CELADE

CENTRO LATINOAMERICANO DE DEMOGRAFIA

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Serie A, N° 137
Marzo, 1976.
1000.

ECONOMIC-DEMOGRAPHIC MODEL
A CASE STUDY OF CHILE AND MEXICO

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Abbreviations

UN	:	United Nations
UN/ECLA	:	United Nations Economic Commission for Latin America
UN/CELADE	:	United Nations Latin American Demographic Centre
UN/ILPES	:	United Nations Latin American Institute for Economic and Social Planning
OECD	:	Organization for Economic Co-operation and Development
ILO	:	International Labour Office
INE	:	Instituto Nacional de Estadística (Chile)
DGE	:	Dirección General de Estadística (México)
CORFO	:	Corporación de Fomento de la Producción (Chile)
ODEPLAN	:	Oficina de Planificación Nacional (Chile)
KEPE	:	Center of Planning and Economic Research (Greece)

ACKNOWLEDGEMENTS

First of all, I would like to express my deep gratitude to the Director of the United Nations Latin American Demographic Centre (CELADE), Miss Carmen A. Miró and to the Deputy Director of the Centre, Professor Juan C. Elizaga, for both their pioneering idea of the investigation of the population features in conjunction with the economic magnitudes by constructing an economic-demographic model for less-developed economy and its application on the basis of real statistical data for Latin American countries.

It is known that a basic prerequisite of any socio-economic research is the researcher to be familiar with the society under study. For a foreign researcher who stays in a country for a short time, such a prerequisite does not exist. Therefore the over-all quality of the work depends on the interest of the Director of the department to which the researcher belongs for this work, the cooperation with him and the staff members of the Centre, their constructive criticism and the information provided by them, etc. In this aspect, I was particularly fortunate. Professor Elizaga gave a part of his time to this project and showed a particular interest in the progress of the study. He also made a constructive criticism on the many details of the model and provided a valuable help as regards the obtaining of statistical data and useful information which was required for this work. Many times, the great experience on these matters of Professor Elizaga was at my disposal. Therefore, deep debts of gratitude are owed to him. Furthermore, the full cooperation with Professor Elizaga in his capacity as Director of this department of the Centre to which I belong, had as result the overcoming of all difficulties that I encountered during the construction of the model. For this help, I would like to express once more my deep gratitude.

Many thanks are also due to Professor Albino Bocaz and the colleagues Messrs. Arthur Conning, Jorge Arévalo, Joop Alberts, Angel Fucaraccio, Armando Di Filippo, Juan León, Juan J. Calderón and Waldomiro Pecht who participated in the conference of 21st November 1974, conducted by Professor Elizaga, for their remarks, which were taken into consideration during the construction of the model. In this opportunity I would like to express my warm thanks to the Director of the National Statistics Institute of Chile, Mr. Sergio Chaparro, for his willingness to make available statistical resources of the Institute and for his participation in the meeting with the Directors of the Departments of the Institute, Messrs. Dunav Vuskovic and Hernán Kappés -many thanks to them- for this project. Many thanks are also due to Mr. Juan J. Calderón who prepared the model applied for the computers and supervised all the stages of data processing.

Many stages in the statistical work of this project were supervised by my assistant, Mr. Guillermo Mundt. Furthermore, he helped me during the over-all conducting of this study. He also carried out the heavy task of collection and elaboration of the statistical data. For these reasons, I express my warm thanks to Mr. Mundt and I feel very much obliged to him. Finally, I express my thanks to Mrs. Erica Wulff for the painstaking work in typing up the handwritten copy into a finished typescript.

Although grateful appreciation is expressed to all of them, any errors and omissions that remain are entirely those of the author.

Stylianos K. Athanassiou

ABSTRACT

The present work is a contribution of the author to the investigation of basic economic and demographic relationships by constructing an economic-demographic model for certain Latin American countries.

The existence of interrelationships and interactions between economic and demographic development has been already proved by many researchers. More specifically, it can be said that an interdependence between the economic and demographic variables exists. In this sense and on the basis of theoretical studies on this matter, the author of this work made an effort to interrelate economic and demographic magnitudes in an interdependent system of equations. Of course, this effort met quite serious difficulties. This is because on the one hand, such a system of equations presupposes restrictions which refer to the mathematical aspects of the model, for instance, linear equations, interdependence of the variables in the system, statistical problems, for instance, identification of the equations, autocorrelation etc. and economic theory which should be expressed by the relationships of the model and on the other hand, the lack of statistical data and the abruptly discontinuous movements in many of the main variables of the economy in Latin American countries which raise serious problems of statistical estimations. All the above restrictions had as a result that only the basic economic and demographic variables would enter in the system and that some relationships would be evaluated out of the system. Furthermore, a numerical model will be applied for the qualitative estimation (age and sex) of some critical age-groups of the demographic variable, labour force, which will be one of the main variables of the system of equations. Thus, the system of equations, the numerical model and the relationships which will be estimated separately, will consist of the economic-demographic model in the general point of view.

Up to day, theoretical aspects have been expressed for this matter. The most of these aspects -models- are mentioned in Chapter 4, section 1. In some of them, statistical data were applied, but without referring to a specific economy of a country. Moreover, none of these studies have been formulated in an interdependent system of equations. Therefore, the need to investigate the interaction of the economic and demographic variables and to make a model, economic and demographic in a system of interdependent variables on the basis of real statistical data for some of less- developed countries as they are in Latin America, became evident and this is the new point of the author in the aforementioned theoretical

aspects.1/ Clearly, continued effort will be necessary in the revising of equations, in the entering of new variables or equations, estimating of parameters, etc. in order that the model will be able to explain completely the contribution of population features in the economic growth of a less-developed economy, even though the statistical formulation of the new model and its working mechanism will be the same as the present one.

1/ Of course this model is mainly based on economic and demographic considerations of the following models: Spengler, J., Points of contact between the growth of population and the growth of national product. World Population Conference, United Nations, New York, 1965. TEMPO, General Electric's Center for Advanced Studies, Description of the Economic Development. California, U.S.A. Demeny, P. and López, A., Construction of General Models of Economic and Social Development. Economic Commission for Latin America/U.N., Santiago, Chile. International Labour Organization, World Employment Programme, Geneva. Switzerland, 1973. Paz, P. and Rodríguez, O., Cinco Modelos de Crecimiento Económico. Instituto Latinoamericano de Planificación Económica y Social, Santiago, Chile, 1970. Kanelopoulos, A., Economic Development, Vol. I. Athens, Greece. Wold, H., Econometric Model Building. North-Holland Publishing Co., Amsterdam, 1964.

1. FIELD OF RESEARCH

1.1 Introduction

The analysis of a socio-economic phenomenon leads us to a set of hypotheses. These hypotheses can be expressed in mathematical forms which are called models. During the last thirty five years, the construction of such models has advanced rapidly in the socio-economic sciences. Thus, a great number of models have been developed by means of which an economy or an area of social activity is described. Furthermore, it has been proved that there are many interrelationships between demographic and economic factors and in general, the increase of national output can be attributed to economic, demographic and social factors. Therefore, in the last few years, an effort is made to relate all the aforementioned factors in a model. This will allow us to see the influence of each factor in the overall economic growth of a country. Finally, a model is suitable for statistical fitting and it can be used for forecasting on a scientific basis. Thus, a model is an instrument of planners and policy makers.

More details about the models as regards their construction, mathematical form, use, etc. are mentioned in the relevant Chapter 4 in which the economic-demographic model to be applied is also included.

1.2 Investigation of economic-demographic relationships

The investigation of the existing relationships between economic and demographic factors in the long-run can be realized from two points of view. The first will refer to the influence of population changes upon the growth of national output. Of course, in addition to population changes, other socio-economic factors are associated with the increase of national output. The second is the reverse viewpoint, i.e. the influence of economic factors, and mainly of national output on population development.

The first case, that is, the impact of population on the growth of national output, is of great importance on account of the efforts being made by all the countries -developed and less-developed- on the one hand,for their economic growth -of which population is the main factor but also the goal- and on the other hand, for increase or decrease of their birth rates.

1.3 Purposes of the present work

The main purpose of this study is the formulation of an economic-demographic model. This model will consist of a number of relationships between the crucial economic and demographic variables on the basis of economic and demographic theory. The parameters of these functional relationships will be statistically estimated on the basis of empirical observations in the period 1960-1970. Thus, we will acquire a quantitative knowledge of the interlinking economic and demographic variables. Furthermore, we will construct a mutually interdependent system of equations. This system of equations will consist of some functional relationships of the economic-demographic model. The construction of this interdependent system is also a purpose of the present work. The central variables of the system of equations will be national output and employed labour force. The direction to be followed, for the investigation of the relationships of this system -macro-model- which will be the main model in the over-all economic-demographic model, will be the impact of economic and mainly of demographic variables upon the national output. Hence, we can say that the macro-model to be built, on the one hand, will be of one direction and on the other hand, can be characterized as an economic growth model due to its direction and to the treatment of the factor population, which will be included in this macro-model, as an exogenous variable. This feature of the macro-model as a model of economic growth will also reflect the economic-demographic model as a whole. Furthermore, this model will refer to the national level and probably, to the secondary sector of economy, if statistical data are available. Finally, the model will be used for making forecasts as far as the development of its endogenous variables, in the post sample period 1971-1975. The endogenous variable, together with the variable population, will be the main variables of the over-all economic-demographic model.

It is obvious that all the factors or relationships of the whole economic-demographic model cannot enter to the interdependent system of equations for many technical reasons, as we will explain in the relevant chapters. On the other hand, the qualitative composition (age and sex) of the variable supply of labour, cannot enter in a model of linear equations. Therefore we will try to investigate some factors or relationships apart from the aforementioned macro-model by the application of supplementary models. Such models will be the numerical model and some single regression equations. By the application of the numerical model, we will estimate labour force by age and sex (some critical age-groups) in the forecasting period 1971-1975. Thus, in addition to the forecast size of the labour force produced by the macro-model we will have also its structure by age and sex. Furthermore, the labour force estimations made by these two models -macro and numerical model- will allow us to make comparisons, on the purpose of ascertaining the reliability of these two models from this point of view. By the regression equations we will estimate a basic economic variable of the economic-demographic model, the consumption expenditure, which will not be included in the macro-model but it is related to the national output and population, both in the sampling period 1960-1970 and the post sample period 1971-1975.

Finally we will compute the per capita income of the countries in which the models will be applied, for the projected period 1971-1975 in order to know the degree of the economic growth of these countries for comparative purposes and for the estimation of a functional relationship in which the variable per capita income is included. These are the purposes of this work to be carried out here. The accomplishment of these purposes will depend mainly upon the adequacy of statistical data which are required by the model and the time available within which this project must be completed.

1.4 Usefulness of the study. Selection of certain Latin American countries for the application of the model

As we said in the introduction of this chapter, there are many relationships between economic and demographic factors. The investigation of these relationships, on the scientific basis, will lead us, on the one hand, to the correct decisions as regards the allocation of economic and human resources in the frame of a socio-economic plan and on the other hand, to the exercising of the indicated economic and demographic policy.

To-day, all the developed countries try to investigate these relationships in mathematical models by means of which the interdependence of demographic and economic factors appears clearly and their statistical estimation is achieved. From this general view, the construction of such a model -economic and demographic- is of great importance for Latin American countries where the economic growth is the main problem for solution due to the low level of per capita income and the high rate of population development. Furthermore, the economic development plans are based on the results of demographic and economic research and their targets are determined in accordance with the economic and population changes. Therefore, data referring to the existing demographic and economic relationships, expected changes in population and economic factors, are necessary for planners and policy makers. Latin American countries are at the stage of economic development and prepare long-term economic plans. This means that they need such data and results derived by the model to be applied and consequently, this model from this point of view, will be also useful.

Finally, the interlinking relationships between demographic and economic variables in an interdependent system of equations on the basis of data of Latin American countries take place for the first time, and this can be considered as an important point of this work.

The selection of Latin American countries for the application of the model will be made on the basis of what has been mentioned in the previous section as regards the adequacy of statistical data and time available. Although all the Latin American countries can be considered as less-developed countries on the basis of the per capita income, however, there are considerable differences among them, both as to the level of per capita income as also as regards other features of less-developed countries.1/ In this instance, an effort will be made to include countries of different level of economic growth for application of the model. Thus, on the basis of the main indicator of the degree of economic growth -per capita income- and available statistical data, Chile and Mexico have been selected for the application of the economic-demographic model.

1.5 Sources of statistical material and structure of the work

The sources of quantitative information about the demographic and economic data used in this study are the official publications of the following organizations and institutions:

- United Nations (Yearbook of National Accounts Statistics, etc.)
- Economic Commission for Latin America/U.N. (Statistical Bulletin for Latin America, etc.)
- Latin American Demographic Centre/U.N. (Demographic Bulletins, etc.)

1/ The per capita income in Paraguay was US$ 149 during the year 1960 while in Venezuela it was US$ 859 in the same year. The typical features of less-developed countries are: low per capita income, unequal income distribution, surplus labour force, small size of internal market and lack of an organized capital market. (Contos, A., The Application of Macro-Economic Models to Development Planning: Peru. Iowa State University, Iowa, U.S.A., 1966. pp. 1-3).

- Instituto Nacional de Estadísticas. Chile. (Statistical Yearbooks, National censuses, etc.)
- Oficina de Planificación Nacional. Chile. (Plan for Economic Development 1960/1970, etc.)
- International Labour Organization. Geneva. (Projections of Labour Force for Latin America, etc.)
- Dirección General de Estadística. México. (Statistical Yearbooks, National censuses, etc.)

But, a study as the present one requires detailed and completely revised statistical data. For serious reasons, the obtaining of such data is not possible for many countries in Latin America. Therefore, the limitations to the present work imposed by the statistical material as we will ascertain during the application of the model, are heavy.

The work consists of nine chapters. In the first chapter, we give a general picture of the study from the point of view of its purposes, usefulness, etc. In the second chapter, we describe in general the problem of economic growth in Latin American countries, population development, etc. In the third chapter, the hypotheses and the basic functional relationships of the main economic and demographic factors are given. The theoretical model and the model to be applied together with its technical and statistical problems are included in the fourth chapter, while in the fifth chapter, we present the numerical model which will be used for estimation of the labour force in a forecasting period of time. Furthermore, in the sixth chapter we realize the empirical analysis of the model as a whole in Chile and Mexico and we investigate the results obtained from the statistical and the economic points of view. In the seventh chapter, we refer to the demographic sub-model and the consumption function. More specifically, in this chapter we apply the numerical model for labour force estimations of some critical age-groups (12-24 years) in Chile and Mexico and we estimate the consumption function in these countries. In the eighth chapter, we investigate the predictive ability of the model and we develop its mathematical form for making long-run forecasts. The forecasts values of the endogenous variables produced by the model are also included in this chapter. Furthermore, we compare the forecast values with the actual ones in order to see the ability of the model to explain the theory which it presents in a future period. Finally, we make extrapolations of the consumption expenditure for the 1971-1975 period and we compute the per capita income of Chile and Mexico in the projected period 1971-1975, on the basis of the results obtained from the model and other data. In the last chapter (ninth chapter) we comment the equations of the interdependent system and the consumption function. In the same chapter a review of findings is made and a summary of general conclusions is presented.

2. ECONOMIC GROWTH. POPULATION

2.1 In general

As it appears from the aim of the present study, the model to be built will include economic-demographic relationships. By these relationships, changes in basic economic and demographic variables as for instance, national income, supply and demand for labour force, will be determined as well as effects of the determinative factors to the aforementioned variables will be estimated. As we said in Chapter 1, section 3, this model will be a model of economic growth. From this point of view, it is considered advisable to refer to certain fundamental concepts as regards the meaning of economic development, its importance for less-developed countries, the realized rate of growth in Latin American countries, etc. It is known that man is the objective scope of economic development. Furthermore, the population is one of the main variables of the model and consequently, its development will cause changes in the other variables of the model.2/ Therefore, a general picture of the evolution of the population of Latin American countries as a whole, its distribution by age and with respect to residence is required to be given in this chapter. Finally, we will mention briefly international migration.3/

2.2 Economic growth as problem. Its meaning

Economic growth, as an objective of applied social sciences, emerged after World War II. During the period from that time up to now, economic development has become the main problem for solution in all countries, regardless of the socio-economic progress they have achieved, and also the fundamental target of economic plans and state policy.

Of course, this problem appears differently from intensity point of view, results, etc. in each country. This is obvious, because the socio-economic and population reality, technological progress, etc. are not the same in all the countries.

Referring to the meaning of the term of economic growth, we meet a great deal of disagreement, or lack of clarity on this point, and this because economic theory does not give the same explanation to the term "economic growth".4/ Here, we shall not deal with the new points or the existing differences regarding this term. We think that it is enough to repeat the definition which was given by Professor Kanelopoulos, A.: "Economic development is the long-term procedure, during which an economy as a whole, realizes an increase and differentiation of the results of its productivity, in conjunction with the structural changes, leading to an increase of the real per capita income of an increasing population".

2/ The size of population is also a component of the indicator by which the level of economic growth is expressed.

3/ The analysis of the variables related to the model is carried out in the relevant chapters for the countries in which the model is applied.

4/ Many writers define the meaning of economic development by its causes, and others by its results. Economic development, however, is not either the cause or the result, but the procedure itself (Kanelopoulos, A., "Economic Development", Vol. I. Athens, Greece. pp. 82-86).

2.3 The main dimension of the degree of economic growth

For the quantitative determination of economic growth there are indicators. The most suitable indicator for measuring the degree of economic development is the per capita income of a country's population.5/ This indicator has the advantage of being acceptable to statistical measurement. In spite of the general acceptance of this indicator, as a measure of the degree of economic development, and the facility of its statistical estimation, it still has some weaknesses and difficulties as to its accurate determination. These difficulties refer both to the national income as also to the population, that is, to those elements which form this indicator.6/ In accordance with this main dimension of the degree of economic growth, less-developed countries are considered to be those economies whose per capita income does not exceed 25 per cent of the corresponding per capita income of the United States.7/

Of course, this dimension must be related also with other economic variables, such as the final consumption, the distribution of income, employment, the educational level, etc. in order to have a complete picture of the economic development of a country. Finally, economic development as a process in time will be characterized and measured by increase in per capita income as we said in the previous section on the basis of the definition of economic growth.

2.4 The problem of economic growth and the less-developed countries

The problem of economic growth appears more intensively in the less-developed countries. This is obvious, because these countries are suffering under economic misery and poverty. These countries are more than two-thirds of the inhabitants of the earth, and they are countries in Africa, Asia and Latin America. The appearance of the problem of economic development in these countries is attributable to two reasons. The first reason is the awakening of the peoples -the great awakening, according to Professor Gunnar Myrdal-that is, in other words, the conscious comprehension by these peoples of what condition they are in, and their belief that they can emerge from this unfavourable situation. A second reason is the belief of the economically developed countries regarding the imperative need of providing material and moral aid to the effort being made by the less-developed countries. This conception came from the fact that the industrially advanced countries saw that the future of humanity will depend upon the less-developed countries and specially, on the manner in which these peoples will try to alter their existing socio-economic situation. Furthermore, if the existing gap between the developed

5/ TEMPO, General Electric's Center for Advanced Studies, Population Growth and Economic Development. California, U.S.A. pp. 1-2. Kanelopoulos, A., Economic Development, Vol. I. Athens, Greece. pp. 105-106. Demeny, P. and López, A., Construction of General Models of Economic and Social Development. United Nations, Economic Commission for Latin America, Santiago, Chile. pp. 1-2.

