAPTER III

1. The symbols \ln , EXP, and t , will be used throughout this chapter to note natural log, exponent, and time period, respectively. The letter k will be used to note age.

2. ** = Coefficient significant at the 1% level,
* = Coefficient significant at the 5% level,
() = Standard error of the coefficient.

This notation will be maintained through the chapter.

3. Lack of disaggregation in mortality information precluded the estimation of survival rates for the urban and rural areas separately.

4. The initial value of this ratio is 1.5. The rural-urban fertility differential can be modified by changing the value of R in equation (8).

5. This specification follows Todaro's model of rural to urban migration. See Michael Todaro, "A Model of Labour Migration and Urban Unemployment in Less Developed Countries", American Economic Review, 55, 1, (1969). Unemployment effects are captured in this equation through the use of urban and rural populations in expression (14).
6. The method used is described in René Wery, "Bachue Modules: Population, Household Income and Labour Market." World Employment Programme Working Paper 84, January, 1980.
7. The initial value of this ratio is 1.042.
8. An initial value of .75 is used in the model based on 1973 Census information.
9. The letter j will be used in the model to note sector of the economy.
10. The initial value of this proportion is .12. It can be modified in the model to simulate alternative shares of foreign capital in overall investment in the country.
11. For a lengthy discussion of the methodology used for the construction of this input-output table see: Evaristo Arrieta, Jorge Centenario, Heli Cedano, "Cuentas Nacio-

cionales e Insumo- Producto: Una Aplicación para Colombia'; Revista de Planeación y Desarrollo, 6,1, Jan - June, 1975, pp. 101-123.

12. See Jaime de Melo, "A Multi-Sector, Price Endogenous Trade Model Applied to Colombia". Ph.D. dissertation, John Hopkins University, 1975, for a discussion of the properties and estimation methodology of these production functions for Colombia.
13. These coefficients were estimated by Hector Correa in his works: "Sources of Economic Growth in Latin America". Southern Economic Journal, 37,1, July, 1970, and Population, Health, Nutrition, and Development, Lexington, Mass: Lexington Books, 1975, table 4.2, pp.48-49. Coefficient values for Colombia are: .0641 for nutrition, 0.038 for health, .0413 for education, and .0449 for housing.
14. Inventories are defined as the amount of excess supply in a given sector. Increases in inventories imply reduction in investment in the given sector in the next period of projection. Accumulated inventories are used to meet unsatisfied demands in case supply falls short of demand requirements.

15. The letter *i* will be used in the model to note social groups.
16. Labour income received by each social group affects wages in the model, but wages are considered more a result of the production process and, therefore, do not feedback into labour payments.
17. See Irma Adelman and Sherman Robinson, Income Distribution in Developing Countries: A Case Study of Korea, Stanford, Stanford Univ. Press, 1978, for a methodology to obtain income distribution at the household level. For reasons explained before, this model only obtains income distribution by social group. However, it is sufficient given the purposes of the model.
18. A discussion of income distribution measures can be found in Jan Tinbergen, Income Distribution Analysis and Policies. North Holland Publishing Company, 1975.
19. See A. Brown and A. Deaton: "Models of Consumer Behavior: A Survey". Economic Journal, December, 1972, for a review of the literature on consumption functions, and the role of demographic variables in them.

20. An income constraint is not imposed on the consumption system. Therefore, an assumption of intertemporal borrowing is implicit here.

21. For a discussion of the basic needs approach to development planning in Latinoamerica see: PREALC, Empleo, Distribución de Ingreso y Necesidades Básicas en América Latina, presented to a Seminar on Basic Needs Planning, Bogotá, March, 1979, and Jorge Graciarena, "La Estrategia de las Necesidades Básicas como Alternativa, Sus Posibilidades en el Contexto Latinoamericano". Revista de la Cepal, Agosto, 1979.

22. Equations for each social group are obtained using S. Reutlinger and M. Solowsky's method in Malnutrition and Poverty: Magnitude and Policy Options. World Bank Oc. Paper 23, Baltimore, 1976. This method leaves the slopes unchanged but modifies the constant term in such a way that the weighted average (using the proportion of population in each group as weights) of values for each social group equals the overall value for the country. This method is used in all equations in this subsystem except for beds, physicians, and square meters.

CHAPTER IV

EXPERIMENTING WITH THE MODEL

A. MODEL VALIDATION

The model was validated against medium and long run trends of the Colombian economy. Growth rates for the main economic aggregates as well as the population obtained from national accounts, and a population survey made in 1978 were compared with those given by the model for the period 1970-1977. On the other hand, growth rates for the same variables for the period 1950-1975 were compared with those obtained using the reference run of the model for the period 1970(71) to 1999(2000). Results are shown in table 4.1. The model tracks the long run trend of most of the economic aggregates fairly well, for example, G.N.P. for the country and for sectors, national income, and the components of final demand. Eventhough the overall rate of investment approximates the long run trend, rates for specific savings components deviate more from historical trends because of the instability of these aggregates through time, as shown by a comparison of long and medium term historical trends in table 4.1. Population shows a declining rate through time in the last fifteen years, and this trend is expected to continue in the future due to fertility decline. For this reason, among others,

T A B L E 4.1

COLOMBIA 2000 MODEL VALIDATION-GROWTH RATES (%)

	<u>Historical Trends</u>		<u>Model Reference Run¹</u>	
	1950-1975 ^a	1970-1977 ^b	1970(71)- 1979(80)	1970(71)- 1999(2000)
G.N.P. (Country)	5.2	6.0	6.2	5.2
G.N.P. (Agriculture)	3.6	4.2	5.2	3.9
G.N.P. (Industry)	6.4	7.0	7.3	5.8
G.N.P. (Services)	5.8	7.4	7.3	5.8
Private Consumption	5.6	6.0	6.3	5.1
Total Investment	3.6	3.9	3.0	3.1
Government Expenditures	2.3	5.0	6.8	5.4
Total Exports	1.5	2.2	2.4	1.9
Total Imports	3.2	3.5	4.4	3.4
National Income	5.2	7.1	6.4	5.1
Final Use Supply (GNP+Imports)	5.0	5.1	6.0	5.1
Urban Population (51-73)	5.4	3.5(73-78) ^c	3.3	2.6
Total Population (51-73)	3.4	2.2(73-78) ^c	2.3	2.0
Per Capita Income	2.1	3.4	4.0	3.0
Household Savings	3.2	10.5(70-74)	5.0	5.0
Corporate Savings	8.0	3.1	2.6	2.7
Government Savings	2.0	.3	3.5	3.3
External Savings	10.0	10.4	3.0	3.1
Illiteracy Rate	-2.7	-5.7	-4.0	-5.1
Infant Mortality Rate	-3.2	-2.7	-3.3	-2.4
Life Expectancy At Birth	1.5	.8(70-76)	.9	.6
Unemployment Rate	.4(64-75)	-1.7	-4.8	-1.4

Table 4.1(Cont.)

Sources: a. D.N.P. "La Economía Colombiana 1950-1975." Revista de Planeación y Desarrollo
Vol. IX, # 3, October - Dec, 1977. Several Tables.

¹Reference Run. Forced equilibrium on product markets. See page 95 for definition.

b. Banco de la República. Cuentas Nacionales de Colombia 1970-1978.

c. DANE. Encuesta Nacional de Hogares. Resultados Demográficos, June, 1978.

per capita income is expected to grow at a higher rate in the period 1970-1999.

A second validation test was made to the model by comparing actual values for the year (1978(77)) with model generated results for the same years. Results are shown in table 4.2. Again, for most economic aggregates deviations from the actual value are within the $\pm 5\%$ mark. Exceptions are the values for exports, imports, and government expenditures. However, these were expected to deviate more since the Colombian economy was affected by a coffee boom during the period 1976-80, which made the external sector and government expenditures values atypical for these years when compared with the long run trend. Values for population and some welfare indicators are also well generated by the model. It is not easy to track the unemployment rate given the unstable nature of the labour market in Colombia. However, the overall trend of unemployment is constant, i.e., the rate of unemployment in year 2000 is unlikely to be much different from that of the seventies. A recent study¹ of employment in Colombia confirms this, although the study notes that underemployment is a far more serious problem than open unemployment. The study concludes that neither population growth nor migration from rural to urban areas are the main nor even important causes of high levels

T A B L E 4.2

COLOMBIA 2000 - MODEL VALIDATION - BASE YEAR = 1970

	<u>Year</u>	<u>Actual Value</u>	<u>Model Value</u> ¹	<u>Deviation</u>	<u>%Deviation</u>
G.N.P. (Country) ²	(1978)	209236*	214006	+ 4770	+ .02
G.N.P. (Agriculture) ²	(1978)	48055*	50128	+ 2073	+ .04
G.N.P. (Industry) ²	(1978)	36182*	38024	+ 1802	+ .05
G.N.P. (Services) ²	(1978)	50400*	47553	- 2847	- .05
Private Consumption ²	(1978)	156324*	153906	- 2418	- .01
Total Investment ²	(1978)	37907*	38356	+ 449	+ .01
Government Expenditures ²	(1977)	15043*	19679	4636	+ .30
Total Exports ²	(1977)	21582*	20259	- 1323	- .06
Total Imports ²	(1978)	26202*	21166	- 5036	- .19
National Income ²	(1978)	183532*	187958	+ 4426	+ .02
Total Population ³	(1978)	25104217	25519611	+ 415394	+ .01
Urban Population ³	(1978)	16058021	16715577	+ 657556	+ .04
Illiteracy Rate (Country) ⁴	(1973)	18.2	19.7	+ 1.5	+ .08
Per Capita Calories/Day (Country) ⁵	(1973)	2141	2110	- 31	- .00
Infant Mortality Rate (Country) ⁶	(1973)	64.6	76.4	+ 11.8	+ .18
Gini Coefficient ⁷	(1974)	47.0	47.3	+ .3	.00
% Houses With Electricity ⁷	(1974)	63.2	67.4	+ 4.2	+ .06
% Houses With Water ⁷	(1974)	63.2	67.4	+ 4.2	+ .06
Unemployment Rate ⁸ (Country)	(1980)	9.2	9.6	+ .4	+ .04

1. Reference Run. Equilibrium in Product Markets. Historical Trends in All Values and Parameters.

* Millions of Colombian pesos of 1970.

Table 4.1. (Cont.)

Souces:

2. Banco de la República. Cuentas Nacionales de Colombia 1970-1978.
3. DANE. Encuesta Nacional de Hogares. Resultados Demográficos, June, 1978
4. CEPAL. "Proyecto de Estratificación y Movilidad Social en América Latina"
Basic Tables, August, 1977.
5. D.N.P. "La Economía Colombiana 1950-1975". Revista de Planeación y Desarrollo,
Vol. IX, #3, October - December, 1977. Table 2.14.
6. Idem, op. cit., Table 2.11.
7. Selowsky, Marcelo. Who Benefits from Government Expenditure? A Case
Study of Colombia, World Bank, 1979.
8. DANE. Resumen Estadístico 1980. Occasional Publication, 1981.

of un-and underemployment. Rather that the composition of exports, and the highly unequal distribution of land tend to reinforce each other to the extent that labor can not be absorbed without substantial structural changes in these two variables.

In spite of the non- predicting purpose of Colombia 2000, based on the above comparisons it can be stated that, in its main components, the model resembles the structure of the Colombian society enough to make conclusions derived from the analysis trustable.

B. REFERENCE RUN

A reference run was made with the model under the assumption of a demand led equilibrium economy, historical trends in all variables and parameters, and public finances and balance of payments in disequilibrium. Although it is recognized that this scenario corresponds to an ideal situation, it serves the purpose of being the basis for comparison of results obtained under disequilibrium situations which might be more likely to occur.

The main results obtained in the reference run are extracted in table 4.3. G.N.P. shows a moderate rate of growth during the overall projection period though it is higher in the 1970-80 decade. The model shows higher rates

T A B L E 4.3

COLOMBIA 2000. REFERENCE RUN, SCENARIO 1: DEMAND LED EQUILIBRIUM ECONOMY,
HISTORICAL TRENDS IN ALL VALUES AND PARAMETERS. (PUBLIC FINANCES AND
BALANCE OF PAYMENTS IN DISEQUILIBRIUM).

<u>SUBSYSTEM</u>	<u>VARIABLES</u>	1970/71	1979/80	1999/2000	ANNUAL GEOMETRIC RATE OF GROWTH(%)	
					1970(71) - 1979(80)	1970(71) - 1999(2000)
<u>ECONOMIC</u> (Millions of Colombian pesos of 1970)						
	G.N.P. (Country)	131824.7	226225.8	554061.6	6.2	5.1
	G.N.P. (Urban)	96117.7	169125.1	443016.0	6.5	5.4
	G.N.P. (Rural)	35707.1	57090.7	111045.6	5.3	4.0
	G.N.P. (Agriculture)	33163.8	52191.8	47812.3	5.2	3.8
	G.N.P. (Industry)	21366.9	40447.8	105948.5	7.3	5.7
	G.N.P. (Services)	26672.4	50490.3	132246.9	7.3	5.7
	Total Supply = Total Demand	222721.0	361123.8	828883.0	4.5	4.6
	Final Demand	133107.4	214975.4	491898.2	5.5	4.6
	Total Investment	30225.3	39579.5	73721.4	3.0	3.1
	Government Savings	6780.2	9201.8	17618.2	3.4	3.3
	Corporate Savings	17964.8	22659.4	38976.0	2.6	2.7
	External Savings	3238.0	4240.0	7898.0	3.0	3.1
	Government Expenditures	12284.0	22238.8	56838.4	6.8	5.4
	Exports	17106.8	21160.4	30168.4	2.4	1.9
	Imports	14923.6	22011.2	39159.5	4.4	3.4
	Capital Payments	67621.2	116248.5	276071.7	6.2	5.0
	Labour Payments	53817.2	95483.1	238379.4	6.6	5.3
	Capital Stock	341976.3	616103.1	1528786.3	6.5	5.3

Table 4.3 (Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLES</u>	1970/71	1979/80	1999/2000	ANNUAL GEOMETRIC RATE OF GROWTH(%)	
					1970(71)- 1979(80)	1970/(71) - 1999/(2000)
	Def-Sup. Current Account	5229.4	11253.4	62352.2	8.9	8.9
	Def-Sup. Balance of Payments	0.0	-6557.6	-29699.2	-	-
	National Income	120473.9	210213.9	511606.9	6.4	5.1
<u>INCOME DISTRIBUTION</u>						
	<u>Gini Index Before Taxes</u>					
	Capital Income	61.1	57.9	56.3	- .6	-.3
	Labour Income	38.7	34.4	30.8	- 1.3	-.8
	Total Income	51.1	47.2	44.4	- .8	-.5
	Gini Index After Taxes	49.6	45.6	42.8	- .9	-.5
	<u>Per Capita Income After Taxes</u>					
	Country	4854.0	6919.9	11583.2	4.0	3.0
	Urban	6152.6	8130.5	12843.3	3.1	2.6
	Rural	2884.5	4532.3	83005.5	5.2	3.7
	Income Taxes	16837.1	29443.7	72056.6	6.4	5.1
<u>CONSUMPTION</u>						
	Household Consumption	98829.0	172058.0	417771.0	6.3	5.1
	Household Savings	2242.2	3478.4	9229.2	5.0	5.0
<u>ESSENTIAL HUMAN NEEDS</u>						
	<u>Illiteracy Rate(%)</u>					
	Country	21.0	14.8	5.0	- 3.8	- 4.8
	Urban	15.0	9.7	.8	- 4.7	- 9.6
	Rural	39.3	31.8	20.5	- 2.3	- 2.2

Table 4.3(Cont.)

<u>ESSENTIAL HUMAN NEEDS(Cont.)</u>	YEAR			ANNUAL GEOMETRIC RATE OF GROWTH(%)	
	1970/71	1979/80	1999/2000	1970(71) - 1979(80)	1970(71) - 1999(2000)
<u>Illiteracy Rate(%)</u>					
Urban Wage Earners	32.1	26.7	17.5	- 2.0	- 2.0
Rural Wage Earners	46.6	38.9	27.2	- 2.0	- 1.8
<u>Per Capita Daily Calories</u>					
Country	2049	2318	2746	1.4	1.0
Urban	2117	2351	2757	1.2	.9
Rural	1907	2230	2704	1.7	1.2
Urban Wage Earners	1919	2168	2593	1.4	1.0
Rural Wage Earners	1555	1897	2404	2.2	1.5
<u>Infant Mortality Rate(%)</u>					
Country	82.0	61.1	41.3	- 3.2	- 2.3
Urban	55.2	41.8	26.4	- 3.0	- 2.5
Rural	119.8	76.3	42.9	- 4.9	- 3.5
Urban Wage Earners	119.6	88.0	53.7	- 3.3	- 2.7
Rural Wage Earners	235.9	143.7	74.3	- 5.3	- 3.9
<u>Female Life Expectancy At Birth</u>					
Country	59.2	64.2	71.5	.9	.6
Urban	63.8	67.7	74.2	.7	.5
Rural	53.9	60.3	68.8	1.2	.8
Urban Wage Earners	56.8	61.1	68.1	.8	.6
Rural Wage Earners	50.0	55.1	64.4	1.1	.9

Table 4.3(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLES</u>	YEAR			ANNUAL GEOMETRIC RATE OF GROWTH(%)	
		1970/71	1979/80	1999/2000	1970(71)- 1979(80)	1970(71)- 1999(2000)
	<u>Per Capita Sq. Meters of Housing</u>					
	Country	6.6	7.2	9.1	1.0	1.1
	Urban	7.8	7.8	9.0	.0	.5
	Rural	4.7	6.0	9.3	2.7	2.4
	Urban Wage Earners	6.1	6.1	7.1	.0	.5
	Rural Wage Earners	4.4	5.7	8.7	2.9	2.4
	<u>Hospital Beds Per 1000 Inhabit.</u>					
	Country	2.0	1.8	1.4	-1.2	-1.2
	<u>Rate of Labour Productivity</u>					
	Urban	.009	.034	.071	2.8	2.1
	Rural	.009	.053	.120	4.9	3.8
	<u>DEMOGRAPHIC</u>					
	Total Fertility Rate	5.7	4.7	2.0	-2.2	-3.5
	Rural-Urban Migration Rate(%)	2.3	1.8	1.3	-2.8	-2.0
	Fem. Labour Force Part. Rate(%)	19.5	22.6	38.1	1.6	2.3
	Dependency Rate	97.7	78.4	48.2	-2.4	-2.4
	<u>Population (Thousands)</u>					
	Country	21787	26739	38302	2.3	2.0
	Urban	13304	17761	27770	3.3	2.6
	Rural	8483	8978	10532	.6	.7
	% Urban	61.0	66.4	72.5	.9	.6

Table 4.3(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLES</u>	YEAR			ANNUAL GEOMETRIC RATE OF GROWTH(%)	
		1970/1971	1979/80	1999/2000	1970(71) - 1979(80)	1970(71) - 1999(2000)
<u>EMPLOYMENT</u>						
	Total Labour Supply(Thousands)	6775	10977	25582	5.5	4.7
	Total Labour Demand(Thousands)	5780	9925	22780	6.2	4.8
	<u>Unemployment Rate</u>					
	Country	14.7	9.6	9.9	- 4.6	- 1.3
	Urban	19.8	12.8	11.7	- 4.7	- 1.8
	Rural	.8	.5	3.6	- 4.6	5.3
	<u>Average Real Wage</u>					
	Urban Skilled	35263	36458	39231	.3	.4
	Urban Unskilled	7408	7517	8089	.2	.3
	Rural Skilled	19910	20805	21852	.5	.3
	Rural Unskilled	6230	6384	6547	.1	.2

of growth for industry and services than for agriculture. This result is consistent with policies designed to protect industry which have prevented higher rates of development of the agricultural sector. On the hand, high rates of growth of services are the result of the inability of the industry sector to absorb a growing labor force in the urban sector caused by high rates of migration in the last three decades, among other factors.

Investment in the model shows a moderate rate of growth during the projection period, and external savings tend to grow at the same rate than any of the sources of internal savings.

Income concentration shows a slight tendency to decline during the projection period. Studies made by Urrutia^{2,3} also predict an improvement in income distribution in the coming years. However, the present income tax structure do not seem to contribute to income redistribution as measured by a Gini index after taxes. The value of this index is 44.4 before taxes against 42.8 after taxes in year 2000.

Per capita income grows faster in the rural than in the urban area. The reason for this result is the gradual displacement of people from rural to urban areas, in spite of a declining migration rate during the period. Higher rates of growth of industry and services are more than compensated by the arrival of migrants to the urban centers.

Illiteracy rates show a decline in all groups, but it is considerably higher for the urban groups. Low income groups show the smallest rates of decline, reinforcing the existing gap between them and the rest of the society.