6/ Except for grants and borrowings, gross national product, GNP, as ordinarily defined, determines national income, Y. The national income, Y, divided by country's population, P, gives the per capita income, $Y/_P$. Furthermore, this indicator of economic development, can be used for international comparisons between countries, as regards the level of their economies.

7/ Kanelopoulos, A., Economic Development, op.cit. pp. 105-107.

and less-developed countries is not reduced, this will have an unfavourable effect upon the investors of developed countries in these latter countries and a drop in trade in the industrially developed countries. In addition to these reasons, there are others, such as cultural, political, etc. The efforts, however, of the less-developed countries for their economic development as also the efforts on the part of the developed countries through the granting of both moral and material aid, had a result in the less-developed countries: the achieving of considerable economic progress and the rise of their standards of living. As an example it is mentioned that during the last decade, 1960-1970, the rate of economic growth of the poorer countries rose to the satisfactory level of 4 percent on the average.8/ This rate of growth exceeds significantly that which they had obtained during the immediately preceding decade (1950-1960). By this continuously increasing rate of growth, the less-developed countries tend to approach the rate of the economically developed countries and consequently, the gap between them decreases. This is a most favourable point for the less-developed countries, as far as realized economic development is concerned.

2.5 Rate of growth in Latin America

In the previous section, we said that the rate of growth in less-developed countries experienced a considerable increase during the period 1960-1970. In this section, we will see to what extent the aforementioned ascertainment is for Latin American countries. On the other hand, this period of time (1960-1970) is the sampling period for the analysis of development of the variables of the model to be applied and consequently, the importance of the picture of the economic growth of these countries increases in this case.

In accordance with the estimates made by the Economic Commission for Latin America (ECLA/United Nations) the average annual rate of growth of the gross domestic product was 5.3 per cent during the period 1960-1970 and it showed a slight increase if we compare with the previous decade 1950-1960 (4.6 per cent).9/ This rate of growth is higher than the average rate of the less-developed countries as a whole in the same period. The rate of growth in Latin America varies in each country. Indeed, from table 2.5.1 we see that there are countries whose rate of growth is at a low level as for instance Haiti (0.5 per cent), Uruguay (1.3 per cent) and countries as for instance Panama (8.0 per cent), Mexico (7.2 per cent), whose rate of growth reaches or exceeds the rate of the developed countries. The rate of growth in Chile, although it is at a medium level (4.3 per cent), however, it differs considerably from the rate of growth in Mexico (7.2 per cent).

The international development strategy provides that the rate of growth should be at least 6 per cent for the developing countries. For some countries in Latin America this target does not seem possible to be achieved while for others it can be said that they will reach or exceed the rate of growth of 6 per cent. Here, it is worth to mention the conclusion of the Economic Commission for

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8/ The rate of economic growth in the United States and Europe for the period 1960-1970 was 4.6 per cent and 4.7 per cent respectively. (United Nations, Yearbook of National Accounts, 1971. New York, U.S.A., 1972).

9/ United Nations, ECLA. Economic Survey of Latin America, 1970. United Nations, New York, 1972. pp. 9-11.

Latin America of the United Nations that the rate of growth of 6 per cent cannot be considered enough for Latin American countries as a whole to overcome the serious socio-economic problems.

Table 2.5.1.

AVERAGE RATE OF GROWTH OF THE GROSS DOMESTIC PRODUCT AT MARKET PRICES FOR CERTAIN COUNTRIES OF LATIN AMERICA IN THE PERIOD 1960-1970

Country	Rate of growth (1960-1970)
Argentina	3.7
Chile	4.3
Haiti	0.5
Mexico	7.2
Panama	8.0
Peru	4.9
Uruguay	1.3
Venezuela	5.8

Source: Economic Survey of Latin America 1970. Economic Commission for Latin America (ECLA). United Nations, New York, 1972.

2.6 Population in Latin American countries

In this section, we shall give a short picture of the population of Latin American countries as a whole, from the point of view of size, rate of growth and sex distribution. Latin America at present has the highest annual population increase. During the 1960's the average annual growth rate for the region as a whole, was 2.86 per cent.10/ This rate of growth followed an upwards trend, if it is compared with the rate of growth of the two last decades, 1940-1950 and 1950-1960, which was 2.34 per cent. The population of twenty countries of Latin America was 275 million persons in the year 1970 compared with 138 million persons which was the population of these countries in the year 1945.11/ This high rate of growth had as a result a doubling (98.7 per cent) of the population of those countries during the last twenty five years (1945-1970).12/

10/ United Nations, ECLA, Economic Survey of Latin America 1970. United Nations, New York, 1972. pp. 12-14.

11/ Latin American Demographic Centre (CELADE), Boletín Demográfico. Year VII, N° 13, Santiago, Chile, 1974. pp. 6-7.

12/ In accordance with the estimates made by CELADE, the population of Latin America will reach 612 million inhabitants in the year 2000, while the population of less-developed countries whose population rate of growth is 2-4 per cent on the average will be 5 050 millions approximately in the same year. Bulletin of Labour Statistics (1974 World Population Year). International Labour Office, Geneva, 1974.

Considering the population of these twenty countries as a whole, and disregarding its regional distribution, the sexes are evenly balanced, with a small surplus of males which, however, is being reduced from census to census.

Table. 2.6.1

PERCENTAGE DISTRIBUTION OF SEXES DURING THE PERIOD 1950-1970

Sex	Years		
	1950	1960	1970
Male	50.41	50.24	50.12
Female	49.59	49.76	49.88

Source: Latin American Demographic Centre (CELADE), Boletín Demográfico Nº 13, Santiago, Chile, 1974.

Based on data of the last census (1970), the number of males and females varies, in the first two five age-groups (0-9) and this can be attributed to infant mortality. As regards the distribution by age, it can be said to be normal, in the sense that there exists in the population the proportion between the young and old age-groups. Finally, the population distribution by region of residence -urban and rural- showed the following changes during the period 1950-1970. The urban population was 149 million persons (54.41 per cent) in 1970 compared with 98 million persons (47.27 of the total population) in 1960 and with 62 million persons (39.22 per cent) in the year 1950. Consequently, the urban population, increased by 142.1 per cent and 52.1 per cent in 1970, in comparison with the years 1950 and 1960 respectively. The rural population showed a drop during the aforementioned period 1950-1970.

In conclusion, we can say that the population development in Latin American countries is characterized in the main by a high natural increase. Furthermore, the increase of population did not cause considerable changes in the age and sex structure of the population of the twenty Latin American countries under survey. On the contrary, the urbanization of these countries showed a considerable increase during the two last decades, 1950-1970.

2.7 International migration

The emigration movement between the countries of Latin America can be considered very small, although its evolution showed an upwards trend since the year 1950 up to day. The number of emigrants was 952 thousands, in the year 1960 in fourteen countries of Latin America. The size of external emigration was 0.84 per cent of the population of those countries.13/ The emigration flows

13/ Morales, J., Panorama de la Migración Internacional entre Países Latinoamericanos. Latin American Demographic Centre (CELADE), Series A, Nº 121, Santiago, Chile, 1974. pp. 10-13. The fourteen countries are: Argentina, Colombia, Costa Rica, Chile, El Salvador, Honduras, México, Nicaragua, Panamá, Paraguay, Perú, República Dominicana and Uruguay.

are mainly among neighbouring countries such as, for example, from Bolivia, Chile, Paraguay, to Argentina, etc. The reasons for these international migrations are mainly economic. Unfortunately, the lack of statistical data, which in this instance is great, does not allow us to expand more on this demographic variable.

3. BASIC HYPOTHESES. FUNCTIONAL RELATIONSHIPS

3.1 Per capita income changes

As we said in Chapter 2, section 3, per capita income is the main dimension for measuring economic growth of a country. On the other hand, the computation of this dimension for the countries in which the model will be applied and for a forecasting period of time, is one of the purposes of the present work.14/

By definition, per capita income is the ratio of national output to the population of a country. Thus, the changes which occur to the variables, national output and population, cause the per capita income changes. By the model to be built -which is the main purpose of this project- the forecast changes of these variables, national output and population, could be determined and consequently, the computation of the per capita income of the countries Chile and Mexico will be possible in the post sample period 1971-1975.15/

In this chapter, we will try to determine the factors which, on the one hand, contribute to the increase of national output and, on the other hand, affect the population development of a country, which consist of some of the main variables of the model. An effort will be also made for the determination of the factors which are related to the other main variables of the model as for instance, labour force, employment, consumption, etc. Thus, we will formulate the relationships of various variables of the model. All the relationships to be formulated, of course, will be based on the existing theory and they will be the hypotheses for testing. Some relationships will consist of the equations of the model to be applied whereas the others will enter to the numerical model or will be single regression equations.

3.2 Population development

In accordance with the demographic theory, population development is influenced by natural increase and migratory movement. The natural increase is defined in the general manner of crude birth rate minus crude death rate, while external migration, which appears in the form of two opposite flows, the incoming immigrants (input) and the outgoing emigrants (output), can be determined as the difference between these flows.16/ In the case that the number of incoming migrants exceeds the number of outgoing emigrants, we have net immigration which can be characterized as positive migration. In the opposite case, we have net emigration or negative migration.17/

14/ Plans for economic growth have mainly two objectives: (1) maximization of national income and (2) maximization of employment.

15/ Per capita income is high in some countries and low in others. Furthermore, per capita changes in a given period of time, for each country.

16/ Friedlander, A., Labour Migration and Economic Growth. The M.T.I. Press, Massachusetts, U.S.A., 1965. pp. 13-14.

17/ Frangos, D., Greek-English Dictionary. Athens, Greece, 1967. pp. 82-88.

Thus, we have

$$d(P) = N^m \pm M^n \qquad (1a)$$

or

$$d(P) = B - D \pm M^n \qquad (1b)$$

where

d(P)	:	Change of population
N^m	:	Excess of births over deaths
M^n	:	Net migration
B	:	Births
D	:	Deaths

The equality (1b) indicates that population change depends on births and deaths and net migration if international migration exists.18/ The number of births and deaths depends on the size and age distribution of population and upon fertility and mortality rates by age and sex.19/ Finally, external migration, which as we have stated, influences the size and age distribution of the population, mainly depends on economic and secondarily on social and political reasons.

3.3 Growth of national output

Growth of output of a country is dependent upon its population and other factors.20/ The "other" factors are capital and natural resources.21/ This can be written in mathematical form as follows:

$$Y = f(P, K, Q) \qquad (1a)$$

or
in explicit form

$$f(Y, P, K, Q) = 0 \qquad (1b)$$

where

Y	:	National output
P	:	Population
K	:	Capital
Q	:	Natural resources
f	:	Symbol of function

18/ For certain countries of Latin America, in which the economic-demographic model is applied, we have negative external migration, that is, net emigration and consequently, we use the expression

$$d(P) = B - D - M^n$$

where, the symbols d(P), B, D and M^n as in relationship (1b).

19/ TEMPO, General Electric's Center for Advanced Studies, Population Growth and Economic Development. California, U.S.A. pp. 3-5.

20/ Spengler, J., Points of Contact between the Growth of Population and the Growth of National Production, Vol. IV. United Nations, New York, 1965. pp. 108-110.

21/ Kanelopoulos, A., Economic Development, Vol. I. Athens, Greece. pp. 265-267.

The functional relationships (1a-1b) express the influence of population and other factors, such as capital and land, on changes in the national output. However, output is directly dependent on the working population, rather than on total population. In fact, a fraction of the population contributes to the productive procedure, the labour force and especially, the employed labour force. Of the other factors, capital can be considered the most important factor, while the factor land in a production function such as (1b) function, which refers to the whole economy of the country, can be considered as constant and consequently, it is omitted among the independent variables.22/ As a consequence, functional relationship (1b) can be written in the following form:

$$Y = f\ (L^e,\ K) \tag{2a}$$

where

L^e	:	Employed labour force
K	:	Capital
Y, f	:	as in relationship (1b)

Furthermore, in the case that capital is fixed in the short-run, but the employed labour force changes, then the national output will be a function of employed labour force variable, as follows:23/

$$Y = f\ (L^e) \tag{2b}$$

The same can be said in the case that the amount of employed labour force is constant in a period of time and capital increases,24/ then we have

$$Y = f\ (K)$$

Finally, the above production function (2a), based on theoretical considerations, has been specified by Cobb-Douglas in the following form:25/

$$Y = a_o {L^e}^{a_1} K^{a_2} \tag{3}$$

where

Y, L^e, K	:	as in relationship (2a)
a_o	:	Arbitrary constant
a_1, a_2	:	Coefficients

Function (3), similarly to function (2a) expresses a relationship between output, employed labour force and capital for a given level of technology and socio-economic organization.

22/ Koutsoyiannis-Kokkova, A., Production Functions in Greek Industry. KEPE. Athens, Greece, 1964. pp. 23-25.

23/ Brennan, M., Preface to Econometrics. South Western Publishing Co., Ohio, U.S.A., 1965. pp. 59-63.

24/ Capital, K, increases annually by the amount of savings, S, i.e. $S = \Delta K$. Savings are also related positively to national output, Y, and negatively to population, P.

25/ Cobb, C. and Douglas, P., "A Theory of Production". American Economic Review, Vol. XVIII. March, 1928.

Finally, the production function (2a) can be called "national" production function because it refers to the national level.

3.4 Labour force

3.4.1 Determinative factors

Labour force of a country, as we saw in the "national" production function, enters as a main independent variable. Labour force is that part of the total population which contributes by the supply of work to production process for economic goals and services and it is usually composed of individuals aged 12-64 able to and desiring to work.26/ The supply of labour, which in this study is taken to be the same as economically active population or the labour force, is a dynamic demographic dimension, i.e. it changes over time and depends mainly upon demographic factors.27/ The main demographic factors are the size and the structure by age and sex of the population of the country.28/ An increase of the population will cause an increase of the size of the age 12-64 groups which as we said previously, consist of the labour force of the country. As a sequence, the growth of labour supply is an increasing function of its population, in the form.

$$L^a = f\ (P) \qquad (1)$$

where

L^a : Total labour force

P : Population of a country

On the other hand, a change of the structure by age and sex of the population will cause changes in labour supply. Furthermore, the degree of participation of age-groups (12-64) for each sex is another factor of supply of labour.29/ An increase or decrease of participation rates will cause an increase or decrease in the labour force. The participation rates are influenced by educational, socio-economic and other factors. Thus, for instance, the school population, obligatory military service, family conditions, etc. affect considerably the critical age-groups (12-24 years) both in their size and their structure by age and sex. Therefore, the entering of aforementioned factors in an economic-demographic model for the investigation of their influence on the supply of labour force is of great importance. Although these factors (educational, socio-economic factors, etc.) cause considerable changes in the participation rates, however, they appear to be relatively less important than the population changes in the formulation of the supply of labour force.30/

26/ The age limits differ in each country; for this reason, mention will be made of each country whose labour force is investigated in the present work.

27/ Siampos, G., Demographic Trends in Greece. Ministry of Coordination, National Press, Athens, 1969, pp. 185-188.

28/ Ypsilantis, J., World and Regional Estimates and Projections of Labour Force. United Nations, Department of Economic and Social Affairs, 1966. pp. 4-6.

29/ Hatzoglou, S., Participation Rates of Greek Population. Athens, Greece, 1966. pp. 8-10.

30/ It was proved that 90 per cent of the net change in labour supply during the decade 1950-1960 was due to changes in the size and the structure by age and sex of the population (Ypsilantis, J., op. cit. pp. 4-6).

3.4.2 Changes in employment and unemployment

The labour force of a country, which as we said in the previous section, is the "supply of work", is classified in two groups: employed -demand for labour force- and unemployed labour force.31/ The growth of demand for labour force is determined by the available labour force and economic factors, for instance, the level of production, capital, etc. Thus, an increase of output, if labour force is not increasing as rapidly as output, creates more jobs and consequently will cause an increase of employed labour force. This relationship, under the above constraint, can be expressed as follows:

$$L^e = f\ (L^a,\ Y) \qquad (1)$$

where

L^e : Employed labour force

L^a : Total labour force

Y : National output

By the same way, we can think of regarding the factor capital, the increase of which will cause an increase of demand for labour force.32/ In these two cases, an increase in labour force, with the level of production, or capital constant, will cause an increase of unemployment.

Here, it is considered advisable to mention the function used by Ferber, R. and Verdoorn, R., as regards the estimation of demand for labour force in industrial sector of an economy.33/ They use as independent variables the level of production at time, t, and lagged one year, t-1, as follows:

$$L^e = f(Y,\ Y_{t-1}) \qquad (2)$$

where

Y_{t-1} : Output lagged one year, t-1, in industrial sector of an economy

L^e, Y : as in relationship (1) but in industrial sector of an economy

Furthermore, a similar to above (2) function was introduced by Fromm, G. and Klein, L.34/ They use as explanatory variables of demand for labour force, the employed labour force lagged one year, L^e_{t-1} instead of Y_{t-1} and the "time" as follows:

$$L^e = f\ (Y,\ L^e_{t-1},\ t) \qquad (3)$$

31/ United Nations, Application of International Standards to Census Data on the Economically Active Population. United Nations, New York, 1951. pp. 12-14.

32/ TEMPO, General Electric's Center for Advanced Studies, Population Growth and Economic Development. California, U.S.A. p. 5.

33/ Ferber, R. and Verdoorn, P., Research Methods in Economics and Business. MacMillan Publishing Co., New York, 1962. p. 374.

34/ Fromm, G. and Klein, L., The Brookings Quarterly Econometric Model of the United States. North-Holland Publishing Co., Amsterdam, 1965. pp. 699-702.

where

L^e_{t-1} : Employed labour force lagged one year, t-1

t : Time

Y : as in relationship (1)

Finally, another similar function to above (2) and (3) was used by Professors Klein and Goldberger in the econometric model of the United States 1929-1952 as regards the demand for labour force.35/ Both functions (2) and (3) are indicated for empirical analysis and forecasting.

As regards the unemployment we can say that the changes in its size are affected by the available labour force and the increase of demand for labour force. Thus, an increase or decrease of employed labour force will cause a decrease or increase of unemployment respectively.

So we have

$$L^u = f\ (L^e) \qquad (4)$$

where

L^u : Unemployed labour force

L^e : as in relationship (1)

3.5 International migration

In Section 2 of the present chapter we also said that external migration is a factor of population development, particularly in migratory countries. Emigration, apart from changes in the size of the population, also causes changes in its structure, by age and sex, in the critical age-groups 20-44.36/ The reason for this is that emigrants generally belong to these age-groups. These age-groups (20-44) are a fraction of the labour force of the country. As a result, it can be said that external migration, which is a movement of the labour force from one country to the other, influences the labour force, both as regards its size

35/ Klein, L. and Goldberger, A., An Econometric Model of the United States, 1929-1952. North Holland Publishing Co., 1955. pp. 16-17.

$$L^e = \left(\frac{W_o}{W}\right) \ (a_o + a_1Y_t + a_2Y_{t-1} + a_3t)$$

where

Y_t, Y_{t-1}, t : as in relationships (2) and (3)

W_o : Value of production

W : Wages per man employed

t : Time

36/ In the case of immigration, we have an increase of the labour force, whilst in the case of emigration, we have a decrease in the number of individuals in the critical age-groups 20-44.

and its distribution by age and sex. 37/ These movements of the labour force are mainly attributable to economic reasons, such as wage-rates, unemployment, other conditions (housing, work, etc), etc. which are incorporated in the factor per capita income. Therefore, international migration can be considered as a function of the differentials of per capita income between two countries where an emigration flow exists. 38/

$$d\ (M) = f(Y^a/p^a - Y^b/p^b) \qquad (1)$$

where

d (M)	:	The change of emigration
Y^a/p^a	:	Per capita income of country, a
Y^b/p^b	:	Per capita income of country, b.

3.6 Technological progress

We have already determined the main factors, demographic and economic, which contribute to the increase of national output. With the passage of time we see a quantitative change in relationship between the factors which consist of the "national" production function. This change is the result of technological progress, which is achieved in the meantime by the application of innovations in the economy. 39/ Therefore, we can say that the increase of national output is also attributable to the technological progress. 40/ In the statistical estimation of the aforementioned function, we shall see in what way the factor, technology, enters to it.

3.7 Socio-economic organization

Socio-economic organization is a fundamental factor for economic development in general. As it is known, the demands of the economy and particularly those of its industrial sector, increase in manpower. For the coverage of the needs in labour force, population movements (from rural to urban areas), training of new workers, etc., will take place. The population movements, as it is known, create many problems, for instance, housing, education, pollution, transportation, etc. while the general and professional education is a problem of organization. Furthermore we have to meet the problems of the new living conditions of

37/ External emigration influences the natural increase of population, by means of a change in the birth rate because the emigrants belong to the reproductive age-groups, and by a change in the death rate.

38/ Friedlander, L., Labour Migration and Economic Growth. The M.I.T. Press, Massachusetts, U.S.A., 1965. pp. 21-28.

39/ Kanelopoulos, A., Economic Development, Vol. I. Athens, Greece. pp. 149-150 and 265-266.

40/ In the relationship between inputs and outputs, technological progress influences as follows: an increase of output with given inputs (neutral change) or unchange of output with the decreased inputs (biased change). Sarantides, S., An Introduction to Economic Analysis. Karaberopoulos, S. Publishing Co., Piraeus, 1971. pp. 274-275.

emigrants, that is, family, social problems. On the other hand, innovations, the result of the great inventions, enter to the economy and the application of these innovations necessitates training.

To meet all the aforementioned problems, an organization, administrative, social and economic, is necessary. We shall not extend ourselves on this factor of socio-economic organization, because its importance is self-evident as regards the effort being made by state to increase national output.

3.8 Consumption

In addition to the factors which affect the changes in national output, the analysis of which, from the point of view of functional relationships we realized in the previous sections of the present chapter, there are also economic factors which are affected by the main dimensions of the economic and demographic part of the model, that is, of national output and population respectively. Among these economic variables, consumption can be considered the most significant.

Total -private and public- consumption consists of all production not used for net capital accumulation, that is, it consists of all the goods produced and consumed. The principal factors of the consumption functions are the following:41/

a) income
b) population factors
c) liquid assets
d) the influence of past standards of living

In accordance with the consumption theory, aggregate consumption is a function of national income. As it is known, the consumer's behaviour differs between developed and less-developed countries. Therefore, the importance of this factor, national income, increases when we refer to the countries of the relatively low standards of living. Another factor of the level of consumption is the income distribution. This factor is also of particular importance for the less-developed countries. This is because, in these countries, the differences between agricultural and urban income are great and the savings of propensities of farmers differ substantially from those of urban population.42/ For the variable income distribution, in these cases, the use of the agricultural income and urban income, as separate variables, is indicated.

Hence, in the language of functional relationships we will have

$$C = f(Y) \qquad (1a)$$

or

$$C = f(Y^a, Y^u) \qquad (1b)$$

41/ Pavlopoulos, P., A Statistical Model for Greek Economy 1949-1959. North-Holland Publishing Co., Amsterdam, 1966. pp. 36-39.

42/ Crockett, J., Consumer expenditures and incomes in Greece. Center of Planning and Economic Research, Athens, Greece, 1967. pp. 48-49.

where

C : Consumption expenditure

Y : National income

Y^a : Agricultural income

Y^u : Urban income

Furthermore, the level of consumption, apart from the aforementioned factors, income and income distribution, depends upon population changes.43/ Such changes refer to the population size, its distribution by age, region etc.44/ Thus, the functional relationship (1a) can be written as follows:

$$C = f\,(Y,\ P) \qquad (2)$$

where

C, Y : as in relationship (1a)

P : Population

The liquid assets is also a determinant of the level of consumption.45/ But, the use of this variable as an explanatory variable in the consumption function is very limited. This is because in many economies the market for liquid assets is very small, as this happens in the less-developed countries.

Finally, the past standards of living affect the consumption changes. The habits accumulated through time surely exercise an influence at the present time. The variable consumption lagged one year, C_{t-1}, is used to express these habits which have been accumulated in the past.46/ By the entering of this variable, consumption lagged one year, C_{t-1}, in the functional relationships (1a-1b) they can be written as follows:

$$C_t = f\,(Y_t,\ C_{t-1}) \qquad (3a)$$

or

$$C_t = f\,(Y_t^a,\ Y_t^u,\ C_{t-1}) \qquad (3b)$$

where

C_t, Y_t, Y_t^a, Y_t^u : as in relationships (1a-1b), at time t

C_{t-1} : Consumption lagged one year, t-1

43/ TEMPO, General Electric's Center for Advanced Studies, Description of the Economic-Demographic Model. California, U.S.A. pp. 19-21 and 26.

44/ As regards the population distribution by region, we can use the rural and urban population. This distribution corresponds also to the aforementioned income distribution.

45/ Brennan, M., Preface to Econometrics. South-Western Publishing Company, Ohio, U.S.A., 1965. pp. 345-346 and Suits, D., An Econometric Model of the Greek Economy. KEPE, Athens, Greece, 1966. pp. 23-40.

46/ Pavlopoulos, P., A Statistical Model for Greek Economy 1949-1959. North-Holland Publishing Co., Amsterdam, 1966. pp. 40-41.

A consumption function is assumed to be linear and in our empirical analysis of this function for the countries Chile and Mexico we will use single regression equations in their linear form.

4. AN ECONOMIC-DEMOGRAPHIC MODEL

4.1 Population as an endogenous variable

Many scientists have stated theories regarding population development.47/ In certain of these theories an effort was made to explain the changes in population in conjunction with the socio-economic growth of peoples.48/ Certain of these theories were not verified by ensuing reality, while other were considered as being obsolete. Thus, one of the most important theories, the Malthusian theory, has been given up, as having many drawbacks, from many points of view,49/ while the more modern theory concerning population of W.S. Thompson and F.W. Notestein, which also refers to the socio-economic level of countries, has had a small application.50/

On the basis of the above thoughts, the increase of population, in the studies of socio-economic phenomenon was considered as an endogenous variable.51/ Therefore, the population factor was the main dimension in the models of classical economists. The models developed since then, considered economic and demographic variables independent of one another -neoclassic theory. Thus, many neoclassical growth models, demographic variables, were assumed to be determined exogenously.52/ However, the recent economic literature in the field of economic development, inherited much from the theory of the classics, particularly as regards the importance of population, and the viewpoints of Malthus concerning population hold a noteworthy position in present-day theory.53/ We therefore have a return to the

47/ United Nations, "History of Population Theories", included in The Determinants and Consequences of Population Trends. United Nations, Population Division, New York, 1953.

48/ Theories regarding population a) that of Professor of Political Economy Thomas R. Malthus, "The Principles of Population" b) that of W.S. Thompson and F.W. Notestein, "Theory of Demographic Transition", 1950.

49/ According to the Malthusian theory, the increase of agricultural production was not foreseen, resulting from the improvement of production methods, as also the high standards of living, as a result of industrialization, the development of transportation and communication, and the decrease of birth rates, on account of birth control.

50/ In recent years it has been supported that neither the European countries developed exactly as foreseen by the theory of "transition" nor have the economically developed countries developed on the basis of the aforementioned theory.

51/ Nelson, R., "Theory of the Low-Level Equilibrium Trap in Underdeveloped Countries". American Economic Review. December 1966. pp. 894-908.

52/ The explanation of demographic behaviour, "was left to demographers, sociologists and biologists", has stated J. Schultz; "The Value of Children, An Economic Perspective". Journal of Political Economy, Vol. 81, March/April 1973.

53/ Kanelopoulos, A., Economic Development, Vol. I, Athens, Greece. pp. 17-21 and 272-291.

classical treatment of population development, as an endogenous variable.54/ This is obvious, because the existence of interrelationships and interactions between demographic and economic growth has been proved and this has been acknowledged by the makers of demographic and economic policy.55/ A great number of theoretical and empirical analyses have incorporated population evolution as a basic variable, affecting and being affected by economic growth.56/

4.2 Theoretical basis of the model

4.2.1 Interdependent system

Models are frequently used in economic analysis for solving quantitative problems. They can be expressed by means of an equation or a system of equations. The equations -structural equations- express the theoretical causalities and interactions which are to be tested against the statistical data. More specifically, they describe the relationships which exist between the sectors of the economic activity or to other non-economic parts and which must be estimated

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54/ Friedlander, S., Labour Migration and Economic Growth. The M.I.T. Press, Massachusetts, U.S.A., 1965. pp. 10-12

55/ Adelman, I., "An Econometric Analysis of Population Growth". The American Economic Review, Vol. 23. 1963. pp. 315-339.

56/ Here we give some of the main and the most recent studies on this subject. Beckmann, M., "Income Growth and Population Growth". European Economic Review. Brussels, Belgium, 1970. pp. 546-552. Brandt, W., Some Observations on the Relationships between Population Increase and Economic Growth. United Nations, World Population Conference, 1965. Choudhry, N. and Kotowitz, V., Some Simple Economic-Demographic Relationships. United Nations, World Population Conference, 1965. Habakuk, J., Population Growth and Economic Development. Leicester University Press, Leicester, 1971. Orstenko, V., Influence of Social and Economic Factors on Demographic Characteristics. United Nations, World Population Conference, 1965. Ronald, B., "Steady-State Paths in an Economy with Endogenous Population Growth". Western Economic Journal. December 1970. Horvat, B., Relation between the Rate of Growth and the Level of Development. Development Research Centre, Bloomington, 1972. Lloyd, R., "A Growth Model with Population as an Endogenous Variable". Population Studies Review, Vol. XXVII. November 1969. López, T., Population Factors in Latin American Economic Development. Universidad de los Andes, Bogotá, 1967. Sudhakar, G., "Interaction between Population Growth and Some Socio-Economic Indicators". Journal of Institute of Economic Research. Dharwar, January, 1968. Thirewall, A., "A Cross Section of Output and Per Capita Income in a Production Function". Manchester School of Economic and Social Studies, N° 14. December 1972. TEMPO, General Electric's Center, Population Growth and Economic Development. TEMPO, General Electric's Center for Advanced Studies, California, U.S.A. The International Labour Office is making an effort to investigate the demographic-economic characteristics in conjunction with educational system, for Asian countries. World Employment Programme, Geneva, 1973. Stone, R., Demographic Accounting and Model Building. OECD, Paris, 1971 is a successful effort of coordinating, within a system, a great variety of demographic and social statistics. Paz, P. and Rodríguez, O., Cinco modelos de Crecimiento Económico. Instituto Latinoamericano de Planificación Económica y Social, Santiago, Chile, 1970.

statistically from empirical observations.57/ It is possible that an interdependence between variables of a system of equations exists. This means that the dependent variable of an equation is an explanatory variable of another equation of the same system of equations and vice versus. In this case we have a system of regression equations with interdependent variables. This system is called interdependent system. Models of more than one equation and the aforementioned type appear in a compound form, on account of the interactions and interdependences of the several variables to be predicted. Such models have two classes of variables: endogenous variables -those explained by the model- affecting one or more variables, but also being affected by one or more variables, and the exogenous ones, which are not explained by the model; they affect variables of the system, but are not affected by the variables of the system.58/ These latter variables are also called predetermined variables.

Furthermore, it is conventional that the variables to be predicted by the model, i.e. the endogenous variables, be denoted as Y's and the predetermined variables, as Z's, each with suitable subscripts.

Finally, a model has three aspects: its economic content, its mathematical form and its technical problems. Economic theory determines the economic aspects of the model, while the suitable mathematical form of the model will allow us the accurate estimation of the paremeters. Both economic aspects and statistical criteria will verify if the adopted form of the model would be the appropriate one. The technical problems are concerned with quantitative expression of the variables, statistical properties of error terms, the problem of identification, etc. As regards the estimation of the parameters, it is made on the empirical data by applying one of the traditional methods, ordinary least squares (OLS) or two-stage least squares (TSLS). In more details, for the aforementioned technical problems, methods etc., as well as how successful the estimation of structural coefficients is we refer to in the next sections of the present chapter and in the empirical analysis of the model applied.

4.2.2 Mathematical consideration of the interdependent system

4.2.2.1 Structural form

Here, we will deal with the mathematical form of interdependent system of equations. In other words what is the proper form that such a model must take in order to estimate the parameters of the variables used.

In general, an interdependent system -model- is a system of linear equations relating the endogenous variables, Y, to the predetermined variables, Z, and the disturbance errors, e.59/

57/ Suits, D., The Theory and Application of Econometric Models. Center of Economic Research. Athens, Greece, 1963 and An Econometric Model of the Greek Economy, Center of Economic Research, Athens, Greece, 1964. pp. 19-20.

58/ Drakatos, C., Econometrics. Kloukinas, S. Publishing Co., Athens, Greece, 1971. pp. 114-119.

59/ Such models have had a wide application in the socio-economic sciences (Wold, H., The Approach of Model Building and the Possibilities of its Utilization in Human Sciences. University of Uppsala, Uppsala, Sweeden, 1964).

Thus, a model of n equations with the same number of endogenous-interdependent-variables, Y, and n predetermined variables, Z, can be mathematically represented in the following manner:60/

$$
\begin{aligned}
Y_{1t} &= b_{12} Y_{2t} + c_{11} Z_{1t} + e_{1t} \\
Y_{2t} &= b_{21} Y_{1t} + c_{22} Z_{2t} + e_{2t} \qquad (1) \\
Y_{3t} &= b_{32} Y_{2t} + c_{33} Z_{3t} + e_{3t} \\
&\cdots \\
Y_{n-1,t} &= b_{n-1,n-2} Y_{n-2,t} + c_{n-1,n-1} Z_{n-1,t} + e_{n-1,t} \\
Y_{n,t} &= b_{n,n-1} Y_{n-1,t} + c_{n,n} Z_{n,t} + e_{n,t}
\end{aligned}
$$

where

$$
Y_{it} = \begin{bmatrix} Y_{1t} \\ Y_{2t} \\ Y_{3t} \\ \vdots \\ Y_{n-1,t} \\ Y_{nt} \end{bmatrix} \qquad
Z_{it} = \begin{bmatrix} Z_{1t} \\ Z_{2t} \\ Z_{3t} \\ \vdots \\ Z_{n-1,t} \\ Z_{nt} \end{bmatrix} \qquad
e_{it} = \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ \vdots \\ e_{n-1,t} \\ e_{nt} \end{bmatrix}
$$

are endogenous, predetermined variables and error terms, respectively.

The system of equations (1) can be expressed in matrix form as follows:

$$Y_{it} = BY_{it} + CZ_{it} + e_{it} \qquad \text{Structural form} \qquad (2)$$

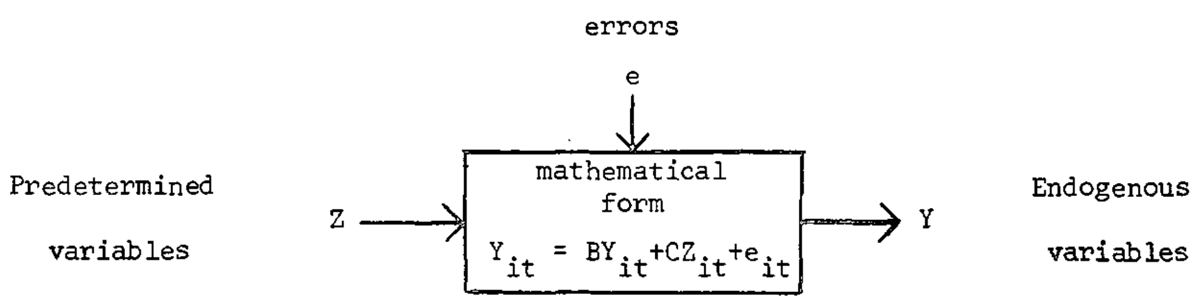
60/ In an economic-demographic model, the variables can be of both categories, economic and demographic variables.
Furthermore, the n-predetermined variables which are in the model (1), can also be in each equation of the system. In this case, only the order of elements of the matrix, C, will change.

where

$$B = \begin{bmatrix} 0 & b_{12} & 0 & 0 & 0 & 0 \\ b_{21} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{32} & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & b_{n-1,n-2} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{n,n-1} & 0 \end{bmatrix} \quad C = \begin{bmatrix} c_{11} & c_{12} & 0 & 0 & 0 & 0 \\ 0 & c_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & c_{33} & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & c_{n-1,n-1} & 0 \\ 0 & 0 & 0 & 0 & 0 & c_{nn} \end{bmatrix}$$

Mathematical completeness requires that there will be as many linearly independent equations as endogenous variables; hence the matrix B must be square and invertible. Furthermore, it is possible that some of the exogenous variables whose values are determined outside the system, will be lagged endogenous variables whose values are also predetermined variables.61/

Finally, the aforementioned model can be represented diagrammatically as follows:



4.2.2.2 Reduced form

The explicit solution of the structural form (2) for Y_{it}, can be made as follows:62/

$$Y_{it} - BY_{it} = CZ_{it} + e_{it} \tag{3}$$

multiplying by the unit matrix, I, we have

$$IY_{it} - BY_{it} = CZ_{it} + e_{it} \tag{4}$$

and

$$(I-B)\ Y_{it} = CZ_{it} + e_{it} \tag{5}$$

61/ Walters, A., An Introduction to Econometrics. MacMillan Publishing Co., London, 1970. pp. 180-181.

62/ Wold, H., Econometric Model Building (Forecasting by the Chain Building). North-Holland Publishing Co., Amsterdam, 1964. pp. 25-30.