Per capita daily calories increase for all groups, but the rural sector shows a higher increase than the urban one. Again, rural to urban migration is responsible for this result. Interesting to note that if present trends continue all groups in the Colombian society will be above the minimum requirement of 2000 per capita daily calories⁴. These result contrasts with those obtained for the illiteracy rate which still will be around twenty percent for low income groups in urban centers and in the rural area, if present trends continue through the future.

Infant mortality rates decline substantially. However, the rate for the rural sector, specially for wage earners, will still be very high by year 2000. The gap between wage earners and the rest of the society tend to decrease during the projection period when historical trends are used to project these indicators to year 2000. Female life expectancy at birth shows a higher rate of growth in the rural sector, and for rural wage earners, thus reducing the existing gap between the urban and the rural sector, and between low income groups and the rest.

Hospital beds show a declining trend through time. In fact, the number of hospital beds per 1000 inhabitants has been declining since 1965, in spite of the decline in the rate of growth of population.⁵ Eventhough this does not always imply a worsening of health conditions of the population, since a good system of community health services could reduce the demand for hospital beds, the number for Colombia is very low when compared with the situation in developed or other developing countries.⁶

Per capita square meters of housing show higher rates of growth in the rural area than in the urban one. Again, rural to urban migration is responsible for this result. Urban wage earners will have the lowest housing space per person by year 2000 if present investment and migration trends continue.

Labour productivity will grow at rates close to historical trends. The overall rate of growth of labour productivity was 2.2% for the period 1951-64 and 4.6% for the 1964-73 period. Historical trends also show a higher rate of growth of labour productivity in the rural than in the urban sector in the period 1964-73 (8.0% vs. 5.7%)⁷.

The total fertility rate shows a declining pattern during the overall projection period. Fertility rates have been declining in Colombia since 1965 and they are expected to continue to decline in the future but at a decreasing rate

of decline. As a result of fertility decline the dependency rate will also drop substantially during the period to an estimated 48.2 figure in year 2000.

Rural to urban migration rates are also expected to decline in the coming years since urbanization rates are approaching saturation levels. With a 50% decline in the rural to urban migration rate during the period 1975-2000 the model shows that 72.6% of the total population will be living in the urban area by the year 2000.

As a result of fertility decline, population growth rates also show a declining trend through the period. If the declining pattern continues the total population of the country will be around the 38 million figure, which is substantially lower than the 46 million population obtained under the assumption of a 3.4% annual rate of growth.⁸

Unemployment rates show a declining pattern, during the first ten years of the projection in spite of the increase in women's labour force participation rates during the period. However, the rate remains almost constant around 9% for the rest of the projection period. The reason is the reduction in labour demand due to increases in labour productivity.

Real salaries are expected to rise as a result of reductions in the labour supply, and increases in labour productivity.

C. EXPERIMENTS

1. Experimental Design

Since the main purpose of the work is to test the relative efficiency of external vs. internal policies in meeting essential human needs of the Colombian population, the experimental setting designed here reflects this purpose. Therefore, the model has two basic scenarios, i.e., open vs. closed economy.

When the open economy scenario is at work the economy is assumed to work in disequilibrium. Any excess supply in trade sectors (agriculture, mining, and industry) is exported on top of the historical exports trend. On the other hand, any excess supply in the non-trade sectors (services) is handled through inventory management, but investment allocation is reduced in the next period so that the model lurches towards equilibrium in the long run. Any excess demand under this scenario is assumed to be imported, and investment is increased in the next period so that equilibrium can be restored in the long run. Experiment ~~one-zero~~ consists of running the model under this scenario without change in variables or parameters to observe the impact of opening the economy on levels of all variables in the model, but specifically on essential human needs indicators.

When the closed economy scenario is at work the economy is assumed to work also in disequilibrium but any excess supply in all sectors of the economy is handle through inventory management, and investment allocation is reduced in the next period,so as to adjust the model to equilibrium in the long run. Any excess demand in the model is assumed to be imported in the short run, but investment is increased in the next period in those sectors having excess demand with the purpose of increasing production, and have the model lurching towards equilibrium in the long run.

Experiment ~~two-zero~~ consists on running the model under this scenario without change in variables or parameters to observe the impact of closing the economy on levels of all variables in the model, especially in essential human needs indicators.

The rest of the experiments are designed to show the combined effect of opening or closing the economy (a change in scenario) plus a change in variables or parameters representing changes in internal policies or strategies. The specific policies used are changes in income taxes, government expenditures, investment allocation, technology, labour productivity, group share in government expenditures, and bargaining power. A description of experiments follows.

a) Tax Reform (Expt. 1)

This policy is simulated in the model by increasing capital income taxes of higher income groups while reducing labour income taxes of wage earners in urban and rural areas. Table 4.4. shows the magnitude of these changes.

Table 4.4.

EXPERIMENT ONE: CHANGES IN CAPITAL AND LABOUR INCOME TAXES

<u>SOCIAL GROUP</u>	<u>REFERENCE RUN</u>		<u>EXPERIMENT</u>		<u>% CHANGE</u>	
	<u>CAPITAL</u>	<u>LABOUR</u>	<u>CAPITAL</u>	<u>LABOUR</u>	<u>CAPITAL</u>	<u>LABOUR</u>
1. Capitalists	.1970	.1970	.2500	.1970	+26.9	0.0
2. Professionals-Tech.	.1480	.1480	.1630	.1480	+10.3	0.0
3. Independent Workers	.1480	.1480	.1630	.1480	+10.3	0.0
4. Urban Wage Earners	.1040	.1040	.1040	.0500	0.0	-51.9
5. Latifundists	.1970	.1970	.2500	.1970	+26.9	0.0
6. Medium-Small Farmers	.1040	.1040	.1144	.1040	10.0	0.0
7. Rural Wage Earners	.1040	.1040	.1040	.0500	0.0	-51.9

b) Fiscal Policy (Expt. 2)

Fiscal policy is simulated in the model by increasing the proportion of government budget allocated to health and education expenditures, so that all groups are equally benefited from this expansion. The proportion of government

budget allocated to health expenditures increases from 14.33% in the reference run to 15.76% in the experiment (10% increase), and the proportion for education expenditures increases from 27.43 in the reference run to 29.95% in the experiment (9.2% increase). Although these changes are rather small, they are within a feasible range given the inflexibility of Colombian institutions with respect to public budget allocation.

c) Investment Allocation (Expt. 3)

Investment allocation is modified by changing the values of the vector of distributional coefficients of investment among different sectors of the economy. Since investment was allocated in the reference run proportionally to the size of capital stock in each sector (balanced growth), the experiment changes the coefficients to simulate an unbalanced growth policy which emphasizes growth in the agricultural sector and reduces growth in the services sector of the urban economy. Table 4.5 shows the old and the new investment vectors of coefficients. The coefficient for the agricultural sector is increased by 10%, while the one for the services sector is reduced by 11.87% in the experiment.

d) Technology Change (Expt. 4)

This experiment is designed for the purpose of observing the impact of a more labour intensive technology on essential human needs. This is accomplished

Table 4.5

EXPERIMENT THREE: CHANGES IN THE VECTOR OF INVESTMENT
ALLOCATION AMONG SECTORS OF THE ECONOMY.

<u>SECTOR</u>	<u>REFERENCE RUN</u>	<u>EXPERIMENT</u>	<u>% CHANGE</u>
1. Agriculture	.3112	.3423	+10.0
2. Mining	.0484	.0484	0.0
3. Food, Bev., Tobacco	.0392	.0392	0.0
4. Textiles	.0386	.0386	0.0
5. Paper, Wood, Leather	.0136	.0136	0.0
6. Rubber And Chemicals	.0295	.0295	0.0
7. Non Metallic Products	.0151	.0151	0.0
8. Metals	.0198	.0198	0.0
9. Machinery	.0090	.0090	0.0
10. Other Industry	.0101	.0101	0.0
11. Electricity, Gas, Water	.0143	.0143	0.0
12. Construction	.0722	.0722	0.0
13. Transportation	.1169	.1169	0.0
14. Services	.2621	.2310	-11.87

in the the model by reducing capital coefficients in the production functions with a compensating increase in those for unskilled labour. Therefore, more unskilled labour is allowed to be absorbed by the economy. Unskilled labour to capital ratios are increased proportionally. Table 4.6 shows the magnitude of these changes.

e) Exogenous Change in Labour Productivity (Expt. 5)

An exogenous change in the rate of growth of labour productivity is simulated in the model by increasing the coefficients of response of labour productivity to changes in levels of essential human needs by 10%. These coefficients increase from a value of .0490, .0640, .0380, and .0413 for housing, nutrition, health, and education, respectively in the reference run, to .0539, .0704, .0418, and .0454 in the experiment. The purpose of this experiment is to observe the direct effect of improvements in productivity of the labour force on total output, and other economic variables in the model.

f) Exogenous Redistribution of Government Expenditures (Expt. 6)

The way this policy is simulated in the model is by exogenously changing the share of social groups in government health and education expenditures, so as to assign a 10% additional share to urban and rural wage earners, and reducing the shares of higher income groups. Table 4.7 shows values for this experiment.

Table 4.6

EXPERIMENT FOUR: CHANGES IN CAPITAL AND LABOUR COEFFICIENTS OF PRODUCTION FUNCTIONS, AND UNSKILLED LABOUR/CAPITAL RATIO.

SECTOR	<u>CAPITAL</u>		<u>UNSKILLED LABOUR</u>		<u>UNSKILLED LABOUR/CAPITAL</u>	
	<u>REF.</u>	<u>EXP.</u>	<u>REF.</u>	<u>EXP.</u>	<u>REF.</u>	<u>EXP.</u>
1. Agriculture	.3085	.2585	.2696	.3196	.01478	.017521
2. Mining	.7401	.6901	.1922	.2422	.00360	.004536
3. Food, Bev., Tobacco	.6383	.5883	.2150	.2650	.00520	.006493
4. Textiles	.3969	.3469	.4403	.4903	.00918	.010222
5. Paper, Wood, Leather	.5198	.4698	.3052	.3552	.00656	.007634
6. Rubber And Chemicals	.5325	.4825	.2009	.2509	.00338	.004221
7. Non Metallic Products	.5617	.5117	.3198	.3698	.00829	.009586
8. Metals	.3383	.2883	.4573	.5073	.00506	.005613
9. Machinery	.4652	.4152	.3221	.3721	.00076	.000877
10. Other Industry	.5535	.5135	.3197	.3697	.01057	.012223
11. Electricity, Gas, Water	.5386	.4886	.2568	.3068	.01355	.016188
12. Construction	.1511	.1511	.6811	.6811	.02113	.021130
13. Transportation	.5668	.5168	.3054	.3554	.00195	.002269
14 Services	.4974	.4474	.2574	.3074	.02741	.033129

Table 4.7

EXPERIMENT SIX: EXOGENOUS CHANGE IN SHARES OF SOCIAL GROUPS IN GOVERNMENT HEALTH AND EDUCATION EXPENDITURES.

<u>SOCIAL GROUP</u>	<u>GOVERNMENT BUDGET SHARES</u>			
	<u>HEALTH</u>		<u>EDUCATION</u>	
	<u>REF.</u>	<u>EXP.</u>	<u>REF.</u>	<u>EXP.</u>
1. Capitalists	.0234	.0134	.0454	.0254
2. Professionals-Tech.	.2153	.1553	.2237	.1637
3. Independent Workers	.2479	.1779	.2043	.1443
4. Urban Wage Earners	.1903	.2903	.1333	.2333
5. Latifundists	.0034	.0034	.0165	.0065
6. Medium-Small Farmers	.2041	.1441	.2005	.1505
7. Rural Wage Earners	.1156	.2156	.1763	.2763

g) Endogenous Redistribution of Government Expenditures (Expt. 7)

This experiment is accomplished by allowing changes in the shares of social groups in government health and education expenditures to be a function of relative power of each group, which, in turn, is a function of per capita income of the group. In addition, a tax reform is simulated in the experiment in the direction of higher capital income and

lower labour income taxes. Tables 4.8 and 4.9 show the values obtained for the power index of each group through the projection period, and the new tax vectors, respectively.

Table 4.8

EXPERIMENT SEVEN: ENDOGENOUS CHANGE IN INDEX OF RELATIVE POWER OF SOCIAL GROUPS.

<u>SOCIAL GROUP</u>	<u>YEAR</u>					
	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>1999</u>
1. Capitalists	.4307	.4175	.4082	.4005	.3940	.3893
2. Professionals-Tech.	.1000	.0974	.0957	.0944	.0934	.0928
3. Independent Workers	.0986	.0951	.0927	.0908	.0894	.0888
4. Urban Wage Earners	.0545	.0537	.0533	.0530	.0526	.0523
5. Latifundists	.2189	.2339	.2446	.2534	.2609	.2660
6. Medium-Small Farmers	.0661	.0694	.0713	.0727	.0737	.0743
7. Rural Wage Earners	.0309	.0327	.0333	.0348	.0357	.0364

SOURCE : Colombia 2000. Computer Printout.

Table 4.9

EXPERIMENT SEVEN: CHANGES IN CAPITAL AND LABOUR INCOME TAXES

<u>SOCIAL GROUP</u>	<u>REFERENCE RUN</u>		<u>EXPERIMENT</u>	
	<u>CAPITAL</u>	<u>LABOUR</u>	<u>CAPITAL</u>	<u>LABOUR</u>
1. Capitalists	.1970	.1970	.5000	.2500
2. Professionals-Tech.	.1480	.1480	.3000	.2000
3. Independent Workers	.1480	.1480	.3000	.1500
4. Urban Wage Earners	.1040	.1040	.1040	.0100
5. Latifundists	.1970	.1970	.5000	.2500
6. Medium-Small Farmers	.1040	.1040	.2500	.1500
7. Rural Wage Earners	.1040	.1040	.1040	.0100

h) An Essential Human Needs Strategy (Expt. 8)

The last experiment combines human needs oriented policies to simulate an overall strategy. This strategy is composed of a tax reform (experiment a), plus an increase in government budget allocation to health and education expenditures (experiment b), plus an exogenous redistribution of government health and education expenditures among social groups (experiment f). It is expected that the combined impact of these three policies would be substantially higher than the impact of each one taken separately. A discussion of results follows.

2. Results Discussion (See tables 4.10 and 4.11)

a. Open vs. Closed Economy (Exps. 1-0, 2-0).

Under both scenarios, open and closed, the economy grows less faster than in the reference run.

These results are expected since the reference run is an unconstrained case, while in the open economy growth is constrained by excess demand in those sectors not having international trade, and in all sectors in the closed economy case. The interesting result is the similarity of results of the open economy case, as compared with those in the reference run, for most economic aggregates. It seems that investment reallocation in the case of a closed economy seriously affects growth, since investment has to be allocated to less dynamic sectors to restore equilibrium in the final product markets.

Income distribution remains the same when the economy is open, and improves when it is closed. This result is due to the fact that the agricultural sector presents higher rates of growth in the close economy than in the open one, and low income groups in the rural sectors are benefited.

The conclusion derived from these results is that the economy seems to perform better in terms of growth, but worse in

TABLE 4.10

COLOMBIA 2000: RELATIVE CHANGES IN VARIABLES BY YEAR 2000 AS COMPARED WITH THEIR VALUES IN THE REFERENCE RUN, USING SCENARIO 1: DISEQUILIBRIUM OPEN ECONOMY.

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	EXPERIMENT (See description at end of Table).								
		<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>ECONOMY</u>										
	G.N.P. (Country)	-2.4	-2.5	-2.2	-4.5	-2.6	-1.1	-2.4	-3.1	-2.3
	G.N.P. (Urban)	-3.1	-3.2	-2.9	-6.2	-28.0	-2.1	-3.1	-4.1	-3.0
	G.N.P. (Rural)	.2	.3	.5	2.2	-22.4	-2.6	.4	.8	.6
	Total Supply	11.6	15.1	15.4	12.2	14.2	16.4	15.4	14.5	15.4
	Total Demand	-1.1	-1.3	-1.0	-3.0	-22.5	-.3	-1.1	-9.2	-1.1
	Final Demand	-1.0	-1.2	-.9	-2.8	-22.7	-.1	-1.0	-1.4	-1.0
	Total Investment	-1.6	-1.6	-1.4	-3.0	-17.7	-1.0	-1.6	-1.9	-1.5
	Government Savings	-5.7	-5.7	-5.5	-7.5	-26.5	-4.9	-5.7	-2.4	-5.6
	Corporate Savings	-3.6	-3.6	-3.4	-5.0	-20.2	-2.9	-3.6	-2.1	-3.5
	External Savings	-4.9	-4.9	-4.8	-6.2	-20.5	-4.3	-4.9	-1.9	-4.8
	Government Expenditures	-2.4	-2.5	-2.2	-4.5	-26.9	-1.4	-2.4	-3.1	-2.3
	Exports	501.0	503.0	503.0	466.0	284.0	507.0	291.0	600.4	504.0
	Imports	71.5	71.0	71.0	62.0	43.0	72.0	71.0	70.0	71.0
	Capital Payments	2.3	2.2	2.5	.6	-29.5	3.4	2.3	1.3	2.5
	Labour Payments	-4.4	-4.5	-4.2	-6.8	-19.5	-3.4	4.5	-5.6	-4.3
	Capital Stock	-.3	-.3	-.3	-.9	-10.5	-.1	.3	-.4	-.3
	Def-Sup. Current Account	282.0	399.0	282.0	256.0	248.0	283.0	281.0	1282.8	399.0
	Def-Sup. Balance of Payments	-5.9	-6.0	-5.9	-6.6	-16.8	-5.7	-5.9	.9	-5.9

Table 4.10 (Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>INCOME DISTRIBUTION</u>										
	<u>Gini Index Before Taxes</u>									
	Capital Income	0.0	0.0	.2	-1.0	-2.3	0.0	0.0	0.0	.2
	Labour Income	-2.9	-2.9	-2.6	-4.2	-6.8	-3.2	-2.9	-3.9	-2.6
	Total Income	0.0	0.0	0.2	-1.1	-6.2	0.0	0.0	.2	.1
	Gini Index After Taxes	.2	-2.3	.5	-.9	-6.0	-2.3	.2	-10.3	-2.1
	<u>Per Capita Income After Taxes</u>									
	Country	-1.2	-1.7	.9	-3.9	-31.4	.1	-1.2	-14.6	.4
	Urban	-1.1	-1.8	1.2	-4.4	-32.5	.2	-1.1	-15.5	.4
	Rural	-1.7	-1.2	0.0	-2.2	-27.5	.3	-1.7	-11.0	.6
	Income Taxes	-1.5	.8	-.5	-2.9	-25.4	.3	-.8	61.4	1.0
<u>CONSUMPTION</u>										
	Household Consumption	-.8	-1.1	-.6	-2.8	-24.6	.2	-.8	-12.0	-.9
	Household Savings	-.8	-1.1	-.6	-2.8	-24.6	.2	-.8	-12.0	-.9
<u>ESSENTIAL HUMAN NEEDS</u>										
	<u>Illiteracy Rate</u>									
	Country	2.0	2.0	-8.3	6.2	66.6	0.0	2.0	20.4	-8.3
	Urban	-22.0	-17.0	-73.0	4.0	290.0	-33.0	2.0	129.5	-27.0
	Rural	1.0	1.0	-1.0	1.4	13.8	.5	-1.4	2.9	-3.9
	Urban Wage Earners	1.1	-1.1	-1.7	2.8	15.6	.6	-15.0	-3.4	-19.6
	Rural Wage Earners	1.8	.7	.4	2.6	9.6	1.4	-6.3	3.3	-9.2

Table 4.10(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>ESSENTIAL HUMAN NEEDS (Cont.)</u>										
<u>Per Capita Daily Calories</u>										
	Country	- .5	- .5	- .5	- .9	-5.2	- .3	- .5	-2.0	- .5
	Urban	- .5	- .1	- .1	- .6	-5.2	0.0	- .3	-2.2	- .1
	Rural	1.9	2.1	1.9	1.9	-1.8	2.1	1.9	-1.4	2.1
	Urban Wage Earners	- .2	.9	-2.8	- .8	-3.6	0.0	- .3	1.3	1.0
	Rural Wage Earners	-1.2	- .1	-1.3	-1.4	-3.8	-1.0	-1.2	.8	- .1
<u>Infant Mortality Rate</u>										
	Country	4.8	6.4	3.7	15.5	145.0	- .5	4.8	12.1	-1.6
	Urban	0.0	0.0	0.0	0.0	152.0	0.0	0.0	18.6	0.0
	Rural	2.5	1.7	0.0	3.2	44.9	.4	2.5	11.9	-.8
	Urban Wage Earners	5.6	-17.0	-3.9	21.5	118.0	.6	5.6	-4.7	-26.7
	Rural Wage Earners	3.7	.6	2.7	4.6	16.2	2.8	3.7	-1.4	-.5
<u>Female Life Expectancy</u>										
	Country	- .3	- .3	- .3	- .8	- .7	0.0	- .3	-2.8	.1
	Urban	-.3	- .4	.3	- .9	-7.0	0.0	- .4	-2.9	0.0
	Rural	- .4	- .3	0.0	- .4	-6.3	-.1	- .3	-2.2	.3
	Urban Wage Earners	- .4	.7	.1	-1.1	-5.8	-.1	.1	-.7	1.7
	Rural Wage Earners	-1.3	- .3	-.9	-1.6	-6.0	-1.0	- .6	-.5	.9
<u>Per Capita Sq. Meters of Housing</u>										
	Country	-.8	-1.5	1.5	-2.3	-25.0	0.0	-.88	12.1	.8