Since the matrix B is square and invertible, we multiply the above equation by $(I-B)^{-1}$ and we get

$$(I-B)^{-1} (I-B) Y_{it} = (I-B)^{-1} (CZ_{it} + e_{it}) \qquad (6)$$

Hence

$$Y_{it} = (I-B)^{-1} CZ_{it} + e^{*}_{it} \quad \text{Reduced form} \qquad (7)$$

in which

$$e^{*}_{it} = (I-B)^{-1} e_{it}$$

where

Y_{it}, Z_{it}, e_{it} as in the system (1)

and

matrices B, C as in the system (2)

The reduced form (7) is indicated for making forecast of Y_{it}, in terms of the predetermined variables, Z_{it}.

4.3 Sequence of the variables in the model building based on the hypotheses. Schematic view of the model

In this section, we shall see the sequence of the economic and demographic variables in the construction of the model, through the relationships - hypotheses mentioned in the previous Chapter 3.

As it is known, an economic-demographic model consists of two parts, the demographic part and the economic part. The first part includes the demographic factors, their relationships, etc. whereas the second part refers to economic variables, their function in the economic system, etc. As mentioned elsewhere, the investigation of interrelationship between these two parts can be realized by two-opposite-directions. In the present work, the impact of population on the growth of national output will be studied, i.e. we follow the direction, from the demographic to the economic part.

In the demographic part, the main dimension is the population, i.e. its size and distribution by age and sex. The factors of the increase of the population and the change of its structure, are natural increase and net migration. Fertility and mortality determine the natural movement, while immigration and emigration determine positive or negative migration, which influences the size and the distribution by age and sex of the population. Internal migration causes population changes with respect to residence (rural and urban population) and, of course, these changes also affect the natural movement of the population.

On the other hand, labour force -size and structure- mainly depends on the size of population and its distribution by age, sex, and the participation rates. Furthermore, labour force is influenced by net emigration. In accordance with the classification of labour force (previous Chapter, section 4.2), a fraction of the labour force is the employed labour force, the size of which affects and is affected by national output. Apart from national output, capital influences the number of individuals employed. As regards the first part of the model we shall not enter into further details on the demographic features, their interactions, etc. nor will we refer to the purely demographic technique used to make population forecasts. This is because population trends for coming years, in Latin American countries, have already been established63/ and consequently, we shall use these forecasts in order to estimate the size of the labour force and especially, the employed labour force which enters in the model as one of its main variables.

As regards the second part -economic part- of the model, national output is the main variable. Based on the hypotheses -national production function, chapter 3, section 3- we have accepted that the employed labour force and capital determine the size of national output. On the other hand, the growth in employed labour force is determined by the growth of labour force and national output or capital, while these latter variables are influenced by savings. Furthermore, the technological progress and socio-economic organization are also two fundamental factors which affect the increase of national output. As regards the consumption, which is a variable to be predicted outside of the model, it is affected by the main dimensions, national output and population, of the system.

From the study of the sequence of the variables in the two sub-systems, demographic and economic, and the interrelationships of these variables in the whole system, we can say in conclusion, that the variables, employed labour force and capital, are the most significant for the determination of the national output, which together with the population consist of the main determinative factors of the consumption. Moreover, national output and population are the two elements by which we can determine the per capita income.

Finally, it is advisable to say that the economic part is described in terms of a set of flow variables while the demographic sub-system is stated in term of stocks. Of course, there are deviations from this general rule, and they are mentioned in the relevant section 5.1 of this chapter in which the quantitative expression of each variable of the model is studied.

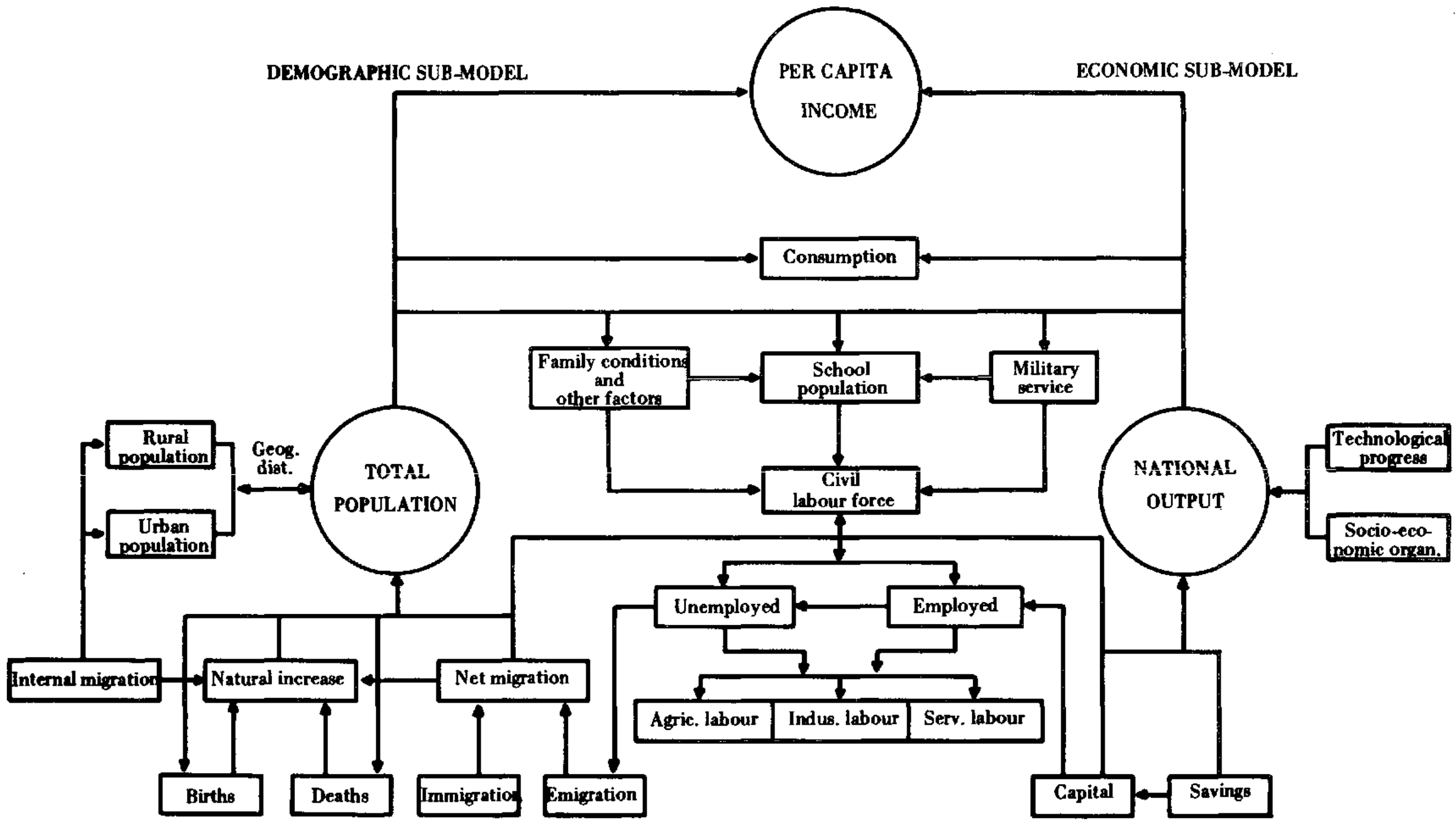
Already, the two parts have been given -demographic and economic- of the model, in which a set of demographic and economic relationships respectively, as also their interrelationships between them, are described. Furthermore, the direction of each variable, from the point of view of its influence on the other, as same has been explained in the present section is also given.

On the basis of these, we shall below illustrate the model schematically. Figure 1 presents the model. Thus, in the left-hand side there is a collection of boxes containing demographic variables, while the right-hand side consists of boxes containing economic variables. In the centre of the scheme, there is the variable, consumption, and at the top of this schematic form of the model, the per capita income. Of course, there are other factors, economic, social and demographic, which influence or are influenced by the variables of the model, but their presentation in Figure 1 was not considered necessary. This is because Figure 1 aims at giving a general picture of an economic-demographic model from the point of view of basic variables, their interrelationships etc. and in the model to be applied a few of the aforementioned variables will enter.

63/ Latin American Demographic Centre (CELADE). Boletîn Demográfico. Year VII, N° 13, Santiago, Chile, 1974 and International Labour Office (ILO), Labour Force Projections. ILO, Geneva, Switzerland, 1971, Part III.

Figure 1

ECONOMIC-DEMOGRAPHIC MODEL



The arrow ——▸ shows direction of influence or simple direction

4.4 The macro-model to be applied

In the mathematical consideration of the model, section 2, we saw that it involves a great number of endogenous and predetermined variables. In the practice, such a number of variables in an economic-demographic model is unmanageable. It requires detailed data which, in most cases, are not available and even if they were, we would face serious problems as regards the defining of the interrelationships, the statistical estimation of the parameters, etc. In general it is indicated that a model must refer to crucial variables so that their interrelationships can be easily determined and the statistical process of their estimation has not many difficulties.

4.4.1 Specification of the model

The model to be applied attempts to investigate the interrelationships between basic economic and demographic variables. The determination of these variables, their interrelationships and the number of equations in the system to be tested against the empirical data, consist of the specification of the model. In the present case, the model attempts to interrelate the national output to employed labour force, capital and population, by means of the factors which, on the one hand, contribute to the increase of national output and on the other hand, determine the development of supply of labour force and the size of employment. The present macro-model consists of the three structural equations and one identity. The equations describe hypotheses about the interrelationship among a number of economic and demographic variables, while the identity defines the relationship -equality- that exists between demographic factors. The equations are stochastic and contain in the left-hand side, the variables to be predicted by the model -endogenous variables- and in the right-hand side, the predetermined variables. Moreover, in the right-hand side of each equation there is an error term, on account for all the variables omitted from the functional relationship and for any deviation between the shape of the assumed function and the true relationship.64/ This error term is assumed to have some properties.65/ Furthermore, these equations are linear both in variables and in parameters.66/

64/ Walters, A., An Introduction to Econometrics. MacMillan Publishing Co., London, 1970. pp. 211-213.

65/ The properties of the error term, e_i, refer to its probable distribution. They are the following:

a) error term, e_i, is a random variable with normal distribution and the mean to be zero, i.e. $E(e_i) = 0$ for $i = 1,2,\dots n$

b) The variance of this variable to be fixed, i.e. $V(e_i)=S^2_{e_i}$ for $i = 1,2,\dots n$

The properties, a and b, can be written as follows:

$$e_i = N\,(0,\ S^2_{e_i}) \text{ for } i = 1,2,\dots n$$

c) The last property attributed to the e_i, is that its values are independent of one another, i.e. $E\,(e_i\, e_j) = 0$ for all $i \neq j$

(Gramer, J., Empirical Econometrics. North-Holland Publishing Co., Amsterdam, 1971. pp. 83-86.

66/ The meaning of linearity of parameters is that the parameters estimated are linear functions of the values of the variables.

As regards the number of variables used by the model, it is seven and they fall in three classes: a) endogenous variables -there are four- which are explained by the model; b) lagged endogenous variable and c) current exogenous variables. In the system there is one lagged endogenous and two current exogenous variables. The variables of two latter classes -predetermined variables- are determined outside of the system of the equations. From a forecasting point of view, the lagged variables can be considered superior to the current exogenous variables. This is because the available information about the lagged variables is given, while values of the exogenous variables should be estimated themselves.67/ Finally, the presence of the lagged variables in a model makes it a dynamic model. In the next two sections we bring together the entire system of equations with a glossary of the symbols in order to obtain a picture of the model to be applied.

4.4.2 Equations of the model

Based on the hypotheses, Chapter 3, the sequence of the variables in the model building as it is mentioned in the third section of the present Chapter and the specification of the model, the equations of the interdependent system to be tested against the data, are the following:

$$Y_t = a_o + a_1 L_t^e + a_2 K_t + e_{1t} \quad (1.1)$$

$$L_t^e = b_o + b_1 Y_t + b_2 L_{t-1}^e + e_{2t} \quad (1.2)$$

$$L_t^a = c_o + c_1 P_t + e_{3t} \quad (1.3)$$

$$L_t^u \equiv L_t^a - L_t^e \quad (1.4)$$

The equations describe the relationships which exist between the variables of the model. Thus, the first equation explains the national production.68/ The second determines the demand for employed labour force and the third equation refers to the development -supply- of the labour force. Consequently, we can say that in the model there is a production function, a demand function for employment and a supply function, of labour force. Furthermore, in the model there is an identity by which we define the unemployment. Of course, the national output and employed labour force are the central variables but also other demographic variables as available labour force, population, etc. appear in the model. Such variables are necessary in an economic-demographic model and make it more appropriate for forecasting purposes. The coefficients -structural coefficients- are the traditional constants of economic analysis, i.e. they measure the elasticities of explained variable with respect to the determinative factors of each equation.

67/ Pavlopoulos, P., A Statistical Model for the Greek Economy 1949-1959. North-Holland Publishing Co., Amsterdam, 1966. pp. 29-32.

68/ Koutsoyiannis-Kokkova, A., Production Functions in Greek Industry. KEPE, Athens, 1964. pp. 61-62.

Finally, the number of variables used by the model is seven of which four are endogenous -affected or being affected, by other variables-. Thus, the system has as many endogenous as there are equations in the system. From this point of view this system of equations can be considered complete.

4.4.3 List of the Variables

The variables in the model by category and in order of appearance are:69/

Endogenous variables

Y : National output (value added), at constant prices (in millions)

L^e : Employed labour force (number of workers in thousands)

L^a : Available labour force (number of workers in thousands)

L^u : Unemployed labour force (number of workers in thousands)

Predetermined variables

K : Gross capital formation, at constant prices (in millions)

L^e_{t-1} : Employed labour force lagged one year, t-1 (number of workers in thousands)

P : Population (in thousands)

Structural coefficients

a_1, a_2

b_1, b_2

c_1

Constants

a_o, b_o, c_o

Random disturbance terms

e_1, e_2, e_3

Superscripts : Number = base year

Subscripts : They refer to the year, t, or lagged one year, t-1

69/ Remarks on the functions of the system from the point of view of the variables used, are included in Chapter 9.

4.5 Technical problems of the model

4.5.1 Quantitative measurement of the variables of the model

After the determination of the model to be applied, the next task is to define the quantitative expression of the various variables which enter in it. The first is production. Ideally, it should refer to the material units of standard type. This is difficult, because the units of product are heterogeneous. As a consequence, the monetary measure of output is that most indicated.70/ Furthermore, the model refers to the national level and in this case, the value-added of the economy is the suitable.71/ The variable "labour" is also measured approximately, and this is so because we do not have "standard labour units" with no variation in skill or intensity, at our disposal. Furthermore, we do not have statistical data for used man-hours of work in the production. For these reasons, in the greater part of this work, we have to use the figures for the total number of individuals in employment.72/ We meet most of the difficulties in the measurement of the capital variable. Capital is a stock concept and relates to a point of time. If we accept the idea of capital stock at any point of time, we will not have, in this manner, the real contribution of the factor "capital" in the model under study. This is because, as argued by Professor Robinson, the capital stock at any time consists of a collection of heterogeneous capital equipment at various stages of its life cycle and various degrees of obsolescence. Nor is it easy to provide, as she points out, a price measure, because the unit measurement varies with the rate of profit and the relative prices of equipment are determined by the future profit expectations.73/

Furthermore, in the case of underemployment of fixed capital, the estimation of the model -production function- will not give the accurate relationship between output-capital.74/

Finally, production is a flow concept relating to a period of time, in contrast with what we accepted for capital. If we accept the idea of capital services consumed over a period of time,75/ although this viewpoint corresponds to reality, it introduces the problem of variation in the stock over time and variation in the rate of utilization. The lack, however, of statistical data on same does not permit us a statistical estimation of capital on the basis of the aforementioned concept. On the existing statistical techniques for estimating

70/ The value of output must be deflated by a price index. In this case, we must also confront the "indices" problems.

71/ Koutsoyiannis-Kokkova, A., Production Functions in Greek Industry. KEPE, Athens, Greece, 1964. pp. 25-26 and 69-70 and Sarantides, S., An Introduction to Economic Analysis. Karaberopoulos, S., Publishing Co., Piraeus, 1971. p. 263.

72/ In this case, "Labour" appears in the sense of a stock concept, and not of a flow concept, as same is observed in the output variable (See Sarantides, S., p. 264).

73/ Robinson, Joan., "The Production Function and the Theory of Capital". The Review of Economic Studies, 1953-1954.

74/ See Sarantides, S., op. cit. pp. 263-264.

75/ In this case we have the flow concept of capital, i.e. capital consumption during the productivity procedure of a period of time.

gross fixed capital, the most usual one is the "inventory method".76/ An inventory is maintained of the capital stock at the base year prices by adding gross investment and by deducting capital consumption. On these elements there are available statistical data.

As regards the variables population and private consumption expenditure, there is not problem for their statistical estimation because we have available statistical data.

Finally, the influence of factor "technological progress" on the increase of output, can be measured by introducing in the model -production function- a simple time-trend or a multiplicative trend term.77/ Of course, this is a manner of entry of the variable into the model under study, but both its analysis and estimation are difficult tasks in the macro-economic time series data.

4.5.2 Economic time series data

For the estimation of the model we will use time series data, that is, observations on the economic variables, such as output, employment, consumption, etc. at different points of time. The use, however, of time series data, as it is known, creates some problems of a statistical nature. These problems, as also their confrontation, are mentioned below. The values of the variables in time series are usually given at current prices. The use of indices for the deflation of the time series, that is, the expression of the values of the variables at constant prices creates, as elsewhere mentioned, various statistical problems.78/ Fortunately, the statistical data of the variables used in the model, are given at constant prices and consequently, the deflation procedure was not necessary, however, the statistical problems are involved in same. Furthermore, the presence of a trend in time series is another serious problem. It introduces a dependence between successive observation, and the elimination of this trend from the time series is not possible in certain cases.79/

Among the problems which arise in the use of the time series data as regards the technological progress, we can say that it is a large and important nuisance variable in macro-production function. This is because part of the output increase, during a period of time, is attributable to the development of technology noted in this period. In addition to this, the rate of technological advance differs between the productivity units as also between the sectors of the economy. We shall not enter into other details regarding the time series data used, because we refer to them during the analysis of the statistical results obtained.

76/ Barna, T., "The Replacement Cost of Fixed Assets in British Manufacturing Industry, in 1955". Journal of the Royal Statistical Society. 1975.

77/ Walters, A., An Introduction to Econometrics. MacMillan and Co., Ltd., London, 1970. pp. 300-304.

78/ Groxton, F.E. and Gowden, D.J., Applied General Statistics. Prentice Hall, New York. pp. 273-275.

79/ Brennan, M., Preface to Econometrics. South Western Publishing Co., Ohio, U.S.A., 1965. pp. 359-362.