Table 4.10 (Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>ESSENTIAL HUMAN NEEDS(Cont.) (Cont.)</u>										
<u>Per Capita Sq. Meters of Housing (Cont.)</u>										
	Country	- .8	-1.5	1.5	-2.3	-25.0	-0.0	- .8	-12.0	.8
	Urban	- .8	-1.5	1.5	-2.3	-25.0	-0.0	- .8	-12.2	.8
	Rural	-1.5	-2.2	0.0	-3.0	-24.0	- .8	-1.5	-11.8	- .8
	Urban Wage Earners	-1.0	-1.0	1.0	-3.0	-25.5	0.0	-1.0	-12.7	1.0
	Rural Wage Earners	- .8	-1.6	.8	-2.4	-23.0	0.0	- .8	- 7.2	0.0
<u>Hospital Beds Per 1000 In Hab.</u>										
	Country	-7.1	-7.1	0.0	-7.1	-14.2	-7.1	-7.1	0.0	0.0
<u>Rate of Labour Productivity</u>										
	Urban	-1.1	-1.1	1.1	-3.4	-23.8	7.9	-1.1	-9.8	0.0
	Rural	- .7	-1.4	.7	- 2.1	-14.5	8.0	0.0	-5.0	1.4
<u>DEMOGRAPHIC</u>										
	Total Fertility Rate	6.7	8.7	- 12.7	17.4	112.0	1.3	6.7	22.7-10.7	
	Rural-Urban Migration Rate	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0
	Fem Labour Force Part.Rate	-3.3	-4.0	6.3	-7.8	-34.4	-.9	-3.3	-11.4	5.1
	Dependency Rate	1.5	2.0	-3.8	4.2	33.0	.2	1.5	8.9	-3.3
<u>Population</u>										
	Country	.5	.7	-1.6	1.3	10.9	.1	.5	2.9	-11.4
	Urban	.5	.7	-1.7	1.4	11.6	.2	.5	3.2	-1.6
	Rural	.4	.6	-1.4	1.1	8.9	0.0	.4	2.3	-1.2

Table 4.10(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>EMPLOYMENT</u>										
	<u>Unemployment Rate</u>									
	Country	-19.0	-21.4	50.7	16.6	45.2	-21.4	26.1	10.2	38.0
	Urban	-25.9	-25.9	37.0	33.3	29.6	-25.9	33.3	-5.1	20.3
	Rural	-23.0	-50.0	261.0	-76.0	223.0	-53.0	0.0	-44.4	246.0
	<u>Average Real Wage</u>									
	Urban Skilled	- 1.7	- 1.7	-1.5	-1.7	-16.1	- 1.0	- 1.7	-2.8	-1.6
	Urban Unskilled	.5	.5	.7	.4	-15.5	1.2	.5	-.1	.6
	Rural Skilled	1.7	1.5	1.9	-5.3	-11.6	2.5	1.7	-1.8	1.7
	Rural Unskilled	-.2	-.3	0.0	-2.5	-14.1	9.0	0.0	-3.9	0.0

Description of Experiments

- 1-0: Disequilibrium in Product Markets: Open Economy. No changes in variables or parameters. Public Finances and Balance of Payments in disequilibrium.
- 1-1: Disequilibrium: Open Economy. Tax Reform: Increase in tax rate for high income groups, and reduction in tax rate for low income groups (See table 4.4).
- 1-2: Disequilibrium: Open Economy. Fiscal Policy: 10% increase in government expenditures on health and education.
- 1-3: Disequilibrium: Open Economy. Investment Policy: More investment allocated to the agricultural sector and reduction in the services sector (See table 4.5).

Table 4.10(Cont.)

- 1-4: Disequilibrium: Open Economy. Technology Change: Less capital intensive and more unskilled labour intensive technology in all sectors, except construction. (See table 4.6).
- 1-5: Disequilibrium: Open Economy. Exogenous increase in labour productivity (10%).
- 1-6: Disequilibrium: Open Economy. Exogenous redistribution of government expenditures on health and education in favour of low income groups. (See table 4.7).
- 1-7: Disequilibrium: Open Economy. Endogenous redistribution of government expenditures as a function of relative power of social groups, plus tax reform (See tables 4.8 and 4.9).
- 1-8: Disequilibrium: Open Economy. Essential Human Needs Strategy: Tax reform (Exp. 1-1), plus fiscal policy (Exp.1-2), plus redistribution of public budget (Exp. 1-6).

Table 4.11

COLOMBIA 2000: RELATIVE CHANGES IN VARIABLES BY YEAR 2000 AS COMPARED WITH THEIR VALUES IN THE REFERENCE RUN, USING SCENARIO 2: DISEQUILIBRIUM CLOSED ECONOMY.

EXPERIMENT(See description end of table).

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>
<u>ECONOMIC</u>										
	G.N.P. (Country)	-15.2	-15.3	-15.0	-16.5	-34.3	-14.3	-15.2	-18.2	-15.1
	G.N.P. (Urban)	-19.9	-20.0	-19.7	-21.9	-38.5	-19.1	-19.9	23.7	-19.8
	G.N.P. (Rural)	3.4	3.4	3.0	5.0	-17.5	4.7	3.5	4.4	3.7
	Total Supply	- 2.8	- 2.9	- 2.6	- 4.5	-23.6	- 1.9	- 2.8	-7.6	- 2.7
	Total Demand	- 7.3	- 7.1	- 7.1	- 8.7	-26.1	- 6.5	- 7.3	-15.5	-19.2
	Final Demand	- 6.9	- 7.1	- 6.7	- 8.3	-25.6	- 6.1	- 6.9	-15.0	- 6.9
	Total Investment	- 9.8	- 9.9	- 9.7	-10.7	-22.6	- 9.3	- 9.8	-11.1	- 9.8
	Government Savings	-16.3	-16.4	-16.2	-17.4	-32.6	-15.6	-16.3	-14.1	-16.2
	Corporate Savings	-12.9	-13.0	-12.8	-13.8	-25.9	-12.3	-12.9	-12.3	-12.8
	External Savings	-12.9	-12.9	-12.8	-13.7	-25.2	-12.4	-12.9	-11.1	-12.8
	Government Expenditures	-14.9	-15.0	-14.8	-16.2	-34.2	-14.1	-14.9	-35.7	-14.8
	Imports	45.7	45.6	45.9	37.4	31.6	46.0	45.5	37.1	45.6
	Capital Payments	- 2.8	- 2.8	- 2.6	- 4.2	-31.6	- 1.7	- 2.7	- 9.2	- 2.6
	Labour Payments	-10.5	-10.6	-10.3	-12.4	-23.7	- 9.6	-10.5	-12.0	-10.4
	Capital Stock	- 3.8	- 3.8	- 3.7	- 4.2	-12.3	- 3.6	- 3.8	- 4.3	- 3.8
	Def-Sup. Current Account	407.0	462.0	408.0	375.0	314.0	408.0	406.0	1328.3	462.0
	Def-Sup. Balance of Payments.	- 9.8	- 9.9	- 9.8	-10.3	-19.0	- 9.6	- 9.8	- 5.5	-9.8

Table 4.11(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>									
		<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>	
<u>INCOME DISTRIBUTION</u>											
	<u>Gini Index Before Taxes</u>										
	Capital Income	- 5.1	- 5.1	- 4.9	- 5.8	- 5.3	- 5.1	- 5.1	- 6.4	- 4.9	
	Labour Income	- 4.7	- 7.4	- 7.1	- 8.7	-11.4	- 7.8	- 7.4	- 9.4	- 7.1	
	Total Income	- 4.7	- 4.7	- 4.5	- 5.6	- 8.8	- 4.7	- 4.7	- 6.3	- 4.5	
	Gini Index After Taxes	- 4.6	- 7.2	- 4.6	- 5.8	- 9.3	- 4.9	- 4.9	-15.9	- 7.0	
	<u>Per Capita Income After Taxes</u>										
	Country	- 8.9	- 9.4	- 7.1	-11.0	-34.9	- 7.8	- 8.9	-21.2	- 7.6	
	Urban	-10.2	-10.8	- 8.2	-12.7	-36.8	- 9.1	-10.2	-23.3	- 8.9	
	Rural	- 4.1	- 3.6	- 2.7	- 4.3	-27.9	- 2.7	- 4.0	-12.9	- 2.1	
	Income Taxes	- 6.8	- 5.5	- 6.7	- 8.6	-28.7	- 5.9	- 6.8	-50.5	- 5.3	
<u>CONSUMPTION</u>											
	Household Consumption	- 8.6	- 6.5	- 6.1	- 8.0	-27.7	- 5.3	- 6.3	-17.1	- 6.3	
	Household Savings	- 8.6	- 6.5	- 6.1	- 8.0	-27.7	- 5.3	- 6.3	-17.1	- 6.3	
<u>ESSENTIAL HUMAN NEEDS</u>											
	<u>Illiteracy Rate</u>										
	Country	22.9	22.9	12.5	27.0	81.2	20.8	22.9	-17.1	14.5	
	Urban	8.0	9.0	3.0	2.0	38.0	7.0	12.0	214.6	8.0	
	Rural	4.4	3.9	1.9	4.4	16.3	3.9	1.9	6.8	- 4.9	
	Urban Wage Earners	6.9	5.2	4.0	8.6	20.8	6.3	- 9.2	3.4	-13.8	
	Rural Wage Earners	5.5	4.4	4.0	5.9	11.8	5.2	- 2.6	7.7	- 5.5	

Table 411(Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>
<u>Per Capita Daily Calories</u>										
Country		- 1.4	- 1.3	- 1.3	- 1.6	- 5.8	- 1.2	- 1.4	--2.4	- 1.3
Urban		- 1.3	- 1.3	- 1.2	- 1.7	- 6.1	- 1.1	- 1.3	--3.5	- 1.3
Rural		- 1.9	2.1	1.8	1.9	- 1.7	- 2.1	1.9	--1.4	2.0
Urban Wage Earners		- 1.3	- .3	- 1.2	- .9	- 4.8	- 1.1	- 1.3	- .2	- .2
Rural Wage Earners		- .4	- 1.3	- 2.5	- 2.6	- 4.3	- 2.2	- 2.4	- .6	- 1.3
<u>Infant Mortality Rate</u>										
Country		36.0	38.1	28.4	45.1	16.6	31.1	36.0	19.1	30.6
Urban		0.0	0.0	0.0	0.0	24.6	00.0	0.0	30.7	0.0
Rural		5.8	5.2	3.8	6.2	45.7	3.1	5.8	14.2	3.1
Urban Wage Earners		40.3	17.6	33.5	55.1	146.5	35.7	40.9	3.3	9.0
Rural Wage Earners		8.5	5.2	7.6	9.0	18.0	7.8	8.5	7.9	5.2
<u>Female Life Expectancy</u>										
Country		- 1.8	- 1.9	- 1.3	- 2.2	- 8.0	- 1.6	- 1.8	-4.5	- 1.5
Urban		- 2.0	- 2.1	- 1.6	- 2.5	- 8.2	- 1.8	- 2.1	-4.8	- 1.7
Rural		- 1.0	- .9	- .6	- 1.0	- 6.6	- .7	- .9	-2.8	- .4
Urban Wage Earners		- 2.1	- 1.0	- 1.6	- 2.7	- 7.2	- 1.8	- 1.6	-2.5	- .1
Rural Wage Earners		- 3.2	- 2.0	- 2.7	- 3.3	- 6.7	- 2.7	- 2.3	-1.4	- .9
<u>Per Capita Sq. Meters of Housing</u>										
Country		- 4.7	- 5.5	- 3.1	- 6.2	-26.7	- 3.9	- 4.7	-15.4	- 3.9
Urban		- 5.5	- 6.3	- 3.1	- 7.1	-27.7	- 4.7	- 5.5	-15.6	- 3.9

Table 4.11 (Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>
<u>Per Capita Sq. Meters of Housing (Cont.)</u>										
Rural		- 5.3	- 5.3	- 3.8	- 6.1	-25.1	- 4.5	- 5.3	-14.0	- 4.5
Urban Wage Earners		- 5.1	- 6.1	- 3.0	- 7.1	-27.5	- 4.0	- 5.1	- 7.0	- 4.0
Rural Wage Earners		- 4.9	- 4.9	- 3.3	- 5.7	-24.7	- 4.1	- 4.9	- 9.6	- 4.1
<u>Hospital Beds per 1000 Inhabit.</u>										
Country		- 4.2	- 5.0	- 2.8	- 5.0	-14.2	- 4.2	- 4.2	- 7.7	- 2.8
<u>Rate of Labour Productivity</u>										
Urban		- 7.9	- 7.9	- 5.6	-10.2	-28.4	0.0	- 7.9	-18.3	- 6.8
Rural		- 4.3	- 5.1	- 3.6	- 5.1	-16.7	4.3	- 3.6	- 9.2	- 2.9
<u>DEMOGRAPHIC</u>										
Total Fertility Rate		44.9	46.3	29.5	51.6	128.8	40.9	44.9	-44.3	31.5
Rural-Urban Migration Rate		7.6	7.6	0.0	7.6	15.3	7.6	7.6	7.7	0.0
Fem. Labour Force Part. Rate		17.7	-18.2	-12.6	-19.8	-27.6	16.4	-17.7	-20.0	-13.0
Dependency Rate		11.0	11.4	6.3	13.0	38.0	9.9	11.0	16.6	6.3
<u>Population</u>										
Country		3.3	3.5	1.3	3.9	12.2	3.0	3.3	5.2	1.5
Urban		3.5	3.7	1.4	4.2	13.2	3.2	3.5	5.8	1.5
Rural		2.8	2.9	1.3	3.3	9.5	2.5	2.8	3.8	1.5

Table 4.11 (Cont.)

<u>SUBSYSTEM</u>	<u>VARIABLE</u>	<u>EXPERIMENT</u>								
		<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>
<u>EMPLOYMENT</u>										
<u>Unemployment Rate</u>										
	Country	-21.4	-21.4	28.5	28.5	-16.6	-30.9	9.5	-5.1	9.5
	Urban	-12.9	-11.1	22.2	40.7	-14.8	-16.6	14.8	3.4	-1.8
	Rural	-30.7	-53.8	14.6	23.0	30.0	-84.0	46.1	-44.4	161.0
<u>Average Real Wage</u>										
	Urban Skilled	-1.6	-1.6	.4	-1.6	-15.3	-1.0	-1.6	-3.1	-1.5
	Urban Unskilled	-5.6	-5.6	-5.4	-5.4	-18.5	-5.0	-5.6	-8.4	-5.5
	Rural Skilled	-7.0	-7.2	-6.9	-12.9	-18.5	-6.4	-7.0	-4.0	-7.1
	Rural Unskilled	-6.1	-6.2	-5.9	-8.0	-17.0	-5.0	-6.0	-11.7	-5.9

Description of Experiments

- 2-0 Disequilibrium in Product Markets: Closed Economy. No changes in variables or parameters. Public Finances and Balance of Payments in Disequilibrium.
- 2-1 Disequilibrium: Closed Economy. Tax Reform: Increase in tax rate for high income groups, an reduction in tax rate for low income groups (See table 4.4)
- 2-2 Disequilibrium: Closed Economy. Fiscal Policy: 10% increase in government expenditures on health and education.
- 2-3 Disequilibrium: Closed Economy. Investment Policy: More investment allocated to the agricultural sector and reduction in the services sector (See table 4.5).

Table 4.11(Cont.)

- 2-4 Disequilibrium: Closed Economy. Technology Change: Less capital intensive and more unskilled labour intensive technology in all sectors, except construction. (See table 4.6).
- 2-5 Disequilibrium: Closed Economy. Exogenous increase in labour productivity.(10%).
- 2-6 Disequilibrium: Closed Economy. Exogenous redistribution of government expenditures on health and education in favour of low income groups. (See table 4.7).
- 2-7 Disequilibrium: Closed Economy. Endogenous redistribution of government expenditures as a function of relative power of social groups, plus tax reform.(See tables 4.8 and 4.9).
- 2-8 Disequilibrium: Closed Economy. Essential Human Needs Strategy: Tax reform(Exp 2-1), plus fiscal policy (Exp. 2-2), plus redistribution of public budget (Exp. 2-6).

terms of income distribution when it is open than in the case of a closed economy as defined here.

Essential human needs indicators perform better in the case of the open economy than in the closed one, emphasizing the importance of growth in poverty alleviation.

Population grows less faster in the open economy than in the close one and, therefore, unemployment rates tend to be also lower.. Real wages are lower in the closed than in the open economy.

The main conclusion emerging from these experiments is that an open economy which promotes growth of the more dynamic sectors of the economy tend to facilitate the accomplishment of higher standards of essential human needs satisfaction and, therefore, reduce poverty, in low income groups.

b. Tax Reform (Exp.1-1, 2-1).

The economy grows at a slightly lower rate than in the non-policy case in both, open and closed economy. However, the economy performs better in terms of growth and income distribution when a tax reform is imposed, in the form of more taxes to capital and less to labour, in the open economy case than in the closed one. Household consumption and savings are also reduced considerably in the case of a closed economy with this tax reform. However, income distribution after taxes improves in both, the open and the closed economy. Essential human needs indicators perform better in the open

than in the close economy. However, a tax reform per se does not seem to have a major impact on essential human needs. Population grows slightly faster in the closed economy than in the open one. Unemployment rates are similar in both cases, but real salaries tend to deteriorate in the closed economy case.

The main conclusion derived from these results is that a modest tax reform per se has a positive effect on essential needs for the poorest but has small negative effects on the growth rate of the economy.

c. Fiscal Policy (Exp. 1-2, 2-2).

Increases on government expenditures on health and education, with no compensating reduction in government investment, have a positive effect on growth in both, the open and the closed economy case, due to gains in labour productivity resulting from better health and education of the population in the labour force. The results suggest that when the economy is open, government investment can be reduced to finance health and education expenditures with no reduction in the rate of growth of the economy, since productivity gains are large enough to compensate for investment reductions. However unemployment rates tend to increase as a consequence of improvements in labour productivity.

d. Investment Allocation Policy (Exps. 1-3, 2-3.)

An unbalanced growth strategy favouring the agricultural sector while reducing investment in the services sector of the urban economy leads, as expected, to a higher rate of growth of rural G.N.P. as compared with the reference allocation case. As a consequence, income distribution improves in both cases, open and closed economy, since the lowest income groups are located in the rural sector, and the agricultural sector uses a high proportion of unskilled labour.

Essential human needs indicators tend to be lower than in the non-policy case in both, open and close economy. Population grows at a faster rate, generating higher rates of unemployment than in the reference run, except for the rural sector.

The conclusion that can be derived from these experiments is that, except for the improvement in income distribution, it is not clear at all that an investment strategy oriented towards the agricultural sector of the Colombian economy could have positive effects on growth and essential human needs performance.

e. Labour Intensive Technology (Exps. 1-4, 2-4)

Output falls in both cases, open and closed economy. The explanation for this lies in the fact that coefficients in the production functions of the model are more capital efficient than labour efficient. Therefore, more labour

intensiveness implies less growth in the economy. However, there is an improvement in income distribution with respect to the non-policy case-.

Essential human needs indicators and productivity rates drop dramatically, as a consequence of output reduction. Fertility rates increase and unemployment rates also go up due to expansion of the labour supply generated by the rise in the rate of growth of population.

The conclusion emerging for these experiments is that unless labour intensive technologies are as efficient as the capital intensive ones, the introduction of an unskilled labour intensive technology is likely to have a negative effect on output and essential human needs.

f. Exogenous Increase in Labour Productivity (Exps. 1-5,2-5).

The economy grows at a slightly higher rate than in the non-policy case, especially in the open economy. Major effects on growth can be expected from larger changes in labour productivity than the one used in these experiments (10%). Income distribution is similar to the non-policy case in both, open and close economy. There is a slight increase in consumption, and, therefore essential human needs indicators tend to rise slightly. Eventhough population grows at a lower rate than in the non-policy case, unemployment rates remain the same, suggesting a compensating effect of reduction in the labour supply and increase in the rate of labour productivity.

g. Redistribution of Government Health and Education

Expenditures in Favour of Low Income Groups. (Exps. 1-6, 2-6).

There are not important effects of this policy on growth of the economy in both, the open and the closed case. Income distribution also remains the same. However, as expected, there are important effects on essential human needs indicators of low wage earners in urban and rural areas in terms of illiteracy rates, complete primary and secondary schooling rates and female life expectancy at birth⁹.

As a consequence of improvements in welfare indicators labour productivity rises in the rural sector, and unemployment rates go up due to the productivity effect.

h. Endogenous Redistribution of Government Health and Education Expenditures as a Function of Relative Power of Each Group, plus Tax Reform (Exps. 1-7, 2-7).

Results of these experiments are negative in terms of growth as well as essential human needs performance.

Two factors explain the result. The economy grows less because the tax reform affects capitalists and therefore, personal savings and investment are reduced. On the other hand, additional government revenue is not spent by the government in additional public expenditures or investment. An interesting experiment is to assume that all the additional revenue is spent on health and education to see if productivity gains compensate for investment losses in output determination.

This is done in the next experiments,

i. An Essential Human Needs Strategy (Exps. 1-8, 2-8)

Results show that a combination of tax reform, increases in government health and education expenditures, and a redirection of these expenditures towards low income groups can greatly improve essential human needs performance without reducing the rate of growth of the economy, since investment losses due to tax reform are more than compensated by improvements in productivity. The only negative effect of this strategy is an increase in unemployment rates due to the rise in the rates of labour productivity.

Interesting to note also that the best results are obtained when the economy is open. This suggests that an optimal essential human needs strategy requires the workings of rapid growth conditions (open economy), and a fiscal policy which has to combine the obtention of additional funds for the government, and the redirection of those funds towards the low income groups of the population in both, urban and rural areas.

3. Essential Human Needs Performance in Low Income Groups

(See tables 4.12, 4.13, and 4.14).

a. Nutrition

Although per capita calories per day are below minimum standards in 1971 for wage earners in both, urban and rural areas (38% of the population), the reference run shows that, if historical trends continue, by year 2000 all groups will be above the minimum standard defined by I.C.C.F. in 1977 for Colombia (1970 per capita calories/day).¹⁰

The best performance is accomplished when the economy is open, and the essential human needs strategy is applied.

b. Education

In spite of the low value for the overall country illiteracy rate in year 2000, they are still high for low income groups in urban and rural areas in the reference run in the same year. The same trend is obtained in complete primary and secondary schooling rates, observing that while the primary rate for the country shows that about 53% of the Colombian population will have completed five years of primary school by year 2000, the same rate will be only 34% for urban wage earners and 30% for rural wage earners. These results call for government intervention. As in the case of nutrition, an open economy essential needs strategy

TABLE 4.12
COLOMBIA 2000

A COMPARISON OF THE LEVELS OF SATISFACTION OF ESSENTIAL HUMAN NEEDS OF LOW INCOME GROUPS IN YEAR 1971 WITH PROJECTED VALUES FOR YEAR 1980 AND 2000 IN THE REFERENCE RUN.

<u>ESSENTIAL HUMAN NEED</u>	<u>INDICATOR</u>	<u>URBAN WAGE EARNERS</u>			<u>RURAL WAGE EARNERS</u>			<u>C O U N T R Y</u>		
		<u>1971</u>	<u>1980</u>	<u>2000</u>	<u>1971</u>	<u>1980</u>	<u>2000</u>	<u>1971</u>	<u>1980</u>	<u>2000</u>
<u>NUTRITION</u>	Per Capita Daily Calories	1919	2168	2593	1554	1896	2403	2049	2317	2746
<u>EDUCATION</u>	Illiteracy Rate(%)	32.1	26.7	17.5	46.6	38.9	27.2	21.0	14.8	5.0
	Complete Primary Schooling Rate(%)	25.1	25.1	33.6	5.3	10.2	29.9	21.0	33.2	52.8
	Complete Secondary Schooling Rate(%)	6.1	6.6	8.2	1.8	2.6	5.8	5.6	6.4	9.6
	Students/Reacher Ratio	32.6	30.6	23.5	32.6	29.1	15.1	30.7	26.7	13.0
<u>HEALTH</u>	Female Life Expectancy At Birth	56.8	61.1	68.1	50.0	55.1	64.4	59.2	64.2	71.5
	Infant Mortality Rate(%)	119.5	87.9	58.7	236.0	143.7	74.3	82.0	61.1	41.3
	Hospital Beds Per 1000 Inhabit.	-	-	-	-	-	-	2.02	1.77	1.35
	Inhabititants Per Physician	-	-	-	-	-	-	2106	1846	1365
<u>HOUSING</u>	Per Capita Sq. Meters of Housing	6.1	6.1	7.1	4.4	5.6	8.7	6.6	7.2	9.1
	%Houses With Electricity	71.0	71.0	87.0	1.0	1.0	40.7	57.0	84.9	99.9
	%Houses With Water	69.8	69.8	89.3	1.0	1.0	38.9	55.0	82.2	99.9

TABLE 4.13
COLOMBIA 2000

EXPECTED LEVELS OF SATISFACTION OF ESSENTIAL HUMAN NEEDS OF LOW INCOME GROUPS, UNDER DIFFERENT EXPERIMENTS,
BY YEAR 2000 .OPEN ECONOMY.

EXPERIMENT (See description at end of Table 4.10).

<u>ESSENTIAL HUMAN NEED</u>	<u>INDICATOR</u>	<u>REF.</u>	<u>1-0</u>	<u>1-1</u>	<u>1-2</u>	<u>1-3</u>	<u>1-4</u>	<u>1-5</u>	<u>1-6</u>	<u>1-7</u>	<u>1-8</u>
<u>NUTRITION</u>	<u>Per Capita Daily Calories</u>										
	Urban Wage Earners	2593	2587	2616	2589	2572	2497	2592	2587	2628	2617
	Rural Wage Earners	2403	2381	2410	2388	2377	2318	2387	2381	2422	2409
	Country	2746	2740	2741	2741	2731	2611	2746	2658	2692	2761
<u>EDUCATION</u>	<u>Illiteracy Rate</u>										
	Urban Wage Earners	17.5	17.7	17.3	17.2	18.0	20.2	17.6	14.9	16.9	14.0
	Rural Wage Earners	27.2	27.7	27.4	27.3	27.9	29.8	27.6	25.5	28.1	24.7
	Country	5.0	5.2	5.1	4.6	5.3	8.3	5.0	5.1	5.9	4.6
<u>HEALTH</u>	<u>Female Life Expectancy</u>										
	Urban Wage Earners	68.1	67.8	68.6	68.2	67.3	64.1	68.0	68.2	68.4	69.3
	Rural Wage Earners	64.4	63.5	64.2	63.8	63.3	60.5	63.7	64.0	64.7	65.0
	Country	71.5	71.3	71.3	71.7	70.9	66.5	71.5	71.3	69.5	71.6
	<u>Infant Mortality Rate</u>										
	Urban Wage Earners	53.7	56.7	44.5	51.6	65.3	117.2	54.0	56.8	51.2	39.3
	Rural Wage Earners	74.2	77.0	74.6	76.2	77.6	86.2	76.3	77.0	73.2	73.8
	Country	41.3	43.3	43.9	39.7	47.7	101.5	41.1	43.3	46.3	40.6
<u>HOUSING</u>	<u>Per Capita Sq. Meters of Housing</u>										
	Urban Wage Earners	7.1	7.0	7.0	7.2	6.9	5.3	7.1	7.0	6.2	7.2
	Rural Wage Earners	8.7	8.6	8.5	8.8	8.5	6.7	8.7	8.6	7.7	8.7
	Country	9.1	9.0	8.9	9.2	8.9	6.8	9.1	9.0	8.0	9.2

TABLE 4.14

COLOMBIA 2000

EXPECTED LEVELS OF SATISFACTION OF ESSENTIAL HUMAN NEEDS OF LOW INCOME GROUPS, UNDER DIFFERENT EXPERIMENTS, BY YEAR 2000. CLOSED ECONOMY.

EXPERIMENT (See description at end of Table 4.11).

<u>ESSENTIAL HUMAN NEED INDICATOR</u>		<u>REF.</u>	<u>2-0</u>	<u>2-1</u>	<u>2-2</u>	<u>2-3</u>	<u>2-4</u>	<u>2-5</u>	<u>2-6</u>	<u>2-7</u>	<u>2-8</u>
<u>NUTRITION</u>	<u>Per Capita Daily Calories</u>										
	Urban Wage Earners	2593	2558	2585	2560	2543	2468	2563	2558	2598	2587
	Rural Wage Earners	2403	2352	2380	2350	2349	2307	2357	2352	2388	2379
	Country	2746	2717	2718	2718	2709	2593	2721	2717	2666	2718
<u>EDUCATION</u>	<u>Illiteracy Rate</u>										
	Urban Wage Earners	17.5	18.7	18.4	18.2	19.0	21.1	18.6	15.9	18.1	15.0
	Rural Wage Earners	27.2	28.7	28.4	28.3	28.8	30.4	28.6	26.5	29.3	25.7
	Country	5.0	6.1	6.1	5.6	6.3	9.1	6.0	6.1	7.0	4.7
<u>HEALTH</u>	<u>Female Life Expectancy</u>										
	Urban Wage Earners	68.1	66.6	67.4	67.0	66.2	63.1	66.8	67.0	67.2	68.0
	Rural Wage Earners	64.4	62.3	63.1	62.6	62.2	60.0	62.5	62.9	63.5	63.8
	Country	71.5	70.2	70.1	70.5	69.9	65.7	70.3	70.2	68.2	70.4
	<u>Infant Mortality Rate</u>										
	Urban Wage Earners	58.7	75.4	63.1	71.7	83.3	132.4	72.9	75.7	55.5	58.6
Rural Wage Earners	74.2	80.5	78.1	79.9	80.9	87.6	79.9	80.5	80.1	77.5	
Country	41.3	56.2	57.1	53.1	59.9	109.9	54.1	56.2	49.2	53.7	
<u>HOUSING</u>	<u>Per Capita Sq. Meters of Housing</u>										
	Urban Wage Earners	7.1	6.7	6.7	6.9	6.6	5.1	6.8	6.7	6.0	6.8
	Rural Wage Earners	8.7	8.3	8.3	8.4	8.2	6.5	8.3	8.3	7.5	8.3
	Country	9.1	8.7	8.6	8.8	8.5	6.7	8.7	8.7	7.7	8.7

combination seems to have the major impact on education indicators of low income groups.

c. Health

Although life expectancy at birth presents a relatively high value for all groups by year 2000 in the reference run, infant mortality rates will still be very high for rural wage earners, if present trends continue.

Hospital beds show a decrease through time. In fact, the number of hospital beds per person in Colombia has declining since 1965.¹¹ On the contrary, the number of persons per physician reduces to about 50% of 1971 average by year 2000.

d. Housing

Except for wage earners in the urban centers, all groups are expected to meet the Colombian minimum housing space standard (9M²) by year 2000. The low figure for urban wage earners is due to a combination of low investment in housing for low income population, and migration from rural to urban centers.

In spite of the high overall country figure for the proportion of houses with electricity and water in the reference run by year 2000, the same proportion will be below 50% for rural wage earners with present trends. This is another area in which government intervention could

reduce the gap with appropriate redirection of government investment in public services towards low income rural groups.

4. Conclusions

The following conclusions can be derived from the analysis:

- a. Reductions in private and public investment do not necessarily mean low output growth. Results show that if additional government funds are spent on essential human needs oriented activities, productivity gains could more than compensate for investment reductions.
- b. Labour intensive technologies can have a negative affect on essential human needs indicators if they are less efficient than the capital intensive ones.
- c. A strategy that combines an open economy with internal policies aimed to spend additional government funds on satisfying the essential human needs of low income groups seems to produce the best results, since productivity gains permit the achievement of rates of growth that are as high as a growth orientated approach without redistribution. This result assumes, of course, that goods produced for export can find a market and that there are no import constraints for those sectors that cannot meet domestic demand.
- d. Except for nutrition, essential human needs of the Colombian population in low income groups will not be satisfied by year 2000, unless a strategy is defined to accomplish minimum goals by this year.

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3. Idem, "Tendencias de la Distribución del Ingreso en Colombia", in 50 Años de Desarrollo Económico Colombiano, La Carreta, July, 1979.
4. See Jorge García, "La Incidencia de la Desnutrición en Colombia", "Desarrollo y Sociedad, No.4, July, 1980.
5. D.N.P. Plan de Integración Nacional, Vol II, Table 9, p.393.
6. DANE. "La Salud en Colombia" Boletín Mensual de Estadística, No. 244, table 29, p.131. In 1968 the United States had 8.3 beds per 1.000 inhabitants, Argentina 6.3 in 1965, Canada 10.2 in 1967, Uruguay 6.4 in 1967.
7. D.N.P. "La Economía Colombiana 1950-1975". Revista de Planeación y Desarrollo, Vol IX, No.3, Oct-Dec., 1977, table 3.35, p. 140.
8. Harold Banguero, El Impacto del Cambio en la Fecundidad y la Mortalidad sobre la Estructura de Edad de la Población Colombiana. Doc. CEDE No.52, 1968.
9. Infant Mortality rates do not change in this experiment because they were made a function of per capita income rather than private and public expenditures on health.
10. García, J., Op. cit.
11. D.N.P. Op.cit. (footnote 5) . .

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STATISTICAL APPENDIX

The main purpose of this appendix is to present to the reader all the information used for the estimation of parameters an model initialization as well as methodological procedures followed in the process of data preparation for the model.

TABLE A-1

DATA USED FOR THE ESTIMATION OF THE FEMALE LIFE EXPECTANCY AT BIRTH EQUATION
(EQUATION 1a. IN CHAPTER III)

Year	(1) Female Life Expectancy At Birth ¹ (FLE)	(2) G.N.P. Per Capita ² (Pesos of 1970) (YP)	(3) Government Expenditures on Health ³ (Millions of pesos of 1970) (SALPE)
1965	57.40	5455	318.8
1966	57.82	5626	376.4
1967	58.24	5758	434.0
1968	58.66	5980	725.6
1969	59.08	6218	1.017.2
1970	59.51	6484	1.318.8
1971	59.94	6619	1.351.3
1972	60.38	6886	1.393.8
1973	60.82	7119	1.436.3
1974	61.25	7286	1.468.4
1975	61.70	7352	1.500.5

^{1/} Data obtained by geometric interpolation using the values for years 1964 and 1973 estimated by Alberto Bayona in La Medida de la Mortalidad en Colombia y Tablas Abreviadas para el País y sus Secciones en 1964 y 1973. Bogotá : FEI, U. Javeriana. Serie de Investigaciones No. 3 July, 1977, pp. 70-108. The value for year 1964 is 56.99 years.

Cont...

Continuation Table A-1.

- 2/ The G.N.P. series was taken from D.N.P. Revista de Planeación y Desarrollo, 9,3 (1977).Table 3.21, pp. 150. The population was obtained by geometric interpolation of the values for the 1951, 1964 and 1973 Censuses of Population. See DANE, La Población de Colombia, XIV Censo Nacional de Población y III de Vivienda. 1973, Bogotá, D.E., Colombia. 1977; XIII Censo Nacional de Población (15 Julio, 1964)-Resumen General, Bogotá, D.E. Imprenta Nacional, 1967, p. 33-108; Censo de Población de Colombia 1951 (Mayo 9), Resumen, Bogotá, D.E., pp. 36-128. The estimated population for years 1951, 1964, and 1973 was 11.228, 17.484 and 22.551 millions . See : D.N.P. "La Economía Colombiana 1950-1975", Revista de Planeación y Desarrollo, IX, 3, Oct. Dec., 1977, Table 3.1.
- 3/ Source : D.N.P., "La Economía Colombiana 1950-1975", Revista de Planeación y Desarrollo, XI, 3, Oct-Dec., 1977, and DANE. Anuario General de Estadísticas Fiscales y Financieras 1970-71. Contraloría General de la República. Estadística Fiscal del Estado, Vol. I, 1976. Linear interpolation was used to obtain values for years 1966, 1968, 1969, 1971, 1972 and 1974.

TABLE A-2

DATA USED FOR THE ESTIMATION OF THE LABOUR FORCE PARTICIPATION RATE OF FEMALES

Year	(1) Economically Active Women ¹ (10 Years old or more)	(2) Total Number of Women (10 Years old or more)	(3) Labour Force Participation Rate of Females ² (10 Years old or more.)
1960	916,333	5,257,437	17,429
1961	943,987	5,425,843	17,398
1962	972,477	5,599,644	17,367
1963	1,001,826	5,779,012	17,336
1964	1,032,062	5,964,149	17,304
1965	1,080,922	6,095,891	17,732
1966	1,132,095	6,230,543	18,170
1967	1,185,691	6,368,170	18,619
1968	1,241,824	6,508,836	19,079
1969	1,300,614	6,552,610	19,550
1970	1,362,188	6,779,559	20,033
1971	1,426,676	6,949,755	20,528
1972	1,474,218	7,103,268	21,036

Continuation Table A-2

Year	(1) Economically Active Women ¹ (10 Years old or more)	(2) Total Number of Women (10 Years old or more)	(3) Labour Force Participation Rate of Females ² (10 Years old or more)
1973	1,564,951	7,260,179	21,555
1974	1,659,046	7,420,542	22,088
1975	1,716,641	7,584,454	22,634

^{1/} Data obtained by geometric interpolation using the values for years 1951, 1964, and 1973 given by the censuses. See : DANE, La Población de Colombia, XIV Censo Nacional de Población y III de Vivienda, 1973, Bogotá, D.E., Colombia. 1977; XIII Censo Nacional de Población (15 Julio, 1964) Resumen General, Bogotá, D.E. Values for the number of economically active women (10 years old or more) in the census dates were : 701,189; 1,032,062, and 1,564,951 for 1951, 1964 and 1973. Values for the total number of women 10 years old or more for the same years were 3,958,545 ; 5,964,149, and 7,260,179.

^{2/} Female Labour Force
Participation Rate = $\frac{\text{Number of economically active females (10 years +)}}{\text{Total number of women 10 years old or more.}} \times 100$

TABLE A-3

DATA USED FOR THE ESTIMATION OF THE FEMALE LABOUR FORCE PARTICIPATION RATE
(EQUATION 4.a IN CHAPTER III)

Year	(1)	(2)	(3)
	Female Labour Force Participation Rate (LFPR)	G.N.P. Per Capita ² (Pesos of 1970) (YP)	Total Fertility Rate of Previous Year ³ (FR _{t-1})
1960	17.429	5088	7.558
1961	17.398	5193	7.274
1962	17.367	5304	7.001
1963	17.336	5275	6.738
1964	17.304	5439	6.485
1965	17.732	5455	6.241
1966	18.170	5636	6.006
1967	18.619	5758	5.781
1968	19.079	5980	5.563
1969	19.550	6218	5.354
1970	20.033	6484	5.153

Cont....

Continuation Table A-3

Year	Female Labour Force Participation Rate (LFPR)	G.N.P. Per Capita ² (Pesos of 1970) (YP)	Total Fertility Rate of Previous Year ³ (FR _{t-1})
1971	20.528	6619	4.959
1972	21.036	6886	4.773
1973	21.555	7117	4.594
1974	22.088	7286	4.421
1975	22.634	7352	4.255

1. Source : Table A.2 of this appendix.

2. Source : See note 2 of table A.1 for reference and methodology.

3. This rate was obtained by geometric interpolation using values for the years 1964 and 1975 given by Donald Bogue, Juan Londoño, and Luis H. Ochoa in Impacto de la Planificación Familiar sobre la Fecundidad en los Departamentos de Colombia. C.C.R.P., June, 1978. The total fertility rate is the number of live births that a woman would have at the end of her reproductive life (15-49 years), assuming that she is exposed to age specific fertility rates observed in a given year. Therefore, it is calculated as the sum of single age specific fertility rates for women from age 15 to 49.

TABLE A-4
 DATA USED FOR THE ESTIMATION OF THE ILLITERACY RATE
 (EQUATIONS 7.a AND 152.a IN CHAPTER III)

Year	(1) Illiterates ¹	(2) Population 7 Years Old and More ¹	(3) Illiteracy Rate ²
1960	3,941,877	11,633,150	33.88
1961	3,969,478	12,014,410	33.04
1962	3,997,273	12,408,170	32.21
1963	4,025,261	12,814,840	31.41
1964	4,053,459	13,234,887	30.63
1965	3,990,151	13,491,430	29.57
1966	3,927,832	13,752,950	28.56
1967	3,866,487	14,019,540	27.58
1968	3,806,099	14,291,290	26.63
1969	3,746,655	14,568,310	25.72
1970	3,688,139	14,850,710	24.83

Cont...

Continuation Table A-4

Year	(1) Illiterates ¹	(2) Population 7 years Old and More ¹	(3) Illiteracy Rate ²
1971	5,630,537	15,138,570	23.98
1972	3,573,834	15,432,020	23.16
1973	3,518,017	15,731,158	22.36
1974	3,463,072	16,036,080	21.59
1975	3,408,985	16,346,930	20.85

1/ Data obtained by geometric interpolation of values for years 1951, 1964, and 1973. Values for 1951, 1964, and 1973 were 3,701, 946; 4,053, 459 and 3,518,017 respectively.