4.5.3 The problem of identification

As it is known, the economic functional relationships -equations- are formulated on the basis of the existing economic theory. The structural equation of a system, which expresses one and only one economic relationship which has been determined by the theory, is called "identified" equation.80/ Furthermore, we distinguish the "just identified" and the "over-identified" equation.81/ In other words, in the first case, it is possible to obtain unique values for all structural coefficients of the equation, whereas, in the second case, the estimation of such values can be made only under restrictions.82/ Here, it is useful to re-express the two conditions -necessary and sufficient- for identification and to investigate the system of equations which is applied from this point of view.

The necessary condition for the identification of an equation of the system is: the number of variables excluded from this equation but contained in the system, should be at least one less than the number of equations of the system. By n, we denote the number of equations, by G, the total number of variables83/ and by H, the number of variables in the equation in question.

Thus

if $G - H = n - 1$, then the equation is just identified

if $G - H > n - 1$, then the equation is over-identified.

Based on the aforementioned condition, the model is over-identified, because all the structural equations are over-identified.84/ On the other hand, the sufficient condition for the identification of an equation belonging to a linear system of equations is: the construction of at least one non-zero determinant of n-1 order from the coefficients of the variables excluded from the equation under study but included in the other n-1 equations.

The fulfillment of the sufficient condition will be examined for each structural equation of the system. Firstly, we construct the determinants already mentioned which are the following:

$A_1 = b_2c_1$ for the first equation

$B_1 = a_2c_1$ for the second equation

80/ Drakatos, C., Econometrics. Kloukinas, S., Publishing Co., Athens, Greece, 1971. pp. 119-128.

81/ In the case of "not identified" equation (under-identified), the entire set of structural equations cannot be estimated statistically, a fact that means that the statistical values obtained cannot be interpreted from economic point of view.

82/ Brennan, M., Preface to Econometrics. South-Western Publishing Co., Ohio, U.S.A., 1965. pp. 384-399.

83/ In the number of variables, the endogenous and predetermined variables are included.

84/ For instance, in the first equation of the system, the number of variables which are excluded from this equation and included in the model, i.e. G-H, is more than n-1. The same can be said for the remaining equations of the system.

and

$C_1 = a_2b_1$ for the third equation

$C_2 = -b_2$ for the third equation

and then we test the condition by which at least one determinant should be non-zero in each equation. Thus, in order that the first equation be identified, the value of the determinant, A_1, should be non-zero, $A_1 \neq 0$. The same can be said for the second equation, i.e. $B_1 \neq 0$. For identification of the third equation, one of the two determinants, C_1 or C_2, is necessary to be zero, i.e. $C_1 \neq 0$ or $C_2 \neq 0$. Based on statistical estimates of the coefficients of each determinant, we are led to the conclusion whether the sufficient condition is fulfilled in the equations of the system.

4.6 Statistical estimation of the parameters

4.6.1 Limitations as regards the estimates

The statistical estimation of the structural coefficients of the model applied is based on eleven annual observations in the case of Chile. These observations cover the period of time 1960-1970 or the period of time 1959-1969 whenever a lagged variable is used in the system of equations. The same can be said with respect to the number of observations and the period of time covered by them, for the case of Mexico in which the model will be also tested. The size of the sample from this point of view -eleven observations- can be considered small. This implies a limitation of the model as regards the estimates. Unfortunately, the lack of statistical data did not allow us to elongate the period of the estimation of the coefficients. Moreover, the period of time of a decade cannot be representative of the economy of a country. This means that the parameter estimates do not reflect the "average" economic behaviour of the variables in the past which is usually used for making forecasts. Apart from the statistical aspects, the period 1950-1960 was rich in the variety of circumstances. Thus, in certain Latin American countries, we had severe disruption of their economies, on account of the political reasons. This makes the economic information for these years of questionable value. On the other hand, the use of an even shorter period of time, in order to avoid the aforementioned difficulties, is not indicated from statistical point of view. In other countries, the rate of growth was high, over the sample period. This creates another serious problems, for instance, a) the problem of intercorrelation among the various time series that is stronger than in the usual case, a fact that reduces the accurate estimation of the effects of the changes in the explanatory variables on the endogenous variables; b) the problem of identification in the functional relationships used.

In the previous section, we said how difficult task the elimination of the trend from the time series is, as well as the ascertainment whether the data identify the function under study of another function of the same system of equations.

Finally, the number of the explanatory variables is small. Two explanatory variables are introduced in each equation of the model while, as it is known, there is a multitude of factors which influence the variable to be predicted. This imposes a restriction of the model with regard to the estimation of the structural coefficients, because it creates problems due to loss of degrees of freedom, identification problems as mentioned previously, completeness of the equations from economic point of view, etc.

However, all the aforementioned limitations do not change the nature of the model. A model is an ideal manner of systematizing available demographic and economic data and making forecasts on a scientific basis, even though there are a few doubts about the information, the application of the model, etc. In this point, we can add that the forecasting as regards the development of the endogenous variables in the coming years shows a successful application of the present economic-demographic model.

4.6.2 Methods of estimation. Statistical criteria

The estimation of the parameters has been carried out by applying ordinary least squares (OLS) to each equation of the model and simultaneous equation methods like two-stage least squares (TSLS) to the system.85/ The estimates of both methods are included in the relevant tables. Here, it is advisable to repeat some of the merits of these two methods.86/ It is well known that certain economic relationships may be non-linearities. These non-linearities can be easily tackled with OLS method, but are difficult in a simultaneous equation estimate. Furthermore, it is easier to experiment with alternative variables and alternative forms of equations in the case of OLS than in the case of TSLS. In the present work, the least squares regression analysis helped us to test the final functional relationships before entering in the system of equations and to compare the statistical results obtained between OLS and TSLS on the basis of the statistical criteria and the merits of these two methods. Furthermore, the OLS estimates, as it is known, in an interdependent system of equations are inconsistent87/ and biased. This bias cannot be eliminated by increasing the sample size. On the other hand, it has been shown by Theil, H. that the generalized variance of ordinary least squares estimates of the parameters around their mean in a single equation is smaller than other unbiased estimates.88/ The TSLS method possesses the merit of giving consistent estimates and small sample bias, but in a sample as small as ours (11 observations), the property of the consistency of this method may not be free from bias. Finally, the simultaneous equation methods generally require the assumption of linearity for computation purposes, and in this case we have the problem of specification error, etc. The OLS method is simple as regards the calculations of the constants and coefficients of an equation. However, the choice between the aforementioned methods and the acceptance of the results obtained should be based on the over-all function of the model as a whole and not in detailed weaknesses of the methods.

85/ Theil, H., Economic Forecasts and Policy. North Holland Publising Co., Amsterdam, 1961.

86/ A summary on the relative merits of the different methods of estimation of the parameters has been provided by Johnston, J., Econometric methods. Mac Graw-Hill Company Inc., London, 1963.

87/ Haavelmo, T., "Methods of measuring the marginal propensity to consume". Journal of American Statistical Association, Vol. 42. pp.14-25.

88/ Theil, H., "Report of the Uppsala Meeting, 1954". Econometrics. April, 1955.

The statistical criteria on the basis of which we can accept or reject an equation of the system are the coefficient of multiple determination, R^2, the standard error of estimates and Von-Newmann's ratio. Thus, the coefficient of multiple determination, R^2, determines the percentage of the variance of the dependent variable explained by the independent variables. The unbiased estimation of this coefficient in the population, $\bar{R}^2$, will be

$$\bar{R}^2_{y.123 \ldots k} = 1 - (1-R^2_{y.12 \ldots k}) \cdot (\frac{n-1}{n-k}) \qquad (1)$$

where, n denotes the number of observations and k denotes the number of variables of each equation.89/ For testing the statistical significance of the coefficient of determination, $\bar{R}^2$, we will use the "F" distribution as follows:

$$F \text{ (from observations)} = \frac{\bar{R}^2_{y.12 \ldots k}}{1-\bar{R}^2_{y.12 \ldots k}} \qquad (2)$$

at a level of 5 per cent or less.

The Von Newmann's criterion is used for the testing of autocorrelation. As it is known, it is the ratio of the average square of the differences of successive values of error term, d^2, to its variance, S^2, corrected by the fraction $\frac{n}{n-1}$ for degrees of freedom. The letter of the operator Σ means "Summation of". This criterion is written

$$\frac{d^2}{S^2} = \frac{\Sigma(e_{it} - e_{it-1})^2}{\Sigma e^2_{it}} \cdot \frac{n}{n-1} \qquad (3)$$

and it is assumed that $E(e_t, e_{t-1}) = 0$ for testing of its statistical significance. The reliability of the statistical estimates of the parameters, will be judged by their standard errors. In other words, the standard errors are the measure of the fit of the data of an equation. The criterion of t-student is taken into consideration for testing of the statistical significance of the parameters estimates, at a level of 5 per cent or less.

Finally, as regards the estimates of regression coefficients we can say the following: Each regression coefficient measures the change of the explained variable caused by the unique change of the explanatory variable and its sign is determined by economic theory. Consequently, we will examine the consistency of the estimates with a priori expectations regarding their sign and their quantitative effects on the endogenous variables based on their magnitude. In the sections which are concerned with the statistical results obtained, we will deal with the aforementioned criteria in more details.

89/ Drakatos, C., Econometrics. Kloukinas, S., Publishing Co., Athens, Greece, 1971. pp. 42-47.

4.7. A further investigation of the model

4.7.1 The identity of the system. The state of full employment

By applying the labour force statistics which treat the classification of the available labour force, we derived the unemployed labour force, as endogenous variable of the model. Indeed, in the model described in section 4 of this chapter an identity for the labour force is included. It is obtained as the sum of the employment and unemployment.

$$L_t^a \equiv L_t^e + L_t^u \qquad (1)$$

It is known that in Latin American countries there is not the state of full employment and consequently, the introduction of the above basic identity in the model was necessary because it reflects the existing situation from this point of view. Furthermore, it allowed us statistically to involve the third equation in the system by means of which we can estimate the development of the labour supply, on the basis of pure demographic factor, population. Based on what we said previously, we are led to the conclusion that the model cannot be applied in the case of full employment, i.e. if

$$L_t^a = L_t^e \qquad (2)$$

4.7.2 Properties of the functions of the system

In addition to the choice of convenient functional relationships in a model, which is an important part of its construction, the determination of properties of its functions is also necessary and useful for their economic and statistical analysis. Of course, the properties of functions will be based on the economic theory and their mathematical form.90/ In this section we will mention the basic properties of the three functions of the model and they will be tested by the numerical results which will be obtained during the empirical measuring of the model.

Thus, in the linear functions of the model we specify that

a) They have continuous partial derivatives which in the case of linear production function -analogous thought can be made for the remaining two functions- will be

$$\frac{dY}{dL} = a_1 \quad \text{and} \quad \frac{dY}{dK} = a_2 \qquad (1)$$

b) None of their explanatory variables may take negative values, i.e. it must be

$$L_t^e \geqslant 0, \quad K \geqslant 0, \quad Y_t \geqslant 0, \quad L_{t-1}^e \geqslant 0, \quad P_t \geqslant 0 \qquad (2)$$

90/ Walters, A., An Introduction to Econometrics. MacMillan Publishing Co., London, 1970. pp. 271-276 and Koutsoyiannis-Kokkova, A., Production Functions in Greek Industry. KEPE, Athens, Greece, 1964. pp. 61-65.

c) The elasticities of their explained variables with respect to explanatory variables will not be constant at different points of the curve, but they change. In the case of the production function, the elasticity of the explained variable, output, Y, with respect to the explanatory variables, employed labour force, L^e, and capital, K, is determined as follows:91/

$$e_{Y,L^e} = \frac{dY}{Y} : \frac{dL^e}{L^e} \tag{3a}$$

$$= \frac{dY}{dL^e} \cdot \frac{L^e}{Y} \tag{3b}$$

$$= a_1 \cdot \frac{L^e}{Y} \tag{3c}$$

and

$$e_{Y,K} = a_2 \cdot \frac{K}{Y} \tag{3d}$$

Finally, in Chapter 6, sections 1.5 and 2.4, the quantitative explanation of the computed elasticities will be made in accordance with the existing theory.92/

91/ In general, the elasticity of a mathematical function, for instance, the function f(X, Y, Z) and as regards the variable, X, is defined as plus or minus its logarithmic derivative with respect to X. We denote the elasticity by $e_X f$ and according to the sign, it will be

$$e_X f = \pm \frac{d \log f}{d \log X} = \pm \frac{X\, df}{f\, dX}$$

92/ Wold, H., Demand Analysis. John Wiley and Sons, New York, 1952. pp. 98-99.

5. NUMERICAL MODEL

5.1 Introduction

The labour force of a country, as we said in Chapter 3, section 4, is a fraction of the total population and it consists of those individuals who contribute by the supply of their work to the productivity procedure. For the enumeration of the labour force we apply the approach "labour force" which, as it is known, is based on the activity of each person during a determined period of time. The sources of statistical data relevant to the labour force in Latin American countries are the censuses and from this point of view the aforementioned approach for enumeration of the labour force is indicated.93/ Furthermore, the ratio of labour force by age-group to the total population of the same age-group gives the degree of participation of each age-group in the labour force.

The coefficient of participation of each age-group in the labour force can be written as follows:

$$e_i = \frac{L_i^a}{P_i} \; 100 \qquad (1)$$

where

L_i^a : Labour force, in the population age-group, i

P_i : Total population in the population age-group, i

e_i : Coefficient of participation rates of labour force, in the population age-group, i

In the macro-model applied, both the size of population and the labour supply enter as the main variables of the model. Furthermore, as it is known, the size of the population and its structure by age and sex, can be estimated in a future period of time, for instance, in a decade, with accuracy. This is because demographic factors are mainly taken into account for the population forecasts and the changes of these factors in a forecasting period of time, on the one hand, are not significant and on the other hand, can be determined more or less exactly. The same does not happen for the estimation of the labour supply in a forecasting period. Although the labour supply is a demographic dimension, however, it depends apart from the population development (size and structure by age and sex), on the non-demographic factors.94/ Such factors are

93/ Athanassiou, S., Manpower Planning in Greece. The English University Press Ltd. London, 1974. pp. 170-171.

94/ Unfortunately, the non-demographic factors for the estimation of the labour supply in the macro-model used are not included for technical reasons of construction of the model. This is a reason for the application of the numerical model, i.e. to estimate the labour supply on the basis of demographic and non-demographic factors, plus the fact that the main factors, which affect the labour force of the age-groups 12-24 and which are to be evaluated by the numerical model, are included in the economic-demographic model, Fig. 1, and consequently, they should be taken into account in the over-all consideration of the model.

mainly the educational and socio-economic factors by means of which we can determine the extent to which each age-group will contribute tothe labour force and, of course, as we said previously, within the limits of the demographic development . Both the determination of these factors and the evaluation of their influence on the age-groups, which also consist of the labour force, is a difficult task as we see in the next section of the present chapter and during the application of the numerical model for the estimation of the labour force and its participation rates. In the present chapter and specifically in the next two sections, 2 and 3, we will determine those factors which affect the labour force of the age-groups 12-24, we will see from the general point of view the difficulties for the evaluation of their influence on the labour force -in more details about these difficulties we refer to in Chapter 7, during the application of the model for Chile and Mexico- and we will present a numerical model in which the main factors affecting the age-groups 12-24 will be included and by means of which we can evaluate their influence on the labour force of these age-groups (12-24 years).

5.2 Factors influencing the size and the structure by age and sex of the labour force of the age-groups 12-24

It is known that certain groups of persons are not included in the "civil" labour force in accordance with the definition of the economically active population.95/ Such groups are the students and the members of the armed forces.96/ The quantitative and structural changes of the school population and the individuals who are serving their obligatory military service -military population- cause changes to those age-groups of the labour force to which they belong (12-24 years). On the other hand, changes in the size and the structure by age and sex both of school population and military population are expected to take place in a future period of time and consequently, these changes should be taken into account for the estimation of the labour force in a forecasting period of time.

The school population is affected by the educational system. The compulsory education and its duration, the basic cycles of studies and their completion which are required by a person in order to enter the university or to obtain a job, the professional and university education, the supply and demand for education, the prevailing socio-economic conditions for education, the looked for increase of educational level of people, etc. consist of the education system or the educational factors influencing the size and the structure by age and sex of school population. Furthermore, efforts are made by all the countries to spread the education, because it is connected to the over-all socio-economic development of the countries. Therefore, we can say that the education system or educational factors will exert a considerable influence on the labour force of the school age population and they should be taken into consideration for the estimation of labour force of age-groups 12-24.

95/ The terms "labour force" and "economically active population" are used with the same meaning in the present work.

96/ Of course, we have the cases of persons with dual status or activities (e.g. a working student), but the number of these persons can be considered small and consequently, does not alter the influence of the school population on the labour force.

The individuals who are serving their military service, are out of the "civil" labour force.97/ The number of these individuals is affected by the size of armed forces of a country and the duration of the obligatory military service. The factor, military service -size of armed forces and duration of obligatory service- affects the size and the structure by age of the male labour force aged 19-24.

Predictions as regards the school population development in coming years can be made. This is because the development of the school population in a forecasting period of time depends on mainly educational factors as they were mentioned previously and which can be determined, whose influence on the age-groups 12-24 can be evaluated. On the contrary, both the size of armed forces and the duration of obligatory military service which differ in each country cannot be predicted as they depend on political considerations and military situations, and they are covered by the secret of national defense and security of the country.

As a conclusion we can say that school population and military service can be considered the main factors influencing the size and the structure by age and sex of the labour force of the age-groups as well as their quantitative and structural changes which surely will take place in a forecasting period of time. Therefore, these factors should be taken into account for the estimation of the labour force of the age-groups 12-24 in a future period of time. These factors, school population and military service, because of their influence on the formation of the labour force of the age-groups 12-24 in a future period of time, enter in the numerical model which is applied for the estimation of the labour force and its participation rates of the age-groups (12-24 years) in a projected period of time.

5.3 Numerical model

Here, we will describe the model which will be applied for the estimation of the labour force of the age-groups 12-24 and the labour force participation rates. The model will be mainly based on the numerical model made by the National Research Foundation.98/ But as the reader can see, many modifications have been made by the author of the present research as regards the number of variables used and their meaning from educational and economic points of view on the purpose of formulation of a complete model for the estimation of the labour force of some critical age-groups and mainly the school age population as well as the computation of its participation rates.

97/ The members of the armed forces are to be included in the economically active population, according to the recommendation of the Sixth International Conference of Labour Statistics (United Nations, Application of International Standards to Census Data on the Economically Active Population. U.N., New York, 1951). But, as we said in the text of present section, we are interested in the "civil" labour force.

98/ National Research Foundation, Long-Term Prospects for the Greek Economy. National Research Foundation, Athens, Greece, 1968. pp. 44-49.

The model will include the main two factors, school population and military service which, as we explained in the previous section 2, affect the critical age-groups (12-24 years) of the labour force. Furthermore, the model can be characterized as a forecasting model because the estimations of the labour force, by means of which they will be made, will refer to a future period of time. A complete description of the model from the point of view of its application, is given in Chapter 7.3 and consequently, in this section we will mention only its general features. Of course, this model can be expanded by introducing more demographic and economic factors, for instance, urbanization, external migration, industrialization, etc. which affect the same or other age-groups of the labour force. The introduction of these factors in the model, on the one hand will not add to it anything else, from the point of view of its process for the estimation of the labour force; on the other hand, it will make it more complicated from the point of view of its computation. Furthermore, the lack of statistical data for these additional factors will not allow the application of the model for practical purposes.

Thus, the model containing the two above mentioned factors, school population and military service can be built as follows:

5.3.1 <u>School age population</u>

It is known that each population age-group includes the economically active and inactive persons. The school population, on the basis of the international instructions for the enumeration of the labour force during the census, is considered economically inactive population. This means that the labour force in a school age population belongs to the non-school population. In addition to the labour force, the non-school population also includes the remaining part of the inactive persons from economic point of view. Consequently, we can say that a part of non-school population participates in economic activities of a country.

We determine the non-school population as follows:

P_i : Total population in the population age-group, i

P_i^s : School population in the population age-group, i

$P_i - P_i^s$: Non-school population in the population age-group, i

Furthermore, we determine the part of non-school population which engages in economic activities of a country as follows:

$\bar{e}(P_i - P_i^s)$: The part of non-school population which consists of labour force in the population age-group, i

It is also known that a part of school population (working students) participates in economic activities of a country.99/ Consequently this part of school population should be added to $\bar{e}\,(P_i - P_i^s)$. So we have

$\bar{e}(P_i - P_i^s) + P_i^{s+w}$: The part of non-school population which consists of labour force in the population age-group, i, plus the school population which also consists of labour force in the population age-group, i

where:

P_i^{s+w} : School population which consists of labour force in the population age-group, i

Thus, the relationship (1) of section 1 of the present chapter, which refers to the labour force participation rates in the population age-group, i, can be written as follows:

$$e = \frac{L_i^a}{P_i} 100 = \frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i} 100 \qquad (1)$$

The above relationship (1) says that the numerator of the ratio for the computation of the labour force participation rates in the school age population, for instance for the age-group, i, is a part of non-school age population, $\bar{e}(P_i - P_i^s)$, plus the working students, P_i^{s+w}.

5.3.2 Members of the armed forces

The formulation of the numerical model for the estimation of the labour force in a population group, i, which includes the number of members of the armed forces can be made as follows:

P_i : The total population in the population age-group, i

P_i^a : The number of the members of the armed forces, in the population age-group, i

$P_i - P_i^a$: The population after the substraction of the members of the armed forces, in the population age-group, i

99/ In Chapter 7, section 3.1, we refer to the determination both of the non-school population and the school population which participate in economic activities of a country as well as in other details for the application of the model in a forecasting period of time.

It is known that a part of non-military population $(P_i - P_i^a)$ participates in economic activities of a country which we define as in the case of the school population as follows:100/

$\bar{e}(P_i - P_i^a)$: The part of non-military population which consists of labour force in the population age-group, i

Thus, the relationship (1) of section 1 of the preeent chapter can be written as follows:

$$e_i = \frac{L^a}{P_i} 100 = \frac{\bar{e}(P_i - P_i^a)}{P_i} 100 \qquad (1)$$

The above relationship (1) has an analogous meaning as the relationship (1) of section 3.1 which refers to the school population. Certainly, the relationship (1) refers to all the members of the armed forces which must be excluded from the population of an age-group, i, for the estimation of the "civil" labour force, but the same procedure must be followed in the case of the individuals who serve their obligatory military service.

5.3.3 Relationship expressing the influence of both factors, school population and members of the armed forces on the labour force 12-24 years

For the formulation of the relationship in which the factors school population and members of the armed forces will be included, we make a transformation of the relationship (1) of section 3.1. Thus,

Given the ratios

$$M_i^s = \frac{P_i^s}{P_i} \qquad (1a)$$

$$M_i^{s+w} = \frac{P_i^{s+w}}{P_i} \qquad (1b)$$

where M_i^s : The ratio of school population and economically inactive population to the total population in the age-group, i

M_i^{s+w} : The ratio of school population which participates in economic activities of the country to the total population in the age-group, i.

100/ The determination of that part of non-military population which also consists of the labour force is not so easy, as in the case of non-school population which participates in economic activities of a country. Unpredictable factors affect the military population and consequently, the non-military changes cannot be determined, whereas the lack of statistical data as regards the military population, as we will explain in Chapter 7, eliminate to the minimum every effort made.

We have

$$P_i M_i^s = P_i^s \tag{2a}$$

and

$$P_i M_i^{s+w} = P_i^{s+w} \tag{2b}$$

we substitute the expressions (2a) and (2b) in the relationship (1) of section 3.1.

We have

$$e_i = \frac{\bar{e}(P_i - P_i M_i^s) + P_i M_i^{s+w}}{P_i} 100 \tag{3a}$$

$$= \left[\bar{e}(1-M_i^s) + M_i^{s+w} \right] 100 \tag{3b}$$

A similar way can be also followed in the case of members of the armed forces.

Thus,

$$M_i^a = \frac{P_i^a}{P_i} \tag{4}$$

where

M_i^a : The ratio of the number of members of the armed forces to the total population in the age-group, i

and

$$P_i M_i^a = P_i^a \tag{5}$$

We substitute the expression (5) in the relationship (1) of section 3.2.

We have

$$e_i = \bar{e}(1-M_i^a)\ 100 \tag{6}$$

Finally, the relationship including the factors school population and members of the armed forces, can be formulated as follows:

$$e_i = \bar{e} \left[1 - (M_i^s + M_i^a) + M_i^{s+w} \right] 100 \tag{7}$$

The relationship (7) says that a part of the population of age-group, i, after the substraction of school population and members of the armed forces, plus the working students consists of the labour force of this age-group, i.

5.4 Other factors influencing the labour force and its participation rates

There are many factors influencing the size and the structure by age and sex of the labour force and consequently its participation rates. Although it is not the purpose of this study to define all these factors, however, it is advisable to mention here the most important ones. By this way we will facilitate the probable expansion of the numerical model in the sense that all the factors, if it is possible, which affect the labour force,be included in the model.

Already, we have examined the factors school population and military service which, as we said, influence the age-groups 12-24 of the labour force. In addition to these factors, the external migration can be considered a significant factor for certain critical age-groups of labour force. External migration, apart from the change it causes to population, affects also the labour force, by its size and its structure, because the persons who emigrate, in their majority, belong to the economically active population of the country. Forecasts about external migration are very difficult because it is determined by a large number of independent factors which cannot be predicted. Furthermore, urbanization and industrialization can be considered as factors which influence the labour force and mainly the labour force by sector of the economy and geographic area, because they cause increase or decrease of the labour force of a sector of the economy or of an area of the country.101/ Furthermore, the existing legislation as regards the limit of beginning of pension, which differs in each country, affects the size of the labour force of 55-59 and 60-65 age-groups. The index of accidents, the possibilities of some persons to have dual status (e.g., working person and pensioner) etc. are few factors which influence the labour force of some age-groups. Finally, "family conditions" is another important factor affecting the critical age-groups of female labour force. The number of children, their age, the marriage, etc. play a vital role in the formulation of the female labour force of some age-groups. Another important factor in this case, of female labour force, is the legislation which usually permits women to retire from the labour force earlier than men, whereas the small possibilities of coming back to the same work of a person who has given up from his work previously -not for pension reasons- reduce the participation of individuals in the economic activity of the country.102/

101/ Athanassiou, S., Urbanization and Industrial Development in Latin American Countries. Latin American Demographic Centre, Series A, N° 125, Santiago, Chile. pp. 40-50.

102/ This mainly happens to the married women who do not continue their work for children reasons and they cannot come back to the same work.

6. EMPIRICAL ANALYSIS OF THE MODEL

6.1 In the case of Chile

6.1.1 Population features

The total "de facto" population of Chile in accordance with the last census (1970) was 8 853 thousand inhabitants, compared with 7 374 thousand inhabitants which was the "de facto" population of the country in 1960. The average annual rate of growth was 1.97 per cent during the decade 1960-1970, which can be considered high. The distribution of the population by urban and rural population is 75.1 per cent and 24.9 per cent respectively in 1970. The urban population, during the aforementioned period (1960-1970) experienced a considerable increase (32.5 per cent). Considering the population as a whole and disregarding its regional distribution (urban and rural) the sexes are evenly balanced, with a slight surplus of women (female 51.2 per cent in 1970). As regards the distribution of population by age, we can say that it is normal in the sense that there are the proportions indicated among young age-groups, economically active population and old age-groups. The mean crude population density within the territory (742 thousand Km^2) was 11.7 persons/$Km.^2$ in 1970 compared with 10 persons/$Km.^2$ in 1960. Furthermore, the labour force -main dimension of the model- amounted to 3 185 thousand persons in 1970 (35.98 per cent of the total population) and it was increased by 27.71 per cent in the period 1960-1970, while employed labour force was 2 994 thousand persons and was increased by 27.71 per cent in comparison with the year 1960. The unemployment was 191 thousand persons in the census year (1970) which amounts to 6 per cent of the labour force. Even though the development of unemployment showed a slight drop in the sampling period (1960-1970), however, the percentage of unemployed labour force can be considered significant.103/

The general picture of Chile from the demographic point of view which we described above, is shown in the following table 6.1.1.1. As a conclusion we can say that the population of Chile is characterized in the main by a high rate of growth and a considerable enlargement of urban population. Bearing in mind the relatively small density, the normal distribution by age and sex, we can say no demographic problem arises from these points of view, and only unemployment remains a serious problem.

103/ The seasonal unemployment in the agricultural sector of the economy causes an increase of the overall unemployment rates for a period of time. Furthermore, the unemployment rates are not the same in Santiago -capital of the country- and in the rest of the country. Indeed, the unemployment rates were 8.4 per cent for Santiago and 6.7 per cent for the rest of the country in 1960. Finally, the unemployment rates vary by age and sex between Santiago and the rest of the country (Herrick, B., Urban Migration and Economic Development in Chile. The M.I.T. Press. Massachusetts, U.S.A., 1965. pp. 56-61). The same can be said for the year 1970.

Table 6.1.1.1

THE DEVELOPMENT OF POPULATION AND LABOUR FORCE IN CHILE
DURING THE PERIOD 1960-1970

(In thousands)

n/n	Composition	Years							Average rate of growth		
		1960	1962	1964	1965	1966	1968	1970	1960-65	65-70	60-70
1.	Employed labour force	2 317	2 406	2 546	2 623	2 703	2 879	2 994	2.51	2.68	2.60
	Index of change	100.00	103.84	109.88	113.21	116.66	124.26	129.22			
	1 : 3	92.90	92.04	92.95	93.54	93.95	95.05	94.00			
	a) Agriculture	711	688	690	710	718	736	738	-0.03	0.78	0.37
	b) Industrial	646	712	771	796	819	819	851	4.26	1.35	2.79
	c) Services	959	1 006	1 086	1 118	1 165	1 323	1 405	3.12	4.48	3.89
2.	Unemployed labour force	177	208	192	181	174	149	191	0.44	1.08	0.76
	Index of change	100.00	117.51	108.47	102.26	98.31	84.18	107.91			
	2 : 3	7.10	7.96	7.01	6.46	6.05	4.92	6.00			
3.	Total labour force	2 494	2 614	2 739	2 804	2 877	3 029	3 185	2.37	2.58	2.48
	Index of change	100.00	104.81	109.82	112.43	115.36	121.45	127.71			
4.	Population	7 374	7 649	7 934	8 080	8 229	8 535	8 853	1.96	1.97	1.97
	Index of change	100.00	103.73	107.59	109.57	111.59	115.74	120.06			
	3 : 4	33.82	34.17	34.52	34.70	34.96	35.49	35.98			

Sources: 1. Dirección de Estadística y Censos. XIII Censo de Población. Santiago, Chile, 29 de noviembre de 1960.
2. Instituto Nacional de Estadísticas. XIV Censo de Población y III de Vivienda, abril de 1970. Muestra de Adelanto de Cifras Censales. Santiago, 1972.
3. Oficina de Planificación Nacional. División de Recursos Humanos.

Note: The minimum age limit for census questions in the year 1970 on economic activities of the individuals was the age 12.

6.1.2 The Chilean economy in the period 1960-1970

Here, we mainly deal with the development of economic factors which are included in the model during the sampling period 1960-1970. We will refer to the gross domestic product by sector and the uses of national resources. Thus, at the end of the period (1970), the gross domestic product (GDP) has increased by 54.29 per cent, the greater increase being realized by the secondary production sector (65.23 per cent) and the lower by the primary production sector (27.32 per cent). The tertiary sector had experienced a considerable increase (51.93 per cent). The industrial sector increased its share in GDP from 39.11 per cent to 41.89 per cent while the agricultural and "services" sector showed a slight drop from 11.56 per cent to 9.54 per cent and from 49.33 to 48.57 per cent respectively. The average rate of growth of GDP was 4.43 per cent in the period 1960-1970. In table 6.1.2.1 we give more details as regards the development of gross domestic product and its structural changes by sector in the period under study (1960-1970). As a conclusion, we can say that important structural changes have not taken place in the GDP and the rate of growth is at the medium level among the rates of growth of the rest of the countries of Latin America.

The per capita income, which is used as a measure of degree of economic development of the country, was US$ 613 in 1970 and consequently, Chile can be considered to be a less-developed country.104/ The average rate of growth of per capita income was 1.8 per cent in the period 1960-1970.105/ As regards the uses of national resources, table 6.1.2.2, the gross fixed investment had increased by 65.03 per cent in the period 1960-1970 and it was 13.87 per cent in 1970. The rate of growth was higher (5.94 per cent) in the semi-period 1960-1965 than the rate of growth in the semi-period 1965-1970 (4.34 per cent) and in the period as a whole (1960-1970), it was 5.14 per cent. The percentage distribution of gross fixed investment by major sectors is given in table 6.1.2.3. From this table, we see that 62.14 per cent was absorbed by construction sector in the early years. At the end of this period (1970) the percentage distribution of gross fixed investment by construction and machinery sector was 54.82 per cent and 45.18 per cent respectively.

On the other hand, consumption had increased by 56.15 per cent, its percentage distribution remained constant (72 per cent) in the sampling period 1960-1970 and the average rate of growth was 4.56 per cent. The proportion of private consumption was 86 per cent and did not change during the period 1960-1970. In the following table 6.1.2.4 the distribution of private consumption by major groups of expenditures is given.

104/ United Nations, Yearbook of National Accounts Statistics 1971. Volume III, International tables. United Nations, New York, 1971.

105/ Serious efforts have been made and are being made for the solution of the problem of economic development and the perspectives, in accordance with the long-term economic plan, can be considered encouraging for this direction.

Table 6.1.2.1

THE DEVELOPMENT OF GROSS DOMESTIC PRODUCT, ITS COMPOSITION AND RATE OF GROWTH BY MAJOR SECTORS IN THE PERIOD 1960-1970

(In million escudos at 1965 prices)

n/n	Sector	Years							Average rate of growth		
		1960	1962	1964	1965	1966	1968	1970	1960-65	65-70	60-70
1.	Agriculture	1 625	1 645	1 827	1 784	1 929	2 114	2 069	1.88	3.01	2.44
	Index of change	100.00	101.23	112.43	109.78	118.71	130.09	127.32			
	1 : 4	11.56	10.50	10.68	9.94	10.04	10.44	9.54			
2.	Industrial[a/]	5 499	6 611	7 315	7 628	8 155	8 464	9 086	5.74	4.57	5.15
	Index of change	100.00	120.22	133.02	138.72	148.30	153.92	165.23			
	2 : 4	39.11	42.18	42.78	42.48	42.43	41.82	41.89			
3.	Services	6 935	7 416	7 957	8 544	9 137	9 663	10 536	4.26	4.28	4.27
	Index of change	100.00	106.94	114.74	123.20	131.75	139.34	151.93			
	3 : 4	49.33	47.32	46.53	47.58	47.54	47.74	48.57			
4.	Gross domestic product	14 059	15 672	17 099	17 956	19 221	20 241	21 691	5.01	3.85	4.43
	Index of change	100.00	111.47	121.62	127.72	136.72	143.97	154.29			

Source: Oficina de Planificación Nacional. Cuentas Nacionales de Chile, 1960-1971 (mimeographed). Santiago, 1972.

a/ Includes mining and quarrying; manufacturing; construction; electricity, gas, water and sanitary services.

Table 6.1.2.3

PERCENTAGE DISTRIBUTION OF GROSS FIXED INVESTMENT BY MAJOR SECTORS IN THE PERIOD 1960-1970

Sector	Years					
	1960	1962	1964	1966	1968	1970
Gross fixed investment	100.00	100.00	100.00	100.00	100.00	100.00
a. Construction and other works	62.14	59.98	63.88	60.10	54.04	54.82
1. Building	34.31	29.51	33.31	32.10	29.63	27.64
2. Other works	27.82	30.46	30.57	28.00	24.42	27.19
b. Machinery and equipment	37.86	40.02	36.12	39.90	45.96	45.18
1. Imports	31.19	31.30	26.22	31.52	33.70	36.66
2. Domestic	6.68	8.72	9.91	8.38	12.26	8.51

Source: Oficina de Planificación Nacional. Cuentas Nacionales de Chile, 1960-1971. Santiago, 1972.

Table 6.1.2.4

PERCENTAGE DISTRIBUTION OF PRIVATE CONSUMPTION EXPENDITURE BY MAJOR GROUP OF EXPENDITURES

Group	Years			
	1960	1963	1966	1969
Total private consumption	100.0	100.0	100.0	100.0
1. Food, drink and tobacco	37.2	34.0	34.8	33.0
2. Clothing and footwear	13.9	16.5	16.0	12.8
3. Other manufactured goods	17.5	20.4	21.7	27.3
4. Residential building expenditure	9.3	9.1	8.0	7.9
5. Services	22.5	20.0	19.5	19.0

Source: ODEPLAN, Antecedentes sobre el desarrollo chileno, 1960-1970. Santiago, 1971.

Table 6.1.2.2

THE USES OF NATIONAL RESOURCES AND THEIR RATES OF GROWTH IN THE PERIOD 1960-1970

(Million escudos at 1965 prices)

Uses of resources	Years							Average rate of growth		
	1960	1962	1964	1965	1966	1968	1970	1960-65	65-70	60-70
1. Consumption	11 788	13 034	14 136	14 556	16 122	17 155	18 407	4.31	4.81	4.56
Index of change	100.00	110.57	119.92	123.48	136.77	145.53	156.15			
1 : 5	73.09	73.15	72.92	71.62	72.54	73.31	72.20			
a. Private	10 132	11 242	12 312	12 563	13 935	14 859	15 816	4.39	4.71	4.55
a : 1	85.95	86.25	87.10	86.31	86.43	86.62	85.92			
b. Public	1 656	1 792	1 824	1 993	2 187	2 296	2 591	3.77	5.39	4.58
b : 1	14.05	13.75	12.90	13.69	13.57	13.38	14.08			
2. Gross fixed investment	2 142	2 626	2 735	2 859	2 900	3 166	3 535	5.94	4.34	5.14
Index of change	100.00	122.60	127.68	133.47	135.39	147.81	165.03			
2 : 5	13.28	14.74	14.11	14.07	13.05	13.53	13.87			
3. Exports	1 938	2 106	2 366	2 515	2 662	2 875	3 034	5.35	3.82	4.58
3 : 5	12.02	11.82	12.20	12.37	11.98	12.29	11.90			
4. Changes in stock	259	53	149	395	542	204	517	8.81	5.53	7.16
4 : 5	1.61	0.30	0.77	1.94	2.44	0.87	2.03			
5. Total	16 127	17 819	19 386	20 325	22 226	23 400	25 493	4.74	4.64	4.69
	100.00	100.00	100.00	100.00	100.00	100.00	100.00			

Source: Oficina de Planificación Nacional. Cuentas Nacionales de Chile, 1960-1971. Santiago, 1972.