Source : DANE, 1951, 1964, 1973 Census Publications. (See note 1 of Table A-2. for full reference).

2/ Data obtained by geometric interpolation using values for the census years. Values for 1951, 1964, and 1973 were 8,702,612 ; 13,234,887 and 15,731,158, respectively.

Source : DANE, 1951, 1964, 1973 Census Publications (See note 1 of Table A-2. for reference).

3/ Illiteracy Rate = $\frac{\text{Number of Illiterates (7 years old or more)}}{\text{Total Population 7 years old or more}} \times 100$

TABLE A-5
 DATA USED FOR THE ESTIMATION OF THE TOTAL FERTILITY RATE EQUATION
 (EQUATION 7.a IN CAPTER III)

Year	(1) Total Fertility Rate ¹ (FR) ⁵	(2) Illiteracy Rate ² (ILLIT)	(3) Female Labour Force Participation Rate ³ (LFPR)	(4) Infant Mortality Rate ⁴ (MORIM)
1960	7.274	33.88	17.429	118.9
1961	7.001	33.04	17.398	112.4
1962	6.738	32.21	17.367	105.7
1963	6.485	31.41	17.336	99.0
1964	6.241	30.63	17.304	92.3
1965	6.006	29.57	17.732	95.6
1966	5.781	28.56	18.170	80.6
1967	5.563	27.58	18.619	75.9
1968	5.354	26.63	19.079	73.9
1969	5.153	25.72	19.550	71.9
1970	4.959	24.83	20.033	70.0

Cont....

Continuation Table A-5

Year	(1) Total Fertility Rate ¹ (FR) ⁵	(2) Illiteracy Rate ² (ILLIT)	(3) Female Labour Force Participation Rate ² (LFPR)	(4) Infant Mortality Rate ⁴ (MORIM)
1971	4.773	23.98	20.528	68.2
1972	4.594	23.16	21.036	66.4
1973	4.421	22.36	21.555	64.6
1974	4.255	21.59	22.088	62.9
1975	4.095	20.85	22.634	61.2

1/ Source : See note 3 of Table A-3 of this appendix for complete reference.

2/ Source : Table A-4 of this appendix.

3/ Source : Table A-2 of this appendix.

4/ Source : D.N.P. *Revista de Planeación y Desarrollo*, IX, 3, Aug.-Dec., 1977, Table 2.11, p.69. Values for the years 1961, 1962, 1963, and 1964 were obtained by linear interpolation between values for years 1961 and 1965.

5/ The total fertility rate is multiplied by an adjustment factor to take into account the non uniformity of the fertility schedule through age. This factor was obtained by dividing the total number of expected births using the actual fertility schedule for year 1971, by the total number of births projected by the model for year 1971. So, that :

$$F_a = \frac{\text{Expected births with non uniform schedule for year 1971}}{\text{Number of births projected by the model with uniform schedule in 1971.}}$$

The estimated value for $F_a = 1.0966$

The assumption underlying this procedure is a constant shape of the distribution of age specific fertility rates.

TABLE A-6

DATA USED FOR THE ESTIMATION OF RURAL-URBAN INCOME PER-CAPITA DIFFERENTIAL AND RURAL TO URBAN
MIGRATION RATES

Year	(1) Rural To Urban Migrants ¹	(2) Rural Population ²	(3) Urban Population ³	(4) Urban G.N.P. ³ (Millions of pesos of 1970)	(5) Rural G.N.P. ³ (Millions of Pesos of 1970)	(6) Rural To Urban Migration Rate ⁴
1960	187,550	7,792,363	7,336,188	51.5671	26.1473	.024068
1961	187,550	7,903,124	7,771,715	54.8165	27.1181	.023731
1962	187,550	8,015,459	8,233,099	58.4743	27.9622	.023398
1963	187,550	8,129,391	8,721,873	60,4816	28,3137	.023071
1964	187,550	8,244,882	9,239,626	64.6289	29.9323	.025507
1965	269,619	8,240,871	9,702,304	67.8547	30.1132	.029042
1966	269,619	8,236,863	10,188,150	72.5736	30.9498	.029489
1967	269,619	8,232,858	10,698,330	75.6967	32.4844	.029944
1968	269,619	8,228,854	11,234,050	80.4112	34.5096	.030405
1969	269,619	8,224,852	11,796,600	86,1596	36.0589	.030874
1970	269,619	8,220,852	12,387,310	93.5092	36.8522	.031349

• Cont...

Continuation Table A-6

Year	(1) Rate To Urban Migrants ¹	(2) Rural Population ²	(3) Urban Population ³	(4) Urban G.N.P. ³ (Millions of pesos of 1970)	(5) Rural G.N.P. ³ (Millions of Pesos of 1970)	(6) Rural To Urban Migration Rate ⁴
1971	269,619	8,216,854	13,007,610	100.3885	37.5005	.031832
1972	269,619	8,212,858	13,658,970	108.2817	40.3463	.032323
1973	269,619	8,208,859	14,342,952	117.4732	42.7215	.032821
1974	269,619	8,204,872	15,061,180	124.7939	43.9930	.033327
1975	269,619	8,200,881	15,815,370	129.9080	46.5696	.033840

1/ The total number of migrants for the intercensal period 1951-64 was obtained by using census information for year 1951 to obtain a ratio of rural to total population as:

$$\frac{\text{Rural Population 1951}}{\text{Total Population 1951}} \times 100 = 61.1$$

This proportion was then applied to the total population in year 1964 to obtain an estimated expected rural population in 1964, under the assumptions of no rural to urban migration, and a constant rate of growth of population in the rural area. The actual population for the area given in the 1964 census was subtracted from the expected population to obtain the number of migrants during the intercensal period, so that $(.611) (17,414,508) = 10,683,034$, and

$10,683,034 - 8,244,882 = 2,438,152 =$ rural to urban migrants (1951-64). The annual flow was then obtained by dividing the total number of migrants in the period by the length of the intercensal period, ie :

$2,438,152/13 = 187,550$ is the estimated annual flow of rural to urban migrants during the period 1951-1964.

Cont...

A, 13 -

Continuation Table A-6

A similar procedure was followed to obtain the annual flow for the period 1964-1973, so that :

$$\frac{\text{Rural Population 1964}}{\text{Total Population 1964}} \times 100 = 47.16, \text{ so that}$$

$$(.4716) (22,551,811) = 10,635,434, \text{ and}$$

$$10,635,434 - 8,208,859 = 2,426,575 = \text{rural to urban migrants (1964-1973),}$$

and

$$2,426,575/9=269.619 = \text{estimated annual flow of rural to urban migrants during the period 1964-1973.}$$

Values for years 1974 and 1975 were obtained by linear extrapolation.

- 2/ Population Sources : 1951, 1964, 1973 Censuses. (See note 1 of Tabla A.2 for references) Intercensal values were obtained by geometric interpolation.
- 3/ G.N.P. Sources : D.N.P. Cuentas Regionales de Colombia 1960-1975, Bogotá, D.E., Editorial Presencia, Nov. 1977. The urban G.N.P. includes the following sectors : industry, construction, commerce, transportation, communications, electricity, gas, water, banking, insurance, services. The rural G.N.P. includes the following sectors : agriculture, fishing and hunting, forestry, and mining.
- 4/ This rate is estimated as:

$$\frac{\text{Colum (1). Table A-6}}{\text{Colum (2). Table A-6}} = \frac{\text{Rural to urban migrants in a given year}}{\text{Total rural population in the same year}}$$

TABLE A-7

DATA USED FOR THE ESTIMATION OF THE RURAL TO URBAN MIGRATION RATE EQUATION

(EQUATION 13.a IN CHAPTER III)

Year	(1) Rural to Urban Migration Rate ¹ (RUM)	(2) Illiteracy Rate ² (ILLIT)	(3) Rural to Urban Income Per-Capita Differential Ratio ³ (YARPOP)
1960	.024068	33.88	1.094809
1961	.023731	33.04	1.055578
1962	.023398	32.21	1.035910
1963	.023071	31.41	.991018
1964	.025507	30.63	.926711
1965	.029042	29.57	.913908
1966	.029489	28.56	.895776
1967	.029944	27.58	.793233
1968	.030405	26.63	.706787
1969	.030874	25.72	.665950
1970	.031349	24.83	.683955

Cont...

Continuation Table A-7

Year	(1) Rural to Urban Migration Rate ¹ (RIM)	(2) Illiteracy Rate ² (ILLIT)	(3) Rural to Urban Income Per-Capita Differential Ratio ³ (YARPOP)
1971	.031832	23.98	.691043
1972	.032323	23.16	.613717
1973	.032821	22.36	.611473
1974	.033327	21.59	.545333
1975	.033840	20.85	.446487

1/ Source : Table A-6 of this appendix.

2/ Source : Table A-5 of this appendix.

3/ This Ratio is defined as:

$$\text{YARPOP} = \frac{(\text{YNA}/\text{UPOP}) - (\text{YA}/\text{RPOP})}{(\text{YA}/\text{RPOP})}$$

where

YARPOP = Rural to urban income per-capita differential ratio,
 YNA = Urban G.N.P. (Column (4) of Table A-6)
 YA = Rural G.N.P. (Column (5) of Table A-6)
 UPOP = Urban population (Column (3) of Table A-6)
 RPOP = Rural population (Column (2) of Table A-6)

This ratio has the advantage of capturing income as well as population changes in the urban and the rural area in a single measure.

TABLE A-8
INITIAL POPULATION BY AREA, SEX, AND AGE. COLOMBIA 1970*

<u>K</u> ^{1/}	<u>HU</u> ^{2/}	<u>MU</u> ^{3/}	<u>HR</u> ^{4/}	<u>MR</u> ^{5/}
0	325163	234615	165583	172647
1	220337	229035	162603	167807
2	215510	223455	159624	162968
3	210683	217876	156645	158127
4	205856	212296	153665	153288
5	201029	206717	150686	148448
6	196202	201138	147707	143609
7	191375	195558	144727	138759
8	186548	189979	141748	133929
9	181721	184400	138768	129090
10	176894	178821	135789	124250
11	173203	176331	130219	117451
12	168665	174492	123889	110253
13	161690	174038	116758	102822
14	153139	174161	109164	95369
15	144468	173628	101456	87824
16	135395	173038	93543	80049
17	127160	169965	86549	73788
18	120527	163190	81062	69861
19	114988	154016	76646	67525
20	109276	145004	72256	65208
21	103643	135681	68066	63217
22	98349	127134	64299	61156
23	93420	120169	60971	58668
24	88869	114303	58045	55984
25	84611	108243	55456	53721
26	80582	102254	53206	51783
27	77156	96780	51195	49909
28	74475	91917	49361	48043
29	72320	87610	47725	46264
30	70335	83545	46293	44589
31	68596	79582	44969	42867
32	66779	76652	44068	41834
33	64701	75133	43717	41810

1/ K = Age

2/ HU = Males-Urban

3/ MU = Females-Urban

4/ HR = Males-Rural

5/ MR = Females-Rural

Cont....

Continuation Table A-8

K	HU	MU	HR	MR
34	62495	74497	43700	42374
35	60447	73962	43709	42878
36	58453	73808	43846	43564
37	56647	72669	43544	43373
38	55107	69829	42498	41751
39	53716	65949	40966	39223
40	52344	62359	39544	36873
41	51102	58746	38157	34483
42	49450	55683	36701	32395
43	47139	53584	35201	30892
44	44460	52116	33710	29787
45	41861	50607	32158	28545
46	39141	48872	30448	27187
47	37083	47285	29274	26167
48	36091	45694	28942	25633
49	35742	44079	29094	25367
50	35317	42580	29197	25130
51	35087	41291	29513	25117
52	34138	39502	28972	24368
53	31982	36919	27035	22430
54	29117	33910	24275	19811
55	26434	31000	21664	17331
56	23635	27901	18837	14662
57	21639	25853	17044	13036
58	20960	25484	16960	13094
59	21093	26115	17906	14177
60	21095	26605	18660	15093
61	21235	27330	19610	16217
62	20805	27058	19603	16422
63	19388	25121	17995	15071
64	17372	22178	15419	12776
65	159476	223829	135260	129008

* This population was obtained by linear interpolation of the population by quinquennial age groups in the 1964 and 1973 Censuses of population. Then, Sprage multipliers were used to disaggregate by single years of age.

Source : DANE, 1964, 1973 Census Publications (See note 1 of Table A-2 for reference).

TABLE A-9

VECTORS OF RELATIVE AGE DISTRIBUTION OF INTERNACIONAL AND RURAL TO
URBAN MIGRANTS. COLOMBIA, 1964-1973

K ¹	HMIGIN ^{2,6}	MMIGIN ^{3,6}	NH ^{4,7}	NM ^{5,7}
0	0.00540	0.00248	0.029948	0.028494
1	0.00540	0.00248	0.026849	0.026899
2	0.00540	0.00248	0.024886	0.025159
3	0.00540	0.00248	0.022965	0.023311
4	0.00540	0.00248	0.021098	0.021391
5	0.00540	0.00248	0.019294	0.019437
6	0.00540	0.00248	0.017564	0.017487
7	0.00540	0.00248	0.015915	0.015577
8	0.00540	0.00248	0.014358	0.013745
9	0.00540	0.00248	0.012902	0.012028
10	0.00540	0.00248	0.011559	0.010383
11	0.00540	0.00248	0.010335	0.008769
12	0.00540	0.00248	0.009242	0.007621
13	0.00540	0.00248	0.008288	0.007137
14	0.00540	0.00248	0.007484	0.007115
15	0.01681	0.00512	0.006774	0.007142
16	0.01681	0.00512	0.006101	0.007285
17	0.01681	0.00512	0.005805	0.007432
18	0.01681	0.00512	0.006023	0.007480
19	0.01681	0.00512	0.006572	0.007476
20	0.03847	0.01083	0.007147	0.007566
21	0.03847	0.01083	0.007841	0.007711
22	0.03847	0.01083	0.008253	0.007837
23	0.03847	0.01083	0.008165	0.007916
24	0.03847	0.01083	0.007766	0.007959
25	0.02834	0.01084	0.007448	0.008000
26	0.02834	0.01084	0.007112	0.008039
27	0.02834	0.01084	0.006913	0.008011
28	0.02834	0.01084	0.006962	0.007886
29	0.02834	0.01084	0.007157	0.007692
30	0.01634	0.01051	0.007287	0.007479
31	0.01634	0.01051	0.007394	0.007233
32	0.01634	0.01051	0.007425	0.006986
33	0.01634	0.01051	0.007333	0.006761

- 1 K = Age
- 2 HMIGIN = International Migrants-Males
- 3 MMIGIN = International Migrants-Females
- 4 NH = Rural to Urban Migrants-Males
- 5 NM = Rural to Urban Migrants-Females.

Continuation Table A-9

K	HMIGIN	MMIGIN	NH	NM
34	0.01634	0.01051	0.007147	0.006537
35	0.00991	0.00516	0.006970	0.006299
36	0.00991	0.00516	0.006811	0.006079
37	0.00991	0.00516	0.006528	0.005746
38	0.00991	0.00516	0.006073	0.005244
39	0.00991	0.00516	0.005519	0.004651
40	0.00694	0.00344	0.004972	0.004075
41	0.00694	0.00344	0.004391	0.003466
42	0.00694	0.00344	0.003978	0.003064
43	0.00694	0.00344	0.003837	0.002990
44	0.00694	0.00344	0.003870	0.003122
45	0.00302	0.00233	0.003867	0.003227
46	0.00302	0.00233	0.003863	0.003362
47	0.00302	0.00233	0.003839	0.003377
48	0.00302	0.00233	0.003761	0.003177
49	0.00302	0.00233	0.003639	0.002842
50	0.00165	0.00130	0.003546	0.002556
51	0.00165	0.00130	0.003506	0.002299
52	0.00165	0.00130	0.003303	0.002038
53	0.00165	0.00130	0.002846	0.001782
54	0.00165	0.00130	0.002249	0.001544
55	0.00106	0.00136	0.001676	0.001302
56	0.00106	0.00136	0.001050	0.001027
57	0.00106	0.00137	0.000711	0.000921
58	0.00106	0.00137	0.000830	0.001071
59	0.00106	0.00137	0.001231	0.001372
60	0.00106	0.00137	0.001584	0.001654
61	0.00106	0.00137	0.001978	0.001977
62	0.00107	0.00137	0.002166	0.002116
63	0.00107	0.00137	0.001995	0.001952
64	0.00107	0.00137	0.001599	0.001600
65 ⁺	0.00107	0.00137	0.009651	0.013038

6 This distribution was estimated by disaggregation of the values for decennial age groups given by D.N.P. in Colombia : Proyecciones de Población 1975-2.000 . Doc. D.N.P.-UDRU-003, Bogotá, D.E., Oct., 1977, p. 53. The estimated international annual migration rate for the intercensal period 1964-1973 was .0024. A vector of exogenous rates in introduced in the model by gradually decreasing this rate to .0012 in the year 2 000 .

Cont....

Continuation Table A-9

7 This distribution was estimated using the residual method to estimate age specific net migration flows in the intercensal period 1964-1973. The method consists on projecting the 1964 age specific population to year 1973 using age specific fertility and survival rates observed during the intercensal period. The result is the expected age specific population in the absence of migration. This population is then subtracted from the actual population estimated in the 1973 Census to obtain age specific net migration flows. The percent distribution by age is obtained as a final step.

Sources : Populations : DANE, 1964, 1973 Census Publications. (See note 1 of Table A-2 for reference).

Fertility Rates : Bogue, et.al (See note 3 of Table A-3 for reference).

Survival Rates : Bayona, Op. Cit., (See note 1 of Table A-1 for reference).

TABLE A-10

ESTIMATED SURVIVAL RATES BY SEX AND AGE FOR VALUES OF LIFE EXPECTANCY
AT BIRTH FROM 50 TO 75 YEARS *

K ¹	MP(x) ² 50	HP(x) ³ 50	MP(x) 55	HP(x) 55
0	0.93530	0.93490	0.95780	0.95540
1	0.98080	0.98020	0.98200	0.98140
2	0.98527	0.98480	0.98622	0.98575
3	0.98974	0.98940	0.99045	0.99010
4	0.99421	0.99400	0.99467	0.99445
5	0.99870	0.99860	0.99890	0.99880
6	0.99848	0.99834	0.99872	0.99858
7	0.99826	0.99808	0.99854	0.99836
8	0.99804	0.99782	0.99836	0.99814
9	0.99782	0.99756	0.99818	0.99792
10	0.99760	0.99730	0.99800	0.99770
11	0.99736	0.99706	0.99780	0.99750
12	0.99712	0.99682	0.99760	0.99730
13	0.99688	0.99658	0.99740	0.99710
14	0.99664	0.99634	0.99720	0.99690
15	0.99640	0.99610	0.99700	0.99670
16	0.99618	0.99586	0.99682	0.99650
17	0.99596	0.99562	0.99664	0.99630
18	0.99574	0.99538	0.99646	0.99610
19	0.99552	0.99514	0.99628	0.99590
20	0.99530	0.99490	0.99610	0.99570
21	0.99490	0.99446	0.99576	0.99532
22	0.99450	0.99402	0.99542	0.99494
23	0.99410	0.99358	0.99508	0.99456
24	0.99370	0.99314	0.99474	0.99418
25	0.99330	0.99270	0.99440	0.99380
26	0.99290	0.99226	0.99408	0.99344
27	0.99250	0.99182	0.99376	0.99308
28	0.99210	0.99138	0.99344	0.99272
29	0.99170	0.99094	0.99312	0.99236
30	0.99130	0.99050	0.99280	0.99200
31	0.98090	0.99006	0.99248	0.99164
32	0.98050	0.98962	0.99216	0.99128
33	0.98010	0.98918	0.99184	0.99092

- 1 K = Age
- 2 MP(x) = Survival Rates-Females (Age x=50)
- 3 HP(x) = Survival Rates-Males (Age x=50)

Cont....

Continuation Table A-10

K	MP(X) 50	HP(X) 50	MP(X) 55	HP(X) 55
34	0.98970	0.98874	0.99152	0.99056
35	0.98930	0.98830	0.99120	0.99020
36	0.98890	0.98786	0.99086	0.98984
37	0.98850	0.98742	0.99052	0.98948
38	0.98810	0.98698	0.99018	0.98912
39	0.98770	0.98654	0.98984	0.98876
40	0.98730	0.98610	0.98950	0.98840
41	0.98630	0.98504	0.98870	0.98746
42	0.98530	0.98398	0.98790	0.98652
43	0.98430	0.98292	0.98710	0.98558
44	0.98330	0.98186	0.98630	0.98464
45	0.98230	0.98080	0.98550	0.98370
46	0.98128	0.97972	0.98456	0.98276
47	0.98026	0.97864	0.98362	0.98182
48	0.97924	0.97756	0.98268	0.98088
49	0.97822	0.97648	0.98174	0.97994
50	0.97720	0.97540	0.98080	0.97900
51	0.97534	0.87340	0.97920	0.97728
52	0.97348	0.97140	0.97760	0.97556
53	0.97162	0.96940	0.97600	0.97384
54	0.96976	0.98740	0.97440	0.97212
55	0.96790	0.96540	0.97280	0.97040
56	0.96604	0.96342	0.97120	0.96866
57	0.96418	0.96144	0.96960	0.96692
58	0.96232	0.95946	0.96800	0.96518
59	0.96046	0.95748	0.96640	0.96344
60	0.95860	0.95550	0.96480	0.96170
61	0.95640	0.95328	0.96264	0.95952
62	0.95420	0.95106	0.96048	0.95734
63	0.89200	0.88884	0.89832	0.89576
64	0.86980	0.86662	0.87616	0.87298
65+	0.77760	0.77440	0.78400	0.78080

Cont....

Continuation Table A-10

X	MP(X) 60	HP(X) 60	MP(X) 65	HP(X) 65
0	0.96440	0.96020	0.96630	0.96310
1	0.98290	0.98260	0.98450	0.98310
2	0.98695	0.98690	0.99882	0.98712
3	0.99100	0.99080	0.99190	0.99115
4	0.99505	0.99490	0.99560	0.99517
5	0.99910	0.99900	0.99930	0.99920
6	0.99896	0.99882	0.99922	0.99908
7	0.99882	0.99864	0.99914	0.99896
8	0.99868	0.99846	0.99906	0.99884
9	0.99854	0.99828	0.99898	0.99872
10	0.99840	0.99810	0.99890	0.99860
11	0.99826	0.99794	0.99882	0.99848
12	0.99812	0.99778	0.99874	0.99836
13	0.99798	0.99762	0.99866	0.99824
14	0.99784	0.99746	0.99858	0.99812
15	0.99770	0.99730	0.99850	0.99800
16	0.99756	0.99714	0.99842	0.99788
17	0.99742	0.99698	0.99834	0.99776
18	0.99728	0.99682	0.99826	0.99764
19	0.99714	0.99666	0.99818	0.99752
20	0.99700	0.99650	0.99810	0.99740
21	0.99674	0.99622	0.99792	0.99718
22	0.99648	0.99594	0.99774	0.99696
23	0.99622	0.99566	0.99756	0.99674
24	0.99596	0.99538	0.99738	0.99652
25	0.99570	0.99510	0.99720	0.99630
26	0.99542	0.99480	0.99702	0.99604
27	0.99514	0.99450	0.99684	0.99578
28	0.99486	0.99420	0.99666	0.99552
29	0.99458	0.99390	0.99643	0.99526
30	0.99430	0.99360	0.99630	0.99500
31	0.99402	0.99330	0.99612	0.99474
32	0.99374	0.99300	0.99594	0.99448
33	0.99346	0.99270	0.99576	0.99422

Cont

Continuation Table A-10

K	MP(X) 60	HP(X) 60	MP(X) 65	HP(X) 65
34	0.99318	0.99240	0.99558	0.99396
35	0.99290	0.99210	0.99540	0.99370
36	0.99262	0.99180	0.99522	0.99344
37	0.99234	0.99150	0.99504	0.99318
38	0.99206	0.99120	0.99486	0.99292
39	0.99178	0.99090	0.99468	0.99266
40	0.99150	0.99060	0.99450	0.99240
41	0.99076	0.98980	0.99396	0.99172
42	0.99002	0.98900	0.99342	0.99104
43	0.98928	0.98820	0.99288	0.99036
44	0.98854	0.98740	0.99234	0.98968
45	0.98780	0.98660	0.99180	0.98900
46	0.98706	0.98580	0.99124	0.98832
47	0.98632	0.98500	0.99068	0.98764
48	0.98558	0.98420	0.99012	0.98696
49	0.98484	0.98340	0.98956	0.98628
50	0.98410	0.98260	0.98900	0.98560
51	0.98274	0.98114	0.98794	0.98434
52	0.98138	0.97968	0.98688	0.98308
53	0.98002	0.97822	0.98582	0.98182
54	0.97866	0.97676	0.98476	0.98056
55	0.97730	0.97530	0.98370	0.97930
56	0.97594	0.97382	0.98264	0.97806
57	0.97458	0.97234	0.98158	0.97682
58	0.97322	0.97086	0.98052	0.97558
59	0.97186	0.96938	0.97946	0.97434
60	0.97050	0.96790	0.97840	0.97310
61	0.96848	0.96576	0.97670	0.97120
62	0.96646	0.96362	0.97500	0.96930
63	0.90444	0.90158	0.91330	0.90740
64	0.88242	0.87934	0.89160	0.88550
65+	0.79040	0.38720	0.79990	0.79360

Cont....

Continuation Table A-10

K	MP(X) 70	HP(X) 70	MP(X) 75	HP(X) 75
0	0.97410	0.97020	0.97670	0.97540
1	0.98700	0.98560	0.98740	0.98720
2	0.99010	0.98902	0.99042	0.99025
3	0.99320	0.99245	0.99345	0.99330
4	0.99630	0.99587	0.99647	0.99635
5	0.99940	0.99930	0.99950	0.99940
6	0.99936	0.99924	0.99950	0.99936
7	0.99932	0.99918	0.99950	0.99932
8	0.99928	0.99912	0.99950	0.99928
9	0.99924	0.99906	0.99950	0.99924
10	0.99920	0.99900	0.99950	0.99920
11	0.99916	0.99894	0.99948	0.99918
12	0.99912	0.99888	0.99946	0.99916
13	0.99908	0.99882	0.99944	0.99914
14	0.99904	0.99876	0.99942	0.99912
15	0.99900	0.99870	0.99940	0.99910
16	0.99896	0.99864	0.99938	0.99908
17	0.99892	0.99858	0.99936	0.99906
18	0.99888	0.99852	0.99934	0.99904
19	0.99884	0.99846	0.99932	0.99902
20	0.99880	0.99840	0.99930	0.99900
21	0.99872	0.99826	0.99924	0.99892
22	0.99864	0.99812	0.99918	0.99884
23	0.99856	0.99798	0.99912	0.99876
24	0.99848	0.99784	0.99906	0.99868
25	0.99840	0.99770	0.99900	0.99860
26	0.99834	0.99756	0.99894	0.99854
27	0.99828	0.99742	0.99888	0.99848
28	0.99822	0.99728	0.99882	0.99842
29	0.99816	0.99714	0.99876	0.99836
30	0.99810	0.99700	0.99870	0.99830
31	0.99802	0.99686	0.99864	0.99824
32	0.99794	0.99672	0.99858	0.99818
33	0.99786	0.99658	0.99852	0.99812

Cont

Continuation Table A-10

K	MP(X) 70	HP(X) 70	MP(X) 75	HP(X) 75
34	0.99778	0.99644	0.99846	0.99806
35	0.99770	0.99630	0.99840	0.99800
36	0.99762	0.99616	0.99834	0.99794
37	0.99754	0.99602	0.99828	0.99788
38	0.99746	0.99588	0.99822	0.99782
39	0.99738	0.99574	0.99816	0.99776
40	0.99730	0.99560	0.99810	0.99770
41	0.99696	0.99512	0.99784	0.99740
42	0.99662	0.99464	0.99758	0.99710
43	0.99628	0.99416	0.99732	0.99680
44	0.99594	0.99368	0.99706	0.99650
45	0.99560	0.99320	0.99680	0.99620
46	0.99524	0.99274	0.99654	0.99590
47	0.99488	0.99228	0.99628	0.99560
48	0.99452	0.99182	0.99602	0.99530
49	0.99416	0.99136	0.99576	0.99500
50	0.99380	0.99090	0.99550	0.99470
51	0.99500	0.98990	0.99496	0.99400
52	0.99620	0.98890	0.99442	0.99330
53	0.99740	0.98790	0.99388	0.99260
54	0.99860	0.98690	0.99334	0.99190
55	0.99980	0.98590	0.99280	0.99120
56	0.99698	0.98492	0.99224	0.99052
57	0.99416	0.98394	0.99168	0.98984
58	0.99134	0.98296	0.99112	0.98916
59	0.98852	0.98198	0.99056	0.98848
60	0.98570	0.98100	0.99000	0.98780
61	0.98398	0.97938	0.98790	0.98588
62	0.98226	0.97776	0.98580	0.98396
63	0.92054	0.91614	0.92370	0.92049
64	0.89882	0.89452	0.90160	0.90012
65+	0.80710	0.80290	0.80950	0.80820

* An initial set of survival rates was obtained for ages 1, 5, 20, 40, 60, and 65+ using the Lx columns of life tables estimated for the U.S. in the N.C.H.S. publication entitled U.S. Decennial Life Tables for 1969-71, Vol. 1, #1, pp 6, 16, 18 and 26. Values for intermediate ages were obtained by linear interpolation among the estimated values. Survival rates for age

Cont....

Continuation Table A-10

O were taken from life tables corresponding to the west region in Ansley Coale and Paul Demeny, Regional Model Life Tables and Stable Populations, Princeton : Princeton Univ. Press, 1966, since this region approximates well the infant mortality patterns of the Colombian population. Some minor modifications were also made in survival rates for ages 61 to 65+ to adjust the survival schedule to the observed gross mortality rate for year 1973.

TABLE A-11
 INPUT - OUTPUT TABLE AT PURCHASER'S PRICES. COLOMBIA 1970 ^{1/}
 (MILLIONS OF PESOS)

Products ² Sectors.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Int. Cons.
1. Agriculture	702	0	19629	1112	325	21	10	0	0	0	0	10	23	1049	22881
2. Mining.	0	39	1	0	7	1165	331	300	4	27	37	107	6	0	2024
3. Food, Bev. Tabacco	1318	0	3398	447	51	456	1	1	0	0	0	0	0	3746	9418
3. Textiles	267	0	113	3792	60	298	4	20	3	54	2	0	0	300	4922
5. Paper, Wood, Leather	25	2	399	52	1239	620	75	74	96	80	8	285	71	1079	4105
6. Rubber and Chemicals	1613	43	415	968	380	2902	223	193	204	258	167	619	1873	881	10739
7. Non Metallic Products	32	7	168	2	12	97	211	13	35	14	2	2245	3	54	2895
8. Metals and Metallic P.	31	7	372	20	72	147	69	1611	802	425	59	1888	51	132	5686
9. Machinery	58	80	231	173	113	146	107	167	411	90	180	105	146	212	2219
10. Other Industry	18	22	88	127	18	28	12	31	19	1004	25	26	500	780	2698
11. Electricity	9	143	176	145	69	186	90	78	20	20	60	26	55	444	1511
12. Construction	10	13	15	12	10	6	3	7	0	2	16	0	36	946	1076
13. Transportation-Communic.	292	320	1059	282	272	225	90	224	83	103	24	199	1664	4591	9428
14. Services	405	110	466	247	387	453	65	305	179	154	94	489	807	6350	10511
Total Intermediate Cons.	4780	786	26530	7379	3015	6750	1291	3024	1856	2221	674	5999	5244	20564	90113

Cont..

Continuation Table A-11

VALUE ADDED

	Agriculture	Mining.	Food Bev. Tobacco	Textiles	Paper Wood Leather	Rubber Chemicals	Non Metallic	Metals	Machinery	Other Industry	Electricity	Construction	Trans. - Communic.	Services	Total
Labour Payments	10094	759	2309	2442	981	1468	644	1015	577	426	652	5377	5136	21931	53811
Capital Payments	24518	2161	4075	1607	1062	1672	826	519	502	528	761	957	6719	21706	67613
Indirect Taxes-Subsidies	- 207	-325	4523	136	63	1057	43	53	101	179	- 11	314	-169	1067	6824
Imports-CIF	773	28	964	217	935	3172	206	2223	4453	3605	0	0	1826	880	19282
Import Taxes	109	4	211	67	156	661	57	457	679	691	0	0	0	0	3100
Margin	(2126)	(84)	(120)	(21)	(43)	(378)	(16)	(43)	(75)	(1)	(702)	(2123)	(51)	(18913)	(24696)
Total Supply	37941	3329	38492	11869	6255	14402	3051	7428	8093	7649	2778	14770	18815	47235	221927

Source : DANE . Input-Output Matrix - Colombia . 1970.

Cont....

FINAL DEMAND

Continuation Table A-11

Products	Priv. Cons.	Govern. Cons.	Priv. Inv.	Public. Inv.	Inventory Changes	Exports FOB	Margin	Total Supply
1. Agriculture	13917	0	1147	0	980	2122	(3106)	37941
2. Mining	0	0	0	0	-7	1312	-0	3329
3. Food. Bev. Tabacco	24316	0	0	0	498	9366	(5106)	11869
4. Textiles Leather	8206	0	0	0	497	839	(2595)	11869
5. Paper, Wood, Leather	2811	0	195	18	116	161	(1151)	6255
6. Rubber and Chemicals	6223	0	0	0	289	435	(3284)	14402
7. Non Metallic Products	376	0	0	0	12	161	(393)	3051
8. Metals and Metallic P.	594	0	1568	18	449	135	(1202)	7248
9. Machinery	1256	0	4685	227	148	83	(525)	8093
10. Other Industry	2250	0	3497	196	418	44	(1454)	7649
11. Electricity	1259	0	0	0	8	0	0	2778
12. Construction	0	0	9969	3725	0	0	0	14770
13. Transportation-Communic.	7419	0	0	0	0	1968	0	18815
14. Services	23961	12284	0	0	0	479	0	47235
TOTAL	92588	12284	21061	4184	3408	17105	(18816)	221927

- A.31 -

1. A detailed description of the 31 x 31 original DANE input-output matrix for year 1970, as well as methodological procedures for its estimation can be found in Evaristo Arrieta, Jorge Centenario, Heli Cedano, "Cuentas Nacionales e Insumo - Producto : Una Aplicación para Colombia". Revista de Planeación y Desarrollo, VII, 1, Jan-June, 1975, pp. 101-123.

Cont

Continuation Table A-11

2. The following aggregates were made to obtain our 14 x 14 input-output matrix from the DANE original 1970 matrix :

Sector in Colombia 2.000 includes sectors in DANE, 1970

- | | |
|-----------------------------|---|
| 1. Agriculture | 1. Agriculture, |
| | 2. Forestry |
| | 3. Hunting and Fishing. |
| 2. Mining | 4. Mining |
| 3. Food, Beverages, Tobacco | 5. Elaborated Coffee |
| | 6. Meats. |
| | 7. Cereals. |
| | 8. Milky Products. |
| | 9. Sugar |
| | 10. Beverages. |
| | 11. Elaborated Tobacco |
| | 12. Other Elaborated Agricultural Products. |

Table A.11 (Cont.)

Sector in Colombia 2000 includes	Sectors in DANE, 1970
4. Textiles,Leather	13. Textiles, Dress Making, Leather.
5. Paper, Wood.	14. Lumber and Furniture.
	15. Paper and Press.
6. Rubber and Chemicals.	16. Rubber and Chemical Products.
	17. Oil Refining
7. Non Metallic Products.	18. Elaborated non Metallic Products.
8. Metallic Products.	19. Metals and Elaborated Metallic Products.
9. Machinery	20. Machinery and Equipment.
10. Other Industry	21. Transportation Materials.
	22. Other Manufactured Products.
11. Electricity, Gas, Water	23. Electricity, Gas, Water.
12. Construction	24. Construction and Public Works.
13. Transportation and Communications.	26. Transportation
	27. Communications.
14. Services.	25. Commerce
	28. Banks, Insurance, Services to Enterprises.

Table A.11 (Cont.)

Sector in Colombia 2000 includes Sectors in DANE, 1970

- 29. Rent.
- 30. Personal Services.
- 31. Government Services

Sectorial values were adjusted proportionally to conform the DANE table totals to totals given by Banco de la República, National Accounts 1950-68, 1968-73, 1970-1976, for year 1970.

TABLE A-12

NATIONAL ACCOUNTS SERIES USED TO ESTIMATE FINAL DEMAND COMPONENTS

(MILLIONS OF COLOMBIAN PESOS OF 1970)

Year	(1) Corporate Savings (SR)	(2) Government Savings (SG)	(3) Government Consumption (CG)	(4) Exports (E)	(5) Gross National Product (GNP)
1950	5.275.01	2.416.27	3.450.1	8.441.0	49.851.0
1951	5.853.83	3.340.84	3.893.8	9.440.7	51.417.0
1952	4.943.38	2.824.21	4.135.3	9.536.7	54.666.9
1953	4.747.60	2.474.00	4.962.6	11.740.2	57.997.2
1954	7.877.35	4.732.55	5.148.9	10.559.6	61.932.9
1955	8.391.29	4.805.20	5.353.6	10.730.8	64.407.0
1956	9.024.85	4.433.65	4.636.1	11.050.6	66.971.0
1957	9.735.20	3.715.22	4.620.7	11.093.5	68.515.5
1958	10.802.81	3.685.98	4.829.3	11.735.6	70.176.8
1959	10.838.91	4.159.88	4.892.6	13.612.7	75.271.5
1960	11.220.74	4.071.43	5.397.0	13.640.1	78.438.4
1961	10.938.49	3.205.25	5.693.1	12.731.2	82.444.0
1962	10.994.14	1.745.98	6.129.3	13.762.8	86.919.1
1963	11.739.70	1.366.04	6.524.4	13.432.4	89.776.6
1964	11.685.52	4.008	6.612.5	14.208.2	95.302.8
1965	11.812.44	3.900.00	7.032.4	15.136.4	98.750.3
1966	12.341.25	5.092.79	7.345.3	14.878.9	104.026.5
1967	11.897.34	5.267.68	7.863.5	16.183.3	108.416.6
1968	12.369.69	6.645.07	7.958.9	17.527.3	115.035.6
1969	13.047.16	8.507.04	8.624.4	18.356.0	122.347.5
1970	13.527.90	7.660.80	9.961.6	18.515.8	130.590.8

SOURCE : Banco de la República. National Accounts, 1950-1967, National Accounts 1968-1972, and National Accounts of Colombia 1970-1976. The implicit deflator was used to obtain the series in Colombian pesos of 1970.

TABLE A-13

SECTORIAL DISTRIBUTION OF VALUE ADDED, IMPORT TAXES, AND RATIO OF VALUE ADDED TO TOTAL OUTPUT

COLOMBIA, 1970

Sector	(1) Gross Value Added ^{1,2} (YAB)	(2) Capital Payments (CAPI)	(3) Labour Payments (SALA)	(4) Net Value Added ^{1,3} (VAN)	(5) Capital Share ⁴	(6) Labour Share ⁵
1. Agriculture	33.161	24.518	10.094	34.612	.7084	.2916
2. Mining	2.543	2.161	759	2.920	.7401	.2599
3. Food, Bev, Tob.	11.962	4.075	2.309	6.384	.6383	.3617
4. Textiles	4.490	1.607	2.442	4.049	.3969	.6031
5. Paper, Wood, L.	3.240	1.062	981	2.043	.5198	.4802
6. Rubber and Ch.	7.652	1.672	1.468	3.140	.5325	.4675
7. Non Metallic P.	1.760	826	644	1.470	.5619	.4381
8. Metallic P.	4.224	519	1.015	1.534	.3383	.6617
9. Machinery	6.237	502	577	1.079	.4652	.5348
10. Other Industry	5.428	528	426	954	.5535	.4465
11. Elect., Gas, Water	2.104	761	652	1.413	.5386	.4614
12. Construction	8.771	957	5.377	6.334	.1511	.8489
13. Transp-Comm.	13.571	6,719	5.136	11.855	.5668	.4332
14. Services	26.671	21.706	21.931	43.637	.4974	.5026
TOTAL	131.814	67.713	53.811	121.424	.5577	.4432

Cont'....

Continuation Table A-13

Sector	(7)	(8)	(9)	(10)
	Ratio of Net of Gross Value Added ⁶	Total Output ^{1,2}	Ratio of Total Output To Gross Value Added ⁷	Import Taxes ^{2,8}
	(RVANB)	(OT)	(COEF)	(VIMP)
1. Agriculture	1.0438	37.941	1.1441	.1410
2. Mining	1.1483	3.329	1.3091	.1429
3. Food, Bev, Tob.	.5337	38.492	3.2179	.2189
4. Textiles	.9018	11.869	2.6434	.3088
5. Paper, Wood, L.	.6306	6.255	1.9306	.1668
6. Rubber and Ch.	.3104	14.402	1.8821	.2084
7. Non Met. P.	.8352	3.051	1.7335	.2767
8. Metallic P.	.3632	7.248	1.7159	.2056
9. Machinery	.1730	8.993	1.2976	.1525
10. Other Industry	.1758	7.649	1.4092	.1907
11. Elect., Gas, Water	.6716	2.778	1.3203	0
12. Construction	.7222	14.770	1.6840	0
13. Transp. Com.	.8736	18.815	1.3864	.0044
14. Services	1.6361	47.235	1.7710	0
TOTAL	.9112	221.927	1.6836	.1613

1. Millions of Colombian pesos of 1970.

2. Source : DANE, - Input-Output Table for year 1970. (See Table A-11 of this Appendix).

3. Net Value Added = Capital Payments + Labour Payments = Gross Value Added - Indirect Taxes + Subsidies - Imports - Import Taxes.