The group food - drink - tobacco consists of the 33 per cent during the year 1969. The groups manufactured goods and services follow with 27.3 per cent and 19 per cent respectively. Of course, the percentage distribution of major groups changed during'the period 1960-1970, but the purpose of this work does not allow us to enter in more details on the changes which have taken place.

The quantitative information for some variables mentioned previously will help us to estimate statistically the system of simultaneous equations by which basic interrelationships among the economic and demographic variables are determined and to use the estimated equations of the model to forecast the development of the most important -endogenous- variables.

6.1.3 Statistical estimates of the structural equations of the model

a) Ordinary least squares (OLS) method

n/n	Statistical estimates	$\bar{R}^2$ (1)	d^2/s^2 (2)
1.	$Y_t = -8\,470.01 + 9.00817\ L^e_t + 0.851657\ K_t$ (0.83965) (0.417971)	0.990	1.52
2.	$L^e_t = 367.59 + 0.039602\ Y_t + 0.605512\ L^e_{t-1}$ (0.011095) (0.123218)	0.996	2.71
3.	$L^a_t = -906.76 + 0.460208\ P_t$ (0.006461)	0.997	2.70

b) Two-stage least squares (TSLS) method

n/n	Statistical estimates	$\bar{R}^2$ (1)	d^2/s^2 (2)
1.	$Y_t = -8\,441.99 + 8.98472\ L^e_t + 0.862385\ K_t$ (0.95508) (0.474912)	0.988	1.05
2.	$L^e_t = 380.16 + 0.040831\ Y_t + 0.592039\ L^e_{t-1}$ (0.014201) (0.157254)	0.995	1.54
3.	$L^a_t = -\ 906.76 + 0.460208\ P_t$ (0.006461)	0.997	2.70

6.1.4 Statistical analysis of the results obtained

In the previous section, the structural equations numbered by a nominal number, with their estimates and statistical criteria are given. A detailed analysis of these statistical results and a comparison of the estimates made by OLS and TSLS methods is attempted hereunder. Firstly, we will examine the consistency of the statistical estimates of structural coefficients with a priori expectations on the basis of economic theory and the ad-hoc limitations of the model. Consistency refers both to the sign and the amount of parameters estimates. Thus, a) the sign of the parameters of the predetermined variables are positive in all the equations of the system as it was expected. The positive sign of the regression coefficients of each equation of the system means that an increase of the determinative factors will cause an increase of the variable -explained- under study. Consequently, an increase of the predetermined variables of the model will cause an increase of the endogenous variables, national output, Y, available and employed labour force, L^a, L^e. b) the amount of parameters estimates shows how much it will be the change of the dependent variable of an equation caused by unique change of one independent variable with the other variables of the equation constant.106/ More details about the sign and the quantitative interpretation of parameters estimates and the features which formulate the magnitude of the elasticity, will be given in the next section.

c) the coefficient of multiple determination, R^2. This coefficient, as we said in Chapter 4, section 6.2, is a measure of the proportion of the variance of the explained variable which can be attributed to the linear influence of the explanatory variables in the sample period.107/ Furthermore, we corrected the coefficient of determination, R^2, by the number of observations and the number of variables in order to have an unbiased estimation of the coefficient in the population. From column (1) of the statistical estimates of the model tables, section 1.3 of the present chapter, it is seen that the fitting regressions which consist of the model applied, have explained a very high percentage of the total variance in the dependent variables. The coefficient of determination, R^2, as it was adjusted by the degrees of freedom, $\bar{R}^2$, on the average for the three structural equations of the system, was more than 99.4 per cent in both of statistical methods of parameters estimations. The third equation of the system has explained 99.7 per cent of the variance of regression, a fact that means that the fit of corresponding line to the data observed must be considered very good. The "F" distribution as a criterion is taken into account on time series for testing the statistical significance of the coefficient of determination, $\bar{R}^2$, and it is investigated at a level of 5 per cent or less.108/ From

106/ Athanassiadis, C., Statistics, Vol. II. Papazissis Publishing Co., Athens, Greece, 1975. pp. 81-86.

107/ Drakatos, C., Econometrics. Kloukinas, S. Publishing Co., Athens, Greece, 1971. pp. 23-27.

108/ The denominator, $1-\bar{R}^2$, of the formula 2, Chapter 4, section 6.2., shows obviously the percentage of the variance of the dependent variable not explained by the independent variables which are included in the equation.

such a point of view, the equations of the model can be considered statistically significant.109/ In conclusion, we can say that the coefficient of multiple determination, $\bar{R}^2$, as a measure of goodness of fit of empirical data, shows that the equations of the interdependent system can be considered the best fitting ones. Moreover, we verify the probable existing correlation between the endogenous and predetermined variables of the three functional relationships of the system and the contribution of these latter variables in the explanation of the variance of dependent variables. d) the reliability of the statistical parameters estimates of an equation is judged by the standard error. The standard errors of the estimated structural coefficients are cited in parenthesis below the corresponding statistical estimates. The criterion of t-student is taken into consideration for testing the statistical significance of the parameters estimates, at a level of 5 per cent or less. On the basis of this criterion, the regression coefficients of the equations of the system are statistically significant. e) autocorrelation. In Chapter 4, section 6.2., we mentioned the Von Neumann's criterion -relationship 3- by which we can test the serial correlation. In other words, the ratio, d^2/S^2 tests a basic property attributed to the random variable, e_t, mentioned in Chapter 4, section 4.4, namely that $E(e_i e_j) = 0$ for all $i \neq j$. This test of significance was made at five per cent level.110/

Thus, it is found that for a sample of 11 observations, the computed values of Von Neumann's ratio, d^2/S^2, greater than 3.19 and smaller than 1.20, indicate the presence of autocorrelation while the computed values of this ratio between the aforementioned critical values lead to the conclusion that autocorrelation does not exist.111/ In all the structural equations of the system by OLS, the value of this ratio, d^2/S^2, is between the aforementioned bounds and consequently it indicates the absence of autocorrelation. The same can be said for the second and third equation by TSLS as regards the absence of autocorrelation. In the first equation by TSLS, the value of ratio d^2/S^2 is smaller than the lower bound (1.20) and it indicates positive serial correlation in the residuals. This probably shows that the specification of functional relationship will be incorrect. More specifically, this means that the form of the equation is not the appropriate one or important explanatory variables have been omitted. The first case, i.e.

109/ Based on the values of the "F" distribution tables, F_2, we have $F_1 > F_2$ and consequently we rejected the zero hypothesis, H = 0, for all the equations of the system. Indeed, this means that a regression exists in the population as it happens in the sample.

110/ Significance levels for the ratio, d^2/S^2 have been calculated by B. Hart: "Significance levels for the ratio of the mean square successive difference to the variance". Mathematical statistics, Vol. 13. 1942. p. 446.

111/ Athanassiadis, C., Statistics, Vol. II and Vol. IV. Papazissis Publishing Co., Athens, Greece. pp. 39-40 and 30 respectively.

the unsuitable functional form, seems to be more probable.112/ In the time-graph of residuals, in the lower part of the diagrams 6.1.4.1-3, the absence or presence of first order serial correlation is exhibited clearly.

Finally, in the case of autocorrelation, as it is known, the parameters estimates are unbiased, i.e. $E(\hat{b}) = b$, but their variances are large and consequently the forecasts based on these estimates will not be efficient.113/

f) multicollinearity. In addition to autocorrelation problem, another serious problem arises in the statistical estimates from time series data, the problem of multicollinearity. It is known that it is not possible to isolate the contributions of the explanatory variables separately in any equation if they are closely related to each other. Furthermore, collinearity between the explanatory variables affects increasingly the standard errors of parameters estimates114/ and consequently it creates doubts upon the significance of the structural coefficients. For these reasons, the examining of the problem of existence of multicollinearity in each equation of the system is required. The method used in dealing with the presence of multicollinearity consists of computing on the one hand, the intercorrelation coefficients, R^2, between the explanatory variables and on the other hand, the partial correlation coefficients, r, between the explained variable and explanatory variables in each equation of the system.115/ Even though the existence of multicollinearity in a particular equation of the system brings difficulties as regards the accuracy of parameters estimates because, as we said previously, it is reflected in the amount of sampling errors, however, it is possible that this equation can be used for making forecasts of the dependent variable in a future period of time.116/ Based on the aforementioned criteria, the explanatory variables of an equation are considered adequately independent if the intercorrelation coefficients, R^2, do not exceed the value 0.70 and the partial correlation coefficients, r, are significant at the 1 per cent level. In the following two tables we present the aforementioned statistical criteria regarding the presence or absence of multicollinearity in the structural equations of the system.

Table 6.1.4.1

THE INTERCORRELATION COEFFICIENTS OF THE EXPLANATORY VARIABLES IN EACH EQUATION OF THE SYSTEM

Equations of the system	Relation	R^2		Pre-assigned critical level
		OLS	TSLS	
1st	L^e on K	0.91	0.91	0.70
2nd	Y on L^e_{t-1}	0.98	0.98	

112/ Drakatos, C., op. cit., pp. 64-65.
113/ Johnston, J., op. cit., p. 179.
114/ Drakatos, C., op. cit., pp. 67-68.
115/ Neisser, H. and Modigliani, F., National Income and International Trade University of Illinois Press. Illinois, U.S.A., 1953. p. 220.
116/ Drakatos, C., op. cit., p. 69.

From table 6.1.4.1 it can be seen that the conditions for presence of multicollinearity are satisfied. Thus, the intercorrelation coefficients are too high and of course, they exceed by far the pre-assigned critical level. Therefore, we cannot isolate the contributions of the explanatory variables to the endogenous variables of the system. Furthermore, as we said previously, the presence of multicollinearity affects the standard errors of parameters estimates, i.e. it makes them to be relatively large and consequently, from this point of view we meet the problem of the statistical significance of the estimated parameters. Fortunately, the presence of multicollinearity did not cause a wide extent effect to the standard errors and the estimates of structural coefficients are considered statistically reliable. Finally, we computed the values of the partial correlation coefficients. We tested the null hypothesis that $r = 0$ by t-test. The results of the significance tests for correlation coefficients are summarized in table 6.1.4.2. These results suggest that the partial correlation coefficients with exception of the coefficient, $\hat{r}_{13.2}$ of the first equation are not significant at the level of 1 per cent.117/ g) constants. The constants estimates of the equations,

Table 6.1.4.2

THE PARTIAL CORRELATION COEFFICIENTS BETWEEN THE EXPLAINED AND EACH OF THE EXPLANATORY VARIABLES IN EACH EQUATION

Equations of the system	Correlation coefficients	Estimated value of $\hat{r}$ by TSLS	Computed value of t-student test	Theoretical value of t-student at one per cent level
1st equation	$\hat{r}_{12.3}$	0.95	12.10	
	$\hat{r}_{13.2}$	0.54	2.25	
2nd equation	$\hat{r}_{12.3}$	0.71	3.74	3.35
	$\hat{r}_{13.2}$	0.79	5.06	
3rd equation	$\hat{r}_{12}$	0.99	28.28	

117/ We were led to the same conclusion as regards the significance of partial coefficients at the level of 1 per cent by applying the Fisher test,

$$F = \frac{z(\hat{r})}{\hat{S}_z} = 1/2 \log \left[\frac{1 + \hat{r}}{1 - \hat{r}}\right] \sqrt{n + (3 + 1)}$$

a_o, b_o, and c_o, do not have a particular meaning from the economic point of view. This is the reason that in many cases of parameters estimates of a model, the constants have not been computed. However, the property as regards the mean of the values of the error term, e_i, to be zero, i.e. $E(e_i) = 0$, mentioned in footnote 1, Chapter 4, section 4.1, reflects the estimation of the constant of a regression equation.118/ h) The property, $E(e_i)=0$. We computed the average of the values of random variable, e_i, in all equations of the system for testing the property $E(e_i)=0$. Indeed, the average value of random variables, $E(e_i)$, was found to be equal to zero, i.e. $E(e_i)=0$. This means that there is not a systematic error in the observations and therefore we can estimate the real relationships in the population from our sample. i) Finally, with regard to the problem of identification and particularly, the sufficient condition, as we said in Chapter 4, section 5.3, we constructed the determinants of n-1 order. Furthermore, we computed the values of three determinants on the basis of the structural coefficients estimates by OLS and TSLS. Thus, in accordance with the statistical estimates by OLS, their numerical values are:

$A_1 = 0.27866$ for the first equation

$B_1 = 0.39194$ for the second equation

and

$C_1 = 0.03373$ for the third equation

$C_2 = -0.605512$ for the third equation

a fact that means that the sufficient condition is fulfilled for the identification of all the structural equations of the system. The same can be said by applying the TSLS estimates.

Having analysed the statistical results obtained, we are led briefly to the following conclusions:

i) The equations of the system can be considered as those best fitting to the empirical data on the basis of the statistical criteria mentioned previously.

ii) The consistency of the estimated parameters with what we expected on an *a priori* ground is a verification of economic hypotheses.

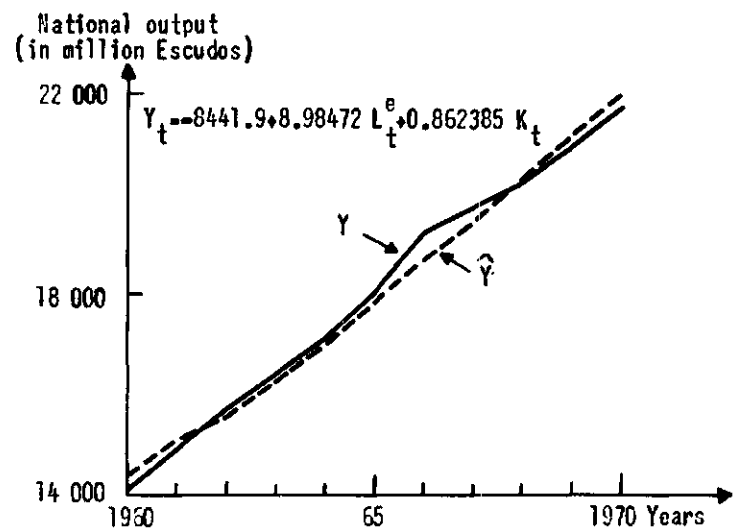
iii) The statistically estimated model can be used for making forecasts as regards the development of the endogenous variables in the coming years, due to the fact that all the required statistical conditions of the model are fulfilled.

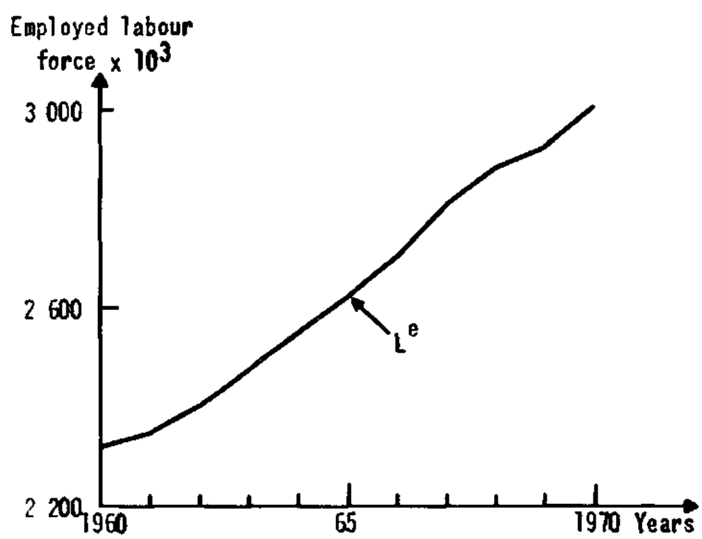
In the diagrams 6.1.4.1-3, we give the observed and estimated values of the endogenous variables of the model, their deviations in percentage and the influence of the explanatory variables of each equation of the system on the basis of the TSLS estimates.

118/ Drakatos, C., *op. cit.*, pp. 52-53.