Cont

Continuation Table A-13

4. Coefficient obtained by dividing, Capital Payments by Net Value Added (Columns (2) by column (4) in this table).
5. Coefficient obtained by dividing Labour Payments by Net Value Added. (Columns (3) by Column (4) in this table).
6. Ratio obtained by dividing column (4) by column (1) in this table.
7. Ratio obtained by dividing column (8) by column (1) in this table.
8. Ratio obtained by dividing Import Taxes by Total Imports in the Input-Output Table. (See Table A-11 of this Appendix).

TABLE A-14

MATRIX OF CAPITAL INCOME RECEIVED BY SOCIOECONOMIC GROUPS BY SECTOR-COLOMBIA. 1970

(THOUSANDS OF COLOMBIAN PESOS OF 1970)

Socioeconomic Group	(1) Agric.	(2) Mining	(3) Manufact.	(4) Elect, G,W,	(5) Construc.	(6) Transport.	(7) Services	Total	%
Urban									
1. Capitalists n = 61	330.0	38.4	473.3	32.4	185.4	484.8	1061.2	2605.5	.1290
2. Professionals-Tech. n = 746	442.1	84.1	856.8	98.4	411.8	1128.6	2501.3	5523.1	.2734
3. Independent Workers n = 961	777.6	25.2	333.8	244.2	428.0	2022.5	5511.7	9343.0	.4626
4. Low Wage Earners n = 798	0	0	0	0	0	0	0	0	0
Rural									
5. Latifundists n = 16	64.8	0	19.3	0	32.1	11.4	96.8	224.4	.0111
6. Medium-Small Farmers n = 1209	1228.2	0	41.8	0	45.8	164.4	1013.3	2502.5	.1239
7. Low Wage Earners n = 1059	0	0	0	0	0	0	0	0	0
TOTAL n = 4850	2842.7	156.7	1725.0	375.0	1103.1	3811.7	10184.3	20198.5	100.0

SOURCE : DANE, Household Income - Expenditures Survey, E.H.4, 1970, and computer cross tabulations.

TABLE A-15

MATRIX OF LABOUR INCOME RECEIVED BY SOCIOECONOMIC GROUPS BY SECTOR COLOMBIA. 1970

(THOUSANDS OF COLOMBIAN PESOS OF 1970)

Socioeconomic Group	(1) Agric.	(2) Mining	(3) Manufact.	(4) Elect,G.W.	(5) Construc.	(6) Transport.	(7) Services	Total	%
Urban									
1. Capitalists n = 61	971.5	132.1	1123.0	53.5	468.5	1018.7	2515.3	6282.6	.0615
2. Professionals-Tech. n = 746	1612.1	459.7	3606.7	391.3	1836.7	5010.2	7663.6	20580.3	.2015
3. Independent Workers n = 961	4494.7	118.8	1559.4	535.8	1993.9	5401.3	7636.7	24740.6	.2422
4. Low Wage Earners n = 798	784.7	482.5	2432.1	209.6	966.2	5446.1	11801.0	22122.2	.2166
Rural									
5. Latifundists n = 16	101.4	0	73.6	0	42.3	32.9	178.0	428.2	.0042
6. Medium-Small Farmers n = 1209	10601.5	103.5	562.6	0	296.4	1299.1	1998.2	14861.3	.1455
7. Low Wage Earners n = 1059	8124.8	634.2	1157.7	110.3	609.6	698.7	1790.0	13125.3	.1285
TOTAL n =4850	26690.7	1930.8	10515.1	1300.5	6213.6	21907.0	33582.8	102140.5	100.0

SOURCE : DANE, Household Income-Expenditures Survey, E.H. 4, 1970, and computer cross tabulations.

TABLE A-16

AVERAGE ANNUAL EXPENDITURES BY CATEGORY, TOTAL EXPENDITURES, AND FAMILY SIZE, BY DEPARTMENT
(THOUSANDS OF COLOMBIAN PESOS OF 1970)

GROUPS 1 AND 5 : CAPITALISTS AND LATIFUNDISTS

Dept 1	Family Size	Food ²	Total Expenditures	Savings	Textiles	Non Metallic	Metalic	Other Industry	Electricity	Construc.	Services	Transp.
1	6.5500	23.7710	83.3499	14.0486	5.6387	0.6096	0.8965	1.0776	2.1222	28.6480	14.9889	5.5974
2	8.3333	37.5455	190.3578	83.2255	23.8533	2.0950	6.8583	1.4813	15.0680	42.3853	54.3070	6.7640
3	6.4333	50.4555	119.4336	6.0197	10.1174	1.5618	2.5367	2.1247	2.8284	34.8169	21.3887	13.6036
4	5.6667	31.2480	69.1640	0.0000	4.7000	0.2900	1.5333	1.4000	3.2000	16.9315	9.2813	0.5800
5	10.5000	39.6985	91.9630	0.0000	13.2865	0.2900	1.2000	0.6420	3.1380	17.8200	14.9520	0.9860
6	7.0000	19.8220	31.9770	21.9730	3.3430	0.1400	0.0000	0.9360	0.7920	0.6000	5.1920	1.1520
8	3.0000	14.7230	35.9910	12.4090	7.3000	0.3000	1.0000	0.8280	0.1800	7.2000	3.8000	0.6600
10	3.0000	20.6270	50.8490	0.0000	4.7400	0.2000	0.0000	6.6000	0.0120	3.6600	15.0100	0.0000
14	3.0000	22.8030	117.9450	48.4550	14.0200	0.9500	8.9500	1.7400	1.6200	24.0000	30.6500	13.2120
17	5.0000	9.2660	12.4860	1.3740	1.8220	0.2100	0.0000	0.1800	0.0240	0.6000	0.0000	0.3840
18	7.5000	46.5725	133.9410	20.1840	9.3420	1.7950	2.6250	2.5490	3.9900	36.6380	24.5795	5.8500
19	8.0000	27.1300	98.4970	16.1430	5.2590	0.1000	0.0000	1.6560	1.8000	33.0960	22.3160	6.8400
20	8.1667	36.7915	112.0968	14.7582	9.4297	1.1058	1.9928	1.7213	5.8680	25.1507	21.7000	8.3370

1 Codes for departments (political divisions) are :

1 = Atlántico, 2 = Bolívar, 3 = Córdoba, 4 = Santander, 5 = Cundinamarca, 6 = Boyacá, 7 = Bogotá, D.E.

8 = Antioquia, 9 = Caldas, 10 = Huila, 11 = Cauca, 12 = Magdalena, 13 = Cesar, 14 = Norte de Santander, 15 = Tolima, 16 = Risaralda,

17 = Quindío, 18 = Chocó, 19 = Valle, 20 = Nariño.

2 See note 1 of Table 3.8 for items included in each expenditure category.

Cont ...

Continuation Table A-16

GROUP 2 : PROFESSIONALS - TECHNICIANS.

Dept.	Family Size	Food	Total Expenditures	Savings	Textiles	Non Metallic	Metallic	Other Industry	Electricity	Construc.	Services	Transp.
1	7.5106	14.7314	39.3772	0.0000	3.1412	0.3624	2.1347	0.4647	1.3227	6.9357	9.0473	1.2382
2	7.6190	16.5604	33.6188	0.0000	3.2749	0.1560	0.9546	0.7116	1.4223	5.5031	3.8903	1.1457
3	6.5946	16.7922	50.2183	0.2255	5.2435	0.3334	1.0001	1.0102	1.8182	13.6100	8.0416	2.3961
4	6.1842	16.2947	38.1584	0.0000	3.8423	0.5932	1.9384	0.6322	1.3364	5.4507	2.7213	5.3492
5	4.9286	16.7147	35.5057	0.0000	3.7709	0.3284	3.2590	0.5606	1.1331	5.5893	3.6307	0.5189
6	7.5349	14.9621	32.7268	0.0000	3.3511	0.3634	1.3262	0.7142	1.4375	4.5199	5.2825	0.7700
7	7.5000	17.1372	40.7423	0.0000	5.4050	0.7775	1.6667	1.0860	1.0920	7.7385	5.3517	0.4880
8	6.0000	10.2216	16.7697	0.0000	2.5021	0.1150	0.0000	0.5726	0.7526	2.1113	0.4260	0.0686
9	6.0417	10.1410	35.2692	0.0000	2.2425	0.0971	0.6083	0.2575	0.3865	2.4714	3.6983	15.3667
10	5.0000	9.3410	16.3170	3.6397	1.2017	0.1867	0.2000	0.0000	0.6800	2.2810	1.7067	0.7200
11	6.2857	14.2027	25.9846	0.0587	3.1025	0.5278	1.7556	0.7069	0.4354	3.8642	1.2707	0.1189
12	6.6296	10.4441	18.4533	0.0000	1.2261	0.0855	0.8867	0.2809	0.5649	2.9331	1.8698	0.1622
13	6.8000	18.4933	34.6928	5.8716	3.6195	0.3613	0.3200	1.1320	1.1480	5.7136	3.1667	0.7384
14	7.6000	14.3315	38.9900	0.0000	3.5125	0.5180	2.4467	0.6328	0.6690	3.8764	4.0751	8.9368
15	6.3704	9.0516	19.0572	2.3402	1.9045	0.0986	0.2978	0.3163	0.8360	4.3469	1.7199	0.4858
16	7.1739	13.6368	29.1299	0.0000	2.2572	0.2527	0.5649	0.7525	1.2355	6.7570	2.884	0.8249
17	6.7429	17.8961	43.2647	0.0000	5.3735	1.1739	2.8453	1.2327	1.8171	7.6909	4.4120	0.8233
18	7.5200	11.7362	29.0916	0.0000	2.6908	0.1536	0.1760	0.7438	1.4664	6.4330	3.3578	2.3342
19	6.9524	15.2454	39.3276	0.0000	3.2118	0.7658	1.5067	0.9017	1.4914	6.9807	4.7885	4.4356
20	6.2381	13.3665	30.7305	1.5021	2.8902	0.1553	0.8934	0.6915	1.2629	6.8918	3.4387	1.1402

Cont....

Continuation Table A-16

GROUP 3 : INDEPENDENT WORKERS-URBAN

Dept.	Family Size	Food	Total Expenditures	Savings	Textiles	Non Metallic	Metalic	Other Industry	Electricity	Construc.	Services	Transp.
1	6.6040	16.6733	45.9416	6.8925	3.9771	0.4356	0.8741	0.7174	2.2852	11.1531	7.1183	2.7075
2	7.8081	18.5216	39.8845	0.0000	3.9922	0.3599	0.7049	0.7832	1.6982	6.0482	5.1582	2.6229
3	5.3582	19.2356	60.6398	0.9447	4.5523	0.3707	0.8250	1.1516	2.2429	21.4602	8.3934	2.4035
4	6.2195	12.1657	23.8495	0.0000	2.1359	0.0727	0.0928	0.4756	4.4188	4.4188	2.7104	0.8982
5	6.2000	18.8690	47.9897	0.0000	5.2179	0.3193	0.7016	0.9314	1.7779	10.4308	7.3179	2.4239
6	6.1296	12.6032	26.4010	0.0000	3.4108	0.3344	1.1271	0.3963	1.1922	4.0231	2.7536	0.5602
7	6.2000	17.6841	48.1624	0.0000	4.6106	0.6697	0.7300	1.0820	1.8852	10.3349	8.4815	2.6844
8	6.8077	7.9945	15.0336	1.2633	1.9467	0.0881	0.0135	0.2885	0.7002	2.0145	1.6623	0.3254
9	6.5316	11.4753	19.4558	1.5754	1.6870	0.2216	0.1986	0.3056	0.9485	2.5064	1.5843	0.5285
10	4.6110	9.9571	20.8079	0.0760	1.2413	0.1169	0.0561	0.2507	0.7300	5.4333	2.0895	0.9309
11	6.0476	11.3582	19.1855	0.0000	2.1787	0.4547	0.4892	0.2834	0.3149	3.1026	0.9850	0.0189
12	5.1915	9.6810	20.6557	0.6287	1.5501	0.0742	0.3872	0.2571	0.7093	5.1014	2.5816	0.2837
13	6.8462	24.1420	57.3303	0.0000	5.1468	0.9098	0.8200	0.7985	1.8434	10.8692	9.0865	3.7132
14	4.9545	8.1346	14.3877	1.9462	1.6913	0.2928	0.6813	0.2419	0.3873	1.6824	0.7836	0.4925
15	6.0698	10.0303	22.4126	0.0000	2.0001	0.0781	1.3140	0.3292	1.0390	5.0713	1.8125	0.7384
16	7.1111	16.2521	52.6079	0.9824	6.2596	1.1763	1.4847	1.3422	1.7653	11.9115	10.3909	2.0253
17	5.4615	20.9586	47.6675	0.0000	2.7851	0.5997	2.0985	1.0223	1.9002	9.8889	7.4208	0.9932
18	4.9737	12.4387	37.3984	1.5686	3.8149	0.3179	0.5158	0.9447	1.2748	9.9928	6.1377	1.9610
19	4.4194	11.6919	28.4909	0.0000	2.2846	0.4223	1.4532	0.5452	1.3486	6.1548	3.7630	0.8272
20	5.7679	16.0284	40.8852	0.0000	4.1357	0.3688	1.5081	0.6802	1.3618	8.2342	5.1871	3.3719

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Cont.....

Continuation Table A-16

GROUP 4 : LOW WAGE EARNERS-URBAN

Dept.	Family Size	Food	Total Expenditures	Savings	Textiles	Non Metallic	Metallic	Other Industry	Electricity	Construc.	Services	Transp.
1	5.9797	12.7166	27.5746	0.0000	2.5348	0.4560	2.1493	0.4539	0.9431	4.8018	2.4550	1.0639
2	6.1400	15.6206	39.7112	2.5292	4.5302	0.4689	1.6833	0.7275	1.7486	7.4719	4.6360	2.8241
3	4.8383	11.1716	30.0331	2.2324	3.2088	0.2774	0.8886	0.6165	1.0188	7.7320	3.7282	1.3912
4	7.3333	16.2862	33.4943	0.3806	3.0811	0.1426	1.4019	0.4879	0.9076	5.1410	5.0466	0.9995
5	5.5000	13.0630	33.5310	0.0000	3.7819	0.2024	1.6207	0.8523	1.1507	7.1913	3.8582	1.8104
6	5.8286	12.4040	32.4914	0.0000	3.3639	0.6210	0.6307	0.6246	1.1787	3.5502	2.1814	5.3099
7	1.7500	3.8070	13.0690	0.3810	1.9400	0.2175	1.9750	0.5310	0.2520	2.1600	1.7665	0.4200
8	6.4286	6.3616	9.8934	0.0000	1.0481	0.0414	0.0000	0.0789	0.3720	1.5406	0.3651	0.0857
9	5.1667	11.0086	17.4862	1.0513	2.1272	0.3220	0.0958	0.3290	0.4060	1.7882	1.1352	0.2740
10	4.2778	7.1894	12.9639	0.0000	1.3165	0.1241	0.0944	0.3813	0.4553	2.4681	0.7300	0.2087
11	6.4000	22.2127	39.0281	0.0000	4.7827	1.0897	1.3957	0.9968	0.7864	4.6240	2.1738	0.9664
12	4.6444	9.5959	17.4126	0.0000	1.3340	0.2062	0.5590	0.3234	0.5581	3.0029	1.6066	0.2355
13	6.1111	17.9796	38.6965	0.0000	6.2657	0.7858	0.6444	0.8027	1.8280	6.1533	3.1358	1.1013
14	5.0000	14.7863	24.7185	2.1911	1.9078	0.1070	0.3708	0.3297	0.5728	3.5239	1.3361	1.7339
15	4.7778	9.3384	18.9838	0.2317	1.8244	0.0304	1.3470	0.5000	0.8720	3.4939	1.0636	0.5142
16	5.9333	15.8168	29.3386	0.0000	3.6029	0.3013	1.4777	0.6721	0.8040	3.5200	2.5231	0.6208
17	5.7500	12.4521	25.6020	0.0000	1.8279	0.2909	0.8150	0.8965	1.1880	5.0267	2.6060	0.5880
18	5.3958	12.0247	29.0501	1.0000	2.9084	0.1936	2.0326	0.6181	1.0932	5.6197	3.5913	0.9684
19	5.6897	14.3331	33.8212	0.0000	4.2156	0.2917	0.9897	0.9032	1.3713	4.4464	5.3048	1.9655
20	5.6437	11.7860	28.5811	0.3313	2.8830	0.2964	1.2625	0.7139	1.0469	5.6939	3.3909	1.5077

Cont ..

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Continuation Table A-16

GROUP 6 : MEDIUM-SMALL FARMERS

Dept.	Family Size	Food	Total Expenditures	Savings	Textiles	Non Metallic	Metallic	Other Industry	Electricity	Construc.	Services	Transp.
1	5.9615	12.0874	16.8330	0.0000	1.2558	0.1361	0.1977	0.1034	0.3288	1.9119	0.6146	0.1972
2	7.0426	10.6553	23.1224	0.0000	2.9350	0.1963	0.5741	0.5341	0.5351	1.7214	5.1667	1.8244
3	6.0000	15.8110	34.6830	0.0000	1.9200	0.0000	0.0000	0.2400	2.1120	6.0000	2.6000	6.0000
4	5.9559	11.1915	15.2637	0.0000	1.2289	0.0358	0.0358	0.0367	0.2002	0.3518	0.7131	0.3700
5	5.5102	9.0576	13.5555	0.0000	1.2373	0.1334	0.0930	0.1370	0.2221	1.0087	1.3207	0.3459
6	6.6522	10.5716	14.5128	2.0311	1.0705	0.1392	0.1759	0.1157	0.3224	1.2595	0.7145	0.1435
7	3.2500	8.2577	16.1380	0.0000	1.3062	0.3550	0.0000	0.3090	1.3590	3.2045	0.9625	0.3480
8	6.2113	6.7326	11.6775	0.3019	1.5649	0.1513	0.2323	0.2790	0.1650	1.1585	1.0157	0.3783
9	6.2727	10.3105	17.0463	1.1818	1.3356	0.0988	0.1456	0.2598	0.4152	2.2637	1.5397	0.6775
10	6.0647	10.0066	15.1510	0.0000	1.1352	0.0721	0.1142	0.1748	0.2584	1.8495	1.1604	0.3798
11	6.2683	8.2161	11.6076	0.0000	1.6221	0.1731	0.0258	0.1438	0.1338	0.5438	0.7117	0.0375
12	5.9074	7.9307	11.2318	0.0000	1.1984	0.0596	0.0559	0.1093	0.2358	0.8619	0.5982	0.1820
13	9.3333	25.4640	40.3827	0.0000	4.2753	0.5667	0.0090	1.0400	0.7800	3.1680	4.0967	0.9920
14	5.0840	7.8011	10.4751	0.4281	1.0412	0.0653	0.1536	0.1735	0.1839	0.4744	0.3771	0.2050
15	6.9592	10.3108	13.8898	1.4384	1.0277	0.0262	0.1174	0.1633	0.2033	1.5192	0.3678	0.1543
16	6.0000	10.8320	24.5880	0.0000	0.0000	0.0000	0.0000	0.0000	0.0240	12.2920	0.7800	0.6600
17	6.7500	9.2325	12.6772	0.0000	1.0585	0.0232	0.0650	0.1140	0.5130	1.1862	0.2897	0.1950
18	7.1429	8.2760	11.0990	0.0000	0.8739	0.0357	0.0000	0.0291	0.0823	1.5191	0.2400	0.0429
19	6.6111	15.4841	20.3657	0.0000	1.7557	0.1636	0.1469	0.2053	0.4240	1.2192	0.6094	0.3573
20	6.5493	11.0140	20.7031	3.1333	2.2230	0.2064	0.0841	0.3375	0.5586	2.9876	2.1037	1.1883

Cont ...

Continuation Table A-16

GROUP 7 : LOW WAGE EARNERS-RURAL

Dept.	Family Size	Food	Total Expenditures	Savings	Textiles	Non Metallic	Metallic	Other Industry	Electricity	Construc.	Services	Transp.
1	6.8158	9.7828	14.4749	0.1322	1.2123	0.1050	0.3166	0.1409	0.2790	1.6634	0.7567	0.2183
2	5.6667	10.8828	16.6987	0.0000	1.9941	0.2063	0.2190	0.4994	0.3520	0.9545	1.2505	0.3400
3	5.0000	7.1200	10.8433	3.9296	0.2221	0.0024	0.000	0.0583	0.3429	1.5603	0.6390	0.8983
4	5.8750	11.0146	16.8023	0.0000	1.8420	0.0956	0.5962	0.2966	0.3868	1.4562	0.5183	0.5959
5	6.2754	12.1820	21.4844	0.0000	1.8158	0.2019	0.1718	0.2698	0.2876	1.1168	1.9999	3.4388
6	6.6095	9.7304	12.5972	0.0000	0.9819	0.1064	0.0412	0.1429	0.3622	0.7055	0.3630	0.1638
7	6.2500	10.3125	21.1300	0.0000	2.4472	0.2900	0.3000	0.5280	0.5550	3.1020	2.2602	1.3350
8	5.9429	6.6769	10.2698	0.0000	1.1849	0.0697	0.2708	0.2513	0.1437	0.8622	0.4737	0.3367
9	6.2308	11.9532	18.8108	0.0000	1.6802	0.1631	0.1683	0.3506	0.6284	1.0159	2.4343	0.4168
10	5.9769	8.5413	11.9482	0.0000	1.0813	0.0734	0.1597	0.1317	0.2013	1.0317	0.4710	0.2566
11	6.7000	7.4732	10.9265	6.3625	0.0100	0.2036	0.0000	0.3132	0.0924	1.0824	0.4857	0.3660
12	6.3492	8.2669	11.7849	0.0000	0.9804	0.0577	0.0473	0.1478	0.1815	0.7903	0.8323	0.4806
13	6.6000	16.9234	25.9780	0.0000	2.1832	0.1640	0.0000	0.5520	0.5688	3.5208	1.0650	1.0008
14	5.8906	9.8132	12.3218	0.0000	1.1608	0.0609	0.0293	0.1841	0.1374	0.3657	0.3316	0.2387
15	6.7000	8.2756	10.8647	0.6870	0.9833	0.0442	0.0365	0.0300	0.1392	1.0864	0.1767	0.0928
16	7.0000	12.2722	16.2495	0.0000	1.3087	0.1637	0.0625	0.1770	0.0870	1.2300	0.4922	0.4560
17	7.5833	9.7934	15.4002	0.4225	2.3042	0.2494	0.0104	0.3390	0.3610	0.8408	1.1028	0.3990
18	6.9231	9.6653	14.0989	0.0000	1.4606	0.0462	0.0000	0.2538	0.1089	1.5880	0.4988	0.4772
19	4.7333	8.2199	14.1155	0.0000	1.4613	0.2309	0.2513	0.2304	0.3464	2.0280	0.7977	0.5496
20	5.5867	9.9385	16.4663	0.0775	1.5698	0.1198	0.1573	0.3298	0.3680	1.7494	1.4687	0.7651

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TABLE A-17

MATRICES OF ACTUAL CONSUMPTION VALUES, PROJECTED VALUES BY ESTIMATED CONSUMPTION FUNCTIONS AND ADJUSTMENT FACTORS FOR CONSUMPTION FUNCTIONS. COLOMBIA 1970.

ACTUAL CONSUMPTION VALUES

Socioeconomic Group ¹	(1) Food	(2) Textiles	(3) Non Metalic	(4) Metalic	(5) Other Industry	(6) Electri city	(7) Cons- truction	(8) Services	(9) Transpor tation	(10) Savings
<u>Urban</u>										
1. Capitalists	252	1082	548	326	635	218	600	907	477	1926
2. Professionals-Technicians	5926	2791	516	1395	491	646	5453	4108	4108	4601
3. Independent Workers	8625	2586	383	606	702	1149	9670	6287	1946	5681
4. Low Wage Earners	3711	1352	227	216	250	409	2012	1488	942	0
<u>Rural</u>										
5. Latifundists	45	94	45	28	54	20	66	88	43	171
6. Medium-Small Farmers.	7008	998	142	53	285	963	4204	1924	2350	3170
7. Low Wage Earners.	2727	576	62	45	146	158	723	632	581	0

1. Sectorial values for year 1970 were obtained from Banco de la República, Cuentas Nacionales de Colombia 1970-1976. Disaggregation by groups was obtained using group shares given by DANE, Household Income Expenditures Survey. E.H., 1970.

Cont

- A.47 -

Continuation Table A-17

PROJECTED CONSUMPTION VALUES² (THOUSANDS OF COLOMBIAN PESOS OF 1970)

Socioeconomic Group	(1) Food	(2) Textiles	(3) Non Metalic	(4) Metalic	(5) Other Industry	(6) Electri- city	(7) Cons- truction	(8) Services	(9) Transpor- tation	(10) Savings
<u>Urban</u>										
1. Capitalists	2865	1530	1524	368	489	236	1394	929	580	907
2. Professionals-Technicians	8135	2438	3144	985	204	437	3448	2854	3070	1334
3. Independent Workers	11804	2275	2802	146	308	784	6215	4136	1505	1676
4. Low Wage Earners	5158	1206	1481	146	107	278	1296	972	723	0
<u>Rural</u>										
5. Latifundists	266	126	158	29	38	20	133	73	48	74
6. Medium-Small Farmers	9348	789	715	15	106	605	2572	1159	1650	859
7. Low Wage Earners	3536	454	302	23	56	96	420	420	363	0

2. Values projected using estimated consumption functions given in Table 3.8 of Chapter III.

Cont....

Continuation Table A-17

ADJUSTMENT FACTORS FOR CONSUMPTION FUNCTIONS³

Socioeconomic Group	(1) Food	(2) Textiles	(3) Non Metalic	(4) Metalic	(5) Other Industry	(6) Electri- city	(7) Cons- truction	(8) Services	(9) Transpor- tation	(10) Savings
<u>Urban</u>										
1. Capitalists	11.35	1.41	2.77	1.12	.76	1.08	2.32	1.02	1.21	.47
2. Professionals-Technicians	1.37	.87	6.08	.70	.41	.67	.63	.64	.74	.29
3. Independent Workers	.87	7.31	.68	.43	.68	.43	.68	.64	.77	.29
4. Low Wage Earners	1.39	.89	6.52	.67	.43	.67	.64	.65	.75	0
<u>Rural</u>										
5. Latifundists	5.84	1.32	3.35	1.04	.70	1.01	2.00	.82	1.12	.43
6. Medium-Small Farmers	1.33	.79	5.01	.28	.37	.62	.61	.60	.70	.27
7. Low Wage Earners	1.29	4.87	.52	.38	.60	.58	.66	.62	.62	0

3. The adjustment factor (f_a) = $\frac{\text{Projected Consumption Value}}{\text{Actual Consumption Value}}$

TABLE A-18

DATA USED FOR THE ESTIMATION OF AVERAGE DAILY PER-CAPITA
CALORIES CONSUMED. COLOMBIA 1951-1975
(EQUATION 143.a IN CHAPTER III)

Years	Average Daily Per Capita Calories Consumed ¹ (CALCA)	Daily Expenditure Expenditure on Food ² (Millions of Pesos of 1970) (GAPEDI)
1951	2278	50.26
1952	2311	47.83
1953	2130	51.26
1954	2159	56.23
1955	2041	57.75
1956	2005	59.45
1957	1965	62.02
1958	1991	63.42
1959	2025	66.75
1960	1994	68.11
1961	2008	75.14
1962	2016	78.66
1963	1872	84.36
1964	1947	91.44
1965	1876	91.12
1966	1930	99.22
1967	1860	101.24
1968	1949	105.63
1969	2072	114.61
1970	1905	122.16
1971	2105	129.61
1972	2133	141.52
1973	2179	160.06
1974	2214	164.54
1975	2217	178.86

1. SOURCE: Jorge García. "La Seguridad de Alimentos en Colombia". Revista de Planeación y Desarrollo. XI, 3, Sept.-Dec. 1979. Annex B, Table 3, p. 168.
2. Private expenditure on food was estimated by multiplying the total private consumption figure given by García, op.cit., Table 4, p. 169, by the proportion of food expenditures (47.5%) on total expenditures for year 1970 given by the DANE Income Expenditures Survey, EH. 4, See DANE. Los Presupuestos Familiares en Colombia, 1971 Bogotá, 1976. The result was then divided by 365 to obtain a daily expenditure on food.

TABLE A-19

DATA USED FOR THE ESTIMATION OF THE INFANT MORTALITY RATE, COLOMBIA
(EQUATION 114.a IN CHAPTER III)

Y E A R	(1) Infant Mortality Rate ^{1/} (Per Thousand) (MORIM)	(2) G.N.P Millions of Pesos of 1970 ^{2/} (Y)
1950	135.8	49405.0
1960	118.9	77645.0
1965	85.6	98156.0
1966	80.6	103674.0
1967	75.9	107615.0
1968	73.9	114804.0
1969	71.9	122182.0
1970	80.0	130361.0
1971	68.2	137889.0
1972	66.4	148672.0
1973	64.6	159195.0
1974	62.9	168766.0
1975	61.2	176480.0

^{1/} SOURCE: D.N.P "La Economía Colombiana 1950-1975". Revista de Planeación y Desarrollo, IX, 3, Oct.-Dec., 1977, Table 2.11, p. 69. The infant mortality rate is defined as the number of deaths less than one year of age divided by the total number of live births in the same year.

^{2/} SOURCE: D.N.P "La Economía Colombiana 1950-1975" Revista de Planeación y Desarrollo, IX, 3, Oct.-Dec., 1977, Table 3-21, p. 130.

TABLE A-20
DATA USED FOR THE ESTIMATION OF THE NUMBER OF HOSPITAL BEDS, COLOMBIA

(EQUATION 145.a IN CHAPTER III)

Y E A R	(1) Total Number of Hospital Beds 1/ (CAM)	(2) Private Daily Expenditure on Health 2/ (Millions of Pesos of 1970) (GASPED)	(3) Public Expenditure on Health 3/ (Millions of Pesos of 1970) (SALPE)
1964	39843	6.99	305.97
1965	40279	7.36	308.04
1966	40715	7.94	373.07
1967	41152	8.16	433.07
1968	41588	8.39	708.81
1969	42024	9.23	997.64
1970	42461	9.69	1304.16
1971	42897	10.39	1344.91
1972	43333	11.33	1384.75
1973	43769	12.77	1432.50
1974	44206	13.13	1765.29
1975	44642	14.21	1473.56

1/ SOURCES: DANE, "La Salud en Colombia". Boletín Mensual de Estadística, 244, Nov., 1971, p. 123, for the 1964 figure, and D.N.P. Plan de Integración Nacional, Vol. II, Table 9, p.393 for the 1975 figure. Intermediate values were obtained by linear interpolation.

2/ Private expenditure on health was obtained by multiplying total private consumption given in Jorge García, "La Seguridad de Alimentos en Colombia", Revista de Planeación y Desarrollo, XI, 3, Sep.-Dec., 1979, Annex B, Table 4, by the proportion of health expenditure (3.8%) on total private expenditure obtained from DANE Income-Expenditure Survey EH-4, 1970. Then the result was divided by 365 to obtain daily expenditure on health.

3/ Source: D.N.P., "La Economía Colombiana 1950-1975." Revista de Planeación y Desarrollo, IX, 3, Oc.-Dec., 1977, Table 2-20, p. 79.

TABLE A-21

DATA USED FOR THE ESTIMATION OF THE NUMBER OF PHYSICIANS. COLOMBIA...
(EQUATION 147.a IN CHAPTER III)

	(1)	(2)	(3)
	Total Number of Physicians 1/ (MED)	Private Daily Expenditure on Education 2/ (Millions of Pesos 1970) (GAEPED)	Public Expenditure on Education 3/ (Millions of Pesos of 1970) (EDUPE)
1965	7383	7.72	1195.28
1966	8100	8.31	1256.46
1967	8650	8.54	1322.03
1968	9007	8.98	1687.10
1969	9153	9.63	2071.56
1970	9299	10.31	2476.25
1971	9693	10.81	2840.43
1972	10087	11.99	3225.27
1973	10482	13.45	3627.20
1974	10876	13.82	3860.12
1975	11491	15.16	4100.86
1976	12096	15.57	4365.70
1977	12700	15.98	4623.80

1/ SOURCES: DANE, "La Salud en Colombia" Boletín Mensual de Estadística, 244 Nov. 1971, p.105 for years 1965-1968, and D.N.P., Plan de Integración Nacional, Vol., II, Table 7, p. 392 for years 1970-1975. The value for year 1969 was obtained by linear interpolation.

2/ Private expenditure on education was obtained by multiplying total private consumption given by Jorge García, "La Seguridad de Alimentos en Colombia", Revista de Planeación y Desarrollo, XI, Sept.-Dec., 1979, Annex B. Table 4, p. 169, by the proportion of education expenditure (4.4%) on total private expenditure obtained from the DANE Income-Expenditure Survey, EH, 4, 1970. The result was then divided by 365 to obtain daily expenditure on education.

3/ SOURCE: D.N.P., "La Economía Colombiana 1950-1975, "Revista de Planeación y Desarrollo. IX,3, Oct.-Dec., 1977, Table 2.20, p. 79.

TABLE A-22
 DATA USED FOR THE ESTIMATION OF SQUARE METERS OF HOUSING PER PERSON, PROPORTION OF HOUSES WITH
 ELECTRICITY AND PROPORTION OF HOUSES WITH PIPED WATER. COLOMBIA
 (EQUATIONS 149, 150.a IN CHAPTER III)

Years	(1) Stock of Square Meters of Housing ¹ Millions of pesos of 1970) (STOCK)	(2) Total Investment on Housing ² (INV)	(3) Proportion of Houses with Piped Water ³ (AGUA)	(4) Proportion of Houses with Electricity ³ (LUZ)	(5) G.N.P. Per- Capita (pesos of 1970) ⁴ (YP)
1951	84.5608	10.0406	.288	.258	4109
1952	85.0970	10.7715	.289	.264	4218
1953	86.0609	14.5569	.290	.270	4326
1954	87.6800	16.9752	.291	.276	4435
1955	88.9093	18.1176	.292	.282	4544
1956	91.0823	17.1972	.293	.289	4653
1957	92.9587	12.9815	.294	.295	4762
1958	94.5489	12.2980	.295	.302	4870
1959	97.2248	13.1867	.296	.309	4979
1960	99.6481	15.4201	.297	.316	5088
1961	102.3528	16.7955	.298	.323	5193
1962	106.3359	16.8584	.299	.330	5304
1963	109.8676	15.4706	.299	.337	5275
1964	113.3044	17.3547	.300	.345	5439
1965	116.9494	16.4311	.328	.367	5455
1966	120.3541	17.9545	.358	.391	5636

Cont

Continuation Table A-22

Years	(1) Stock of Square Meters of Housing ¹ (Millions of pesos of 1970) (STOCK)	(2) Total Investment on Housing ² (INV)	(3) Population of Houses with ³ Piped Water ³ (AGUA)	(4) Proportion of Houses with ³ Electricity ³ (LUZ)	(5) G.N.P. Per- Capita (Pesos of 1970) ⁴ (YP)
1967	123.4679	19.3595	.390	.417	5758
1968	127.3617	22.2461	.429	.444	5980
1969	131.2293	22.9191	.464	.473	6218
1970	136.4873	26.4408	.507	.503	6484
1971	141.3553	28.0666	.552	.536	6619
1972	145.2215	27.7862	.603	.571	6886
1973	151.3988	29.1516	.657	.608	7119

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1 The total number of square meters available in a given year was estimated by combining information for the 1951, and 1973 national housing censuses, and information about the number of square meters constructed between the censuses, as follows

a. The total number of square meters per room was estimated using the relation:

$$\text{Square Meters Per room} = \frac{\text{Total Number of Meters Constructed between the Censuses}}{\text{Total Number of Added Rooms between the Censuses}}$$

The total number of square meters constructed between the censuses was obtained from CENAC. See C. Rodríguez, "El Mercado de Cemento en Colombia : Demanda, Oferta, Precios", Tesis de Magister, Universidad de los Andes, 1979. The total number of rooms added to the stock between the censuses was estimated by subtracting the total number of rooms available in the previous census from the total number of rooms appearing in the most recent census. The estimated number was 14 square meters per room.

b. The stock of square meters of housing available in each census year was then obtained multiplying the

Cont

Continuation Table A-22

stock of rooms existing by the estimated average number of square meters for room. Then, several depreciation rates were tried to obtain a rate that would give the stock of square meters in the most recent census when applied year to year to the stock of the previous census plus the new meters constructed in that year. This depreciation rate was approximately 2%. In this way, the complete series from 1951 to 1973 was constructed.

2 This includes public and private investment on housing. The cost per square meter of housing (COME in chapter III) was estimated as a weighted average of the cost for year 1971, so that:

$$\text{Weighted Average Cost of Square Meter Constructed} = \frac{\text{Monthly Budget x Square Meters}}{\text{Total Number of Square Meters Constructed during year 1971}}$$

3 These proportions were estimated using the 1951, 1964, and 1973 housing censuses made by DANE, and then interpolating for the intercensal years.

4. See note 2 of Tabla A-1 for sources and methodology.

TABLE A-23

DATA USED FOR THE ESTIMATION OF ILLITERACY, COMPLETE PRIMARY AND SECONDARY SCHOOLING RATES, AND STUDENTS/TEACHER RATIO. COLOMBIA
(EQUATIONS 152.a, 153.a, AND 155.a IN CHAPTER III)

	(1) Illiteracy Rate (ILLIT)	(2) Complete Primary Schooling Rate ² (PRIMAC)	(3) Complete Secondary Schooling Rate ³ (SECUND)	(4) Students/ Teacher Ratio ³ (AT)	(5) Private Daily Expenditure on Education (Millions of Pesos of 1970) (GAEPED)	(6) Public Expenditure on Education (Millions of Pesos of 1970) (EDUPE)
1951	42.54	14.86	1.76		4.28	255.58
1952	41.48	15.36	1.83		4.06	263.56
1953	40.44	15.89	1.90		4.32	292.92
1954	39.43	16.43	1.97		4.71	322.75
1955	38.45	16.99	2.05		4.87	355.54
1956	37.49	17.57	2.13		5.04	388.86
1957	36.55	18.17	2.21		5.21	424.04
1958	35.64	18.79	2.30		5.39	462.58
1959	34.75	19.43	2.39		5.57	520.86
1960	33.88	20.09	2.48		5.76	582.57
1961	33.04	20.78	2.58		6.27	720.02
1962	32.21	21.49	2.68		6.65	864.54
1963	31.41	22.22	2.78		7.04	1019.73
1964	30.63	22.98	2.89		7.69	1111.99
1965	29.57	23.64	2.99		7.72	1195.28
1966	28.56	24.33	3.10		8.31	1256.46
1967	27.58	25.04	3.20		8.54	1322.03
1968	26.63	25.76	3.32	36.87	8.98	1687.10
1969	25.72	26.51	3.43	36.37	9.63	2071.56
1970	24.83	27.28	3.55	35.93	10.31	2476.25
1971	23.98	28.07	3.67	35.48	10.81	2840.43
1972	23.16	28.89	3.80	35.04	11.99	3225.27
1973	22.36	29.72	3.93	34.59	13.45	3627.20
1974	21.59	30.59	4.07	34.15	13.82	3860.12
1975	20.85	31.48	4.21	33.70	15.16	4100.86
1976	-	-	-	33.26	15.57	4365.70
1977	-	-	-	32.81	15.98	4623.80
				32.37		

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Cont.....

Continuation Table A-23

- 1 See Table A-4 for the methodology and sources used for the estimation of the illiteracy rate.
- 2 The methodology and sources used for the estimation of these rates were the same as the illiteracy rate. (See Table A-4). These rates were defined as:

$$\text{Complete Primary Schooling Rate} = \frac{\text{Number of Persons with Complete Primary (12 years old or more)}}{\text{Total Population 12 years old or more}} \times 100$$

$$\text{Complete Primary Schooling Rate} = \frac{\text{Number of Persons with Complete Secondary (18 years old or more)}}{\text{Total Population 18 years old or more}} \times 100$$

- 3 SOURCE: "Educación Primaria en Colombia 1957-74, "Boletín Mensual de Estadística, 288 July, 1975. Table 39. p.56
- 4 See note 2 of Table A-21 for sources and methodology.
5. See note 3 of Table A-21 for sources and methodology.

TABLE A.24
COEFFICIENTS OF DISTRIBUTION OF GOVERNMENT HEALTH AND EDUCATION
EXPENDITURES AMONG SOCIAL GROUPS. COLOMBIA. 1970.

<u>Social Group</u>	<u>Health</u>	<u>Education</u>
Urban	.6772	.6166
Rural	.3228	.3934
Capitalists	.0234	.0454
Professionals -Technicians	.2153	.2237
Independent Workers	.2479	.2043
Urban Wage Earners	.1903	.1333
Latifundists	.0034	.0165
Medium-Small Farmers	.2041	.2005
Rural Wage Earners	.1156	.1763

Source: DANE E.H.4 Income - Expenditures Survey, 1971.

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