Diagram 6.1.4.1

FIRST EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE NATIONAL OUTPUT, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM

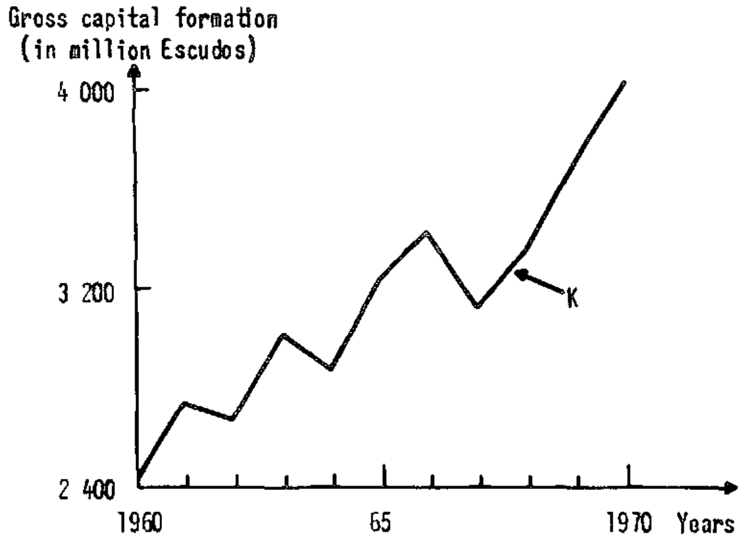




(continued)

Diagram 6.1.4.1 (concluded)

FIRST EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE NATIONAL OUTPUT, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM



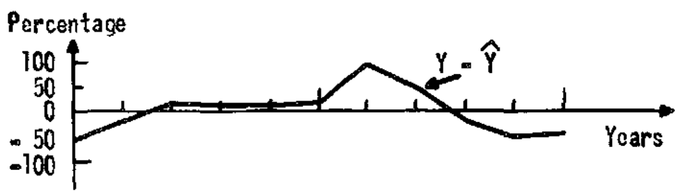
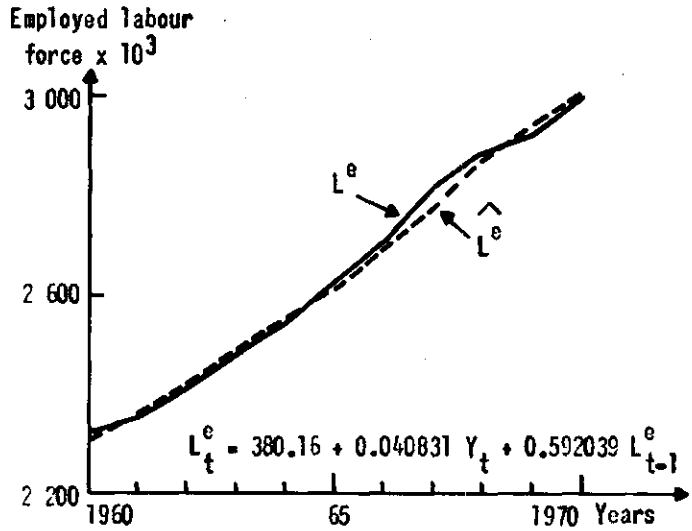
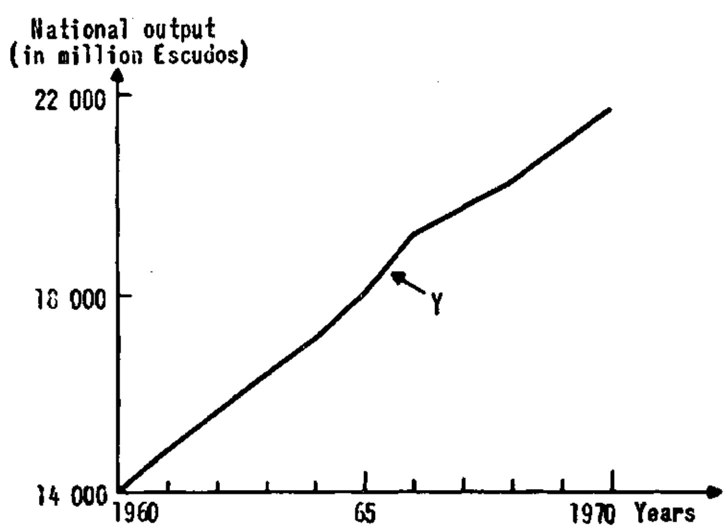


Diagram 6.1.4.2

SECOND EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE EMPLOYED LABOUR FORCE, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM





(continued)

Diagram 6.1.4.2 (concluded)

SECOND EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE EMPLOYED LABOUR FORCE, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM

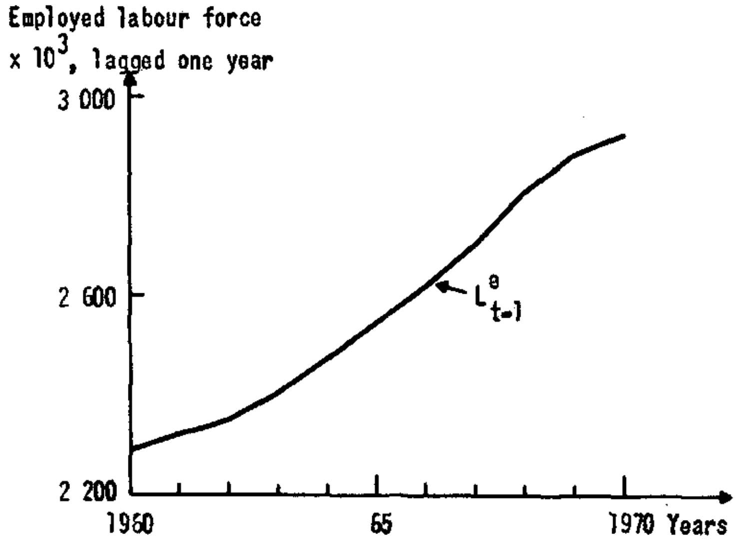
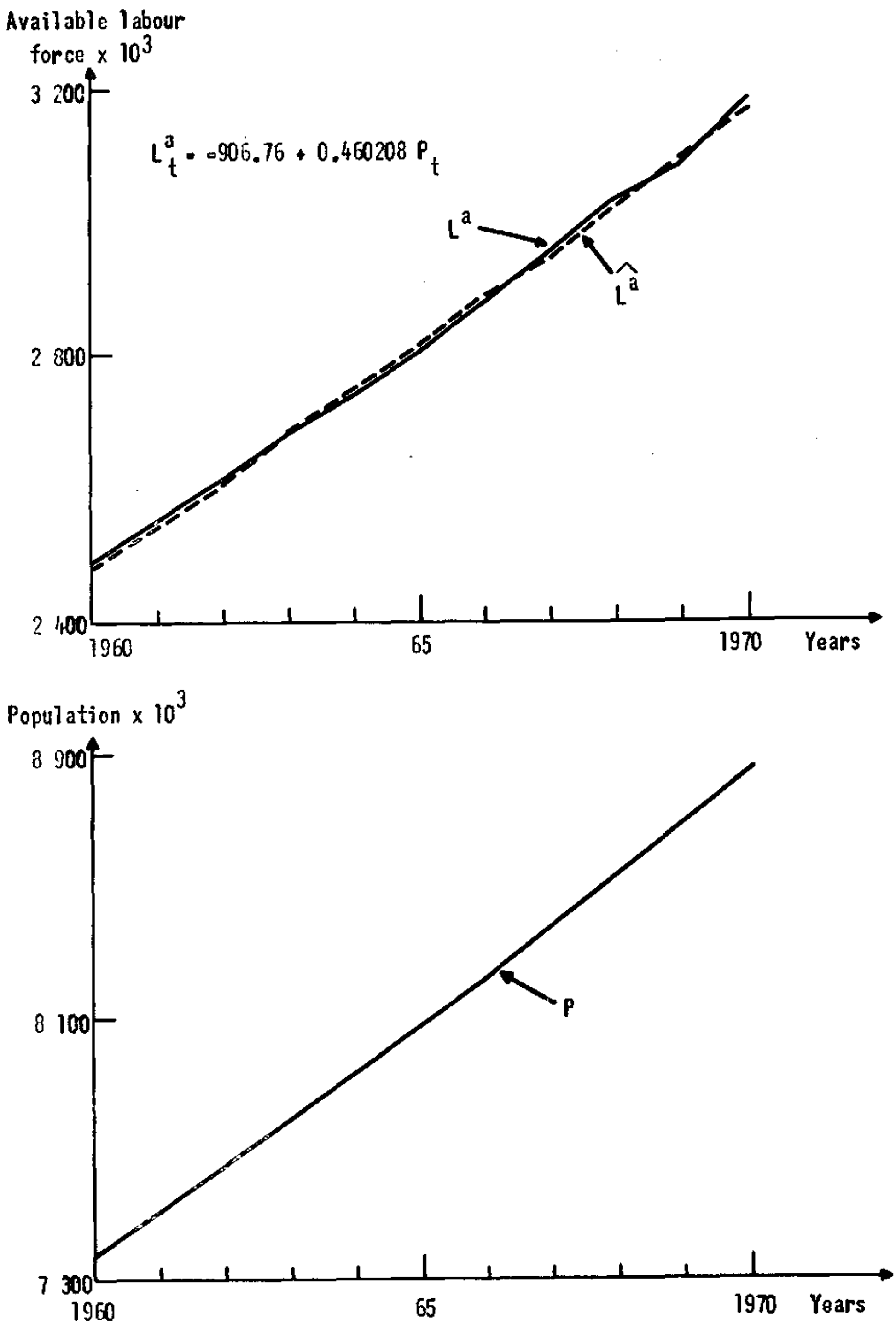


Diagram 6.1.4.3

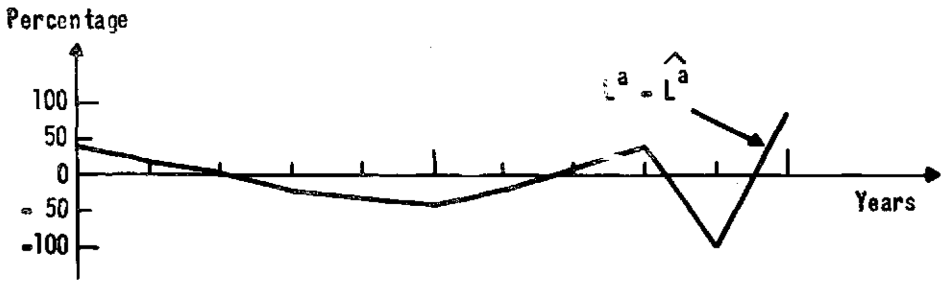
THIRD EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE AVAILABLE LABOUR FORCE, THEIR DEVIATIONS AND THE INFLUENCE OF THE EXPLANATORY VARIABLE OF THE SYSTEM



(continued)

Diagram 6.1.4.3 (concluded)

THIRD EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE AVAILABLE LABOUR FORCE, THEIR DEVIATIONS AND THE INFLUENCE OF THE EXPLANATORY VARIABLE OF THE SYSTEM



6.1.5. Elasticities

In a quantitative economic analysis, the existing relationship between two economic magnitudes is measured by elasticity119/ and consequently its investigation is deemed necessary in a study as the present one. In Chapter 4, section 7.2 (footnote 91), we represented the mathematical concept of elasticity. In accordance with this concept, the short-run and long-run income elasticity, for the second equation of the system and for the year 1970 and for the period 1960-1970 respectively, is computed as follows:

1. Short-run elasticity

$$e_{L^e Y} = \frac{dL^e}{dY} \cdot \frac{Y}{L^e}$$

$$= 0.29 \quad \text{(OLS)}$$

$$= 0.30 \quad \text{(TSLS)}$$

2. Long-run elasticity

$$\bar{e}_{L^e Y} = \frac{dL^e}{dY} \cdot \frac{\bar{Y}}{\bar{L}^e}$$

$$= 0.27 \quad \text{(OLS)}$$

$$= 0.28 \quad \text{(TSLS)}$$

In other words, the income elasticity is equal to the product of the derivatives of labour force employed with respect to income by ratio, $Y/_{L^e}$, in the case of short-run elasticity and by, $\bar{Y}/_{\bar{L}^e}$, -average values of the variables Y and L^e- in the case that the elasticity refers to a period of time. By the same way, we can compute the elasticities of the other explanatory variables of the system. This is done in table 6.1.5.1.

Elasticities measure the percentage effect upon the explained variables of a change of one per cent in the corresponding explanatory variables; they are independent of measuring units of the variables and their analysis is based on the sign and their amount.120/ From the point of view of sign, the income elasticity drawn has the sign indicated by economic theory. Regarding the amount, the average income elasticity is 0.27 per cent and this means that if the average income increases by ten per cent, the employed labour force will increase by 2.70 per cent.

119/ Kevork, C., The Demand for Durable Goods. Bank of Greece, Athens, 1964. pp. 50-51.

120/ The sign indicates the direction of the change of the variable under study caused by each explanatory variable of the equation, while the amount shows how much will the change be.

Table 6.1.5.1

ELASTICITIES WITH RESPECT TO THE EXPLANATORY VARIABLES OF THE EQUATIONS OF THE SYSTEM BY OLS AND TSLS

Equation	Variable	Average elas- ticity	Point elasticities					
			1960	1962	1964	1966	1968	1970
First	Employed labour force	1.33 (1.32)	1.48 (1.48)	1.38 (1.38)	1.34 (1.34)	1.27 (1.26)	1.28 (1.28)	1.24 (1.24)
"	Gross capital formation	0.15 (0.15)	0.15 (0.15)	0.15 (0.15)	0.14 (0.15)	0.15 (0.15)	0.15 (0.14)	0.16 (0.16)
Second	National output	0.27 (0.28)	0.24 (0.25)	0.26 (0.27)	0.27 (0.27)	0.28 (0.29)	0.28 (0.29)	0.29 (0.30)
"	Employed labour force lagged one year	0.59 (0.58)	0.60 (0.58)	0.59 (0.58)	0.59 (0.58)	0.59 (0.57)	0.59 (0.58)	0.59 (0.58)
Third	Total population	1.32 (1.32)	1.36 (1.36)	1.37 (1.37)	1.33 (1.33)	1.32 (1.32)	1.30 (1.30)	1.28 (1.28)

Note: In parentheses the elasticities by TSLS are included.

In conclusion, as regards the properties of the functions of the system mentioned in Chapter 4, section 7.2, we can say that all the elasticities have positive sign as it was expected. Furthermore, we observe -table 6.1.5.1.- that the short-run elasticities are not constant at different time points. This means that the influence of each explanatory variable on the endogenous variable of the equations of the system was different at these time points -years- of the sampling period 1960-1970. Finally, the elasticity of the employed labour force, L_t^e, and the population, P_t, is more than the unit, i.e. over-elastic whereas the elasticities of the remaining explanatory variables are under-elastic. Of course, these statistical features of elasticities show the importance of the determinative factors in each particular equation of the system.

6.1.6 Comparison of the statistical estimates

During the analysis of the statistical results obtained we were led to the conclusion that the equations of the model can be considered the best ones on the basis of the coefficient of determination, $\bar{R}^2$. In the first equation of the system this measure of goodness of fit of empirical data obtained by the traditional method of OLS is slightly better than that obtained by the method of TSLS. Furthermore, in the same equation, the value of d^2/S^2 statistic for the testing of the auto-correlation is also better with the method of OLS because it indicates the absence of autocorrelation. The value of d^2/s^2 statistic is also larger by the method OLS than that obtained by TSLS in the second equation, but it is within the limits of absence of autocorrelation. The amounts of the structural coefficients are the same approximately by both statistical methods and this means that their importance in explaining the variation of the endogenous variable does not vary between the two statistical methods. Comparing the amounts of coefficients of the variables of the system as a whole, we observe that the variable, employed labour force, L^e, takes the larger value and this, of course, reflects the importance of this variable in the whole system. Finally, as regards the standard errors of the parameters estimates, we observe that they are better estimated by the consistent method.

6.2 In the case of Mexico

6.2.1 A review of the development of certain demographic and economic magnitudes in the period 1960-1970

Mexico belongs to the group of Latin American countries which showed a rapid population growth rate over the last two decades 1950-1960 and 1960-1970.121/ The rate of growth was 3.5 per cent in the 1960's.122/ The total population of the country is 48 225 thousand persons in the census year 1970 compared with 34 923 thousand persons which was the population in 1960. The same can be said as regards the development of urban population of the country. Thus, the rate of growth of urban population increased to 5.0 per cent in the 1960's from 4.7 per cent in the previous decade (1950-1960). The urban population consists of 58.71 per cent of the total population in 1970 and it was increased by 60.01 per cent, in comparison with the year 1960.

On the other hand, the population aged 0 to 14 years, which is an important demographic feature of population development, increased at much the same rate approximately, (3.7 per cent) as the total population in the period 1960 and it represented the same proportion, 46.21 per cent, in the census years 1960 and 1970. The proportion of males and females underwent no change during the 1960's (49.90 per cent males). Furthermore, no demographic problem arises from the point of view of density of population (24.51 persons/Km^2). Finally, the labour force is of 26.77 per cent of total population and it experienced an increase of 14.72 per cent in 1970 from 11 253 thousand persons (1960) to 12 912 thousand persons. The distribution of labour force by sectors and branches of economic activity is given in table 6.2.1.1.

121/ This group is composed of six countries: Peru, Paraguay, El Salvador, Honduras, Mexico and Ecuador.

122/ United Nations, ECLA. Economic Survey of Latin America, 1970. United Nations, New York, 1972. pp. 34-36.

Table 6.2.1.1

LABOUR FORCE, ITS DISTRIBUTION BY MAJOR SECTORS AND BRANCHES IN THE CENSUS YEARS 1960 AND 1970a/

Sector and branches	Distribution				Change (percentage)	
	Absolute		Relative		Absolute	Relative
	1960	1970	1960	1970	1960/70	1960/70
Agriculture	6 084 126	5 396 958	54.07	41.81	-11.29	-22.67
Mining and quarrying	141 095	190 565	1.25	1.48	35.06	18.40
Manufacturing industry	1 550 860	2 293 821	13.78	17.77	47.91	28.96
Electricity - gas	41 266	56 374	0.37	0.44	36.61	18.92
Construction	407 233	603 860	3.62	4.68	48.28	29.28
Transport	356 939	390 014	3.17	3.02	9.27	- 4.73
Commerce and services	2 671 778	3 977 948	23.74	30.81	48.89	29.78
Total	11 253 297	12 909 540	100.00	100.00	14.72	-

Source: 1. Dirección General de Estadística, VIII Censo General de Población, 1960, Población Económicamente Activa, México, D.F., 1964.
2. Dirección General de Estadística, IX Censo General de Población, 1970, Resumen General Abreviado, México, D.F., 1972.

a/ Labour force aged 12 years and over.

From the above table, the following can be seen: The agricultural sector, from the point of view of persons employed, decreased by 11.29 per cent during the period 1960, while the manufacturing branch and the tertiary sector, from the same point of view, increased by 47.91 per cent and 48.89 per cent respectively, in the same sampling period (1960-1970). The construction branch also experienced a considerable increase (48.28 per cent). The enlargement of the construction branch, which is a characteristic of the labour market of the country, can be attributable to the fact that the construction is the first and temporary stage of employment of the people who move from agricultural to industrial -urban- area.123/

123/ Germidis, D., Labour Conditions and Industrial Relations in the Building Industry in Mexico. Development Centre. Organization for Economic Cooperation and Development (OECD), Paris, 1974. pp. 12-13.

The development of certain economic variables in the period 1960-1970 was as follows: The rate of economic growth was 7.1 per cent during the period 1960-1970 and it was higher than the rate for the previous period 1950-1960 (5.8 per cent). The main stimulus for growth came from the steady extension of manufacturing (8.9 per cent), the expansion of construction (10 per cent), tourism, etc.124/ The gross domestic product has been doubled (98.5 per cent) in the decade 1960-1970. The same can be said for the sector of "services", the greater increase being realized by the industrial sector (133.1 per cent) which consists of 34.28 per cent of the GDP in the year 1970. The agricultural sector had experienced an increase of 44.89 per cent and it had decreased its share in GDP from 15.93 per cent to 11.63 per cent in the period under study (1960-1970). In table 6.2.1.2 we give the picture of development of the GDP by sector and the rates of growth during the semi-periods 1960-1965 and 1965-1970 as well as in the whole period 1960-1970. As a conclusion we can say that the economy of Mexico is characterized by a high rate of growth and particularly, the secondary sector of the economy. The per capita income was US$ 632 in 1970 and its rate of growth was 3.69 per cent in the period 1960-1970.125/ From this point of view of magnitude of per capita income, Mexico belongs to the less-developed countries.

Furthermore, in table 6.2.1.3 we refer to the uses of national resources. Thus, consumption had increased by 99.7 per cent, its percentage distribution fluctuated between 72.9 per cent and 74.5 per cent and the average rate of growth was 7.16 per cent during the sampling period 1960-1970. The proportion of private consumption and total consumption was 91.2 per cent at the end of the period (1970). The gross fixed investment had also experienced a high rate of growth (8.4 per cent) at the same period of time (1960-1970) and its increase was 124.7 per cent. The percentage distribution of gross fixed investment by major sectors in the year 1969 was as follows: building and other construction, 54.51 per cent; transport equipment and machinery, 41.84 per cent and land improvement, etc., 3.65 per cent. Exports, although they followed an upwards trend in the sampling period 1960-1970, however, they recorded a slight fall from the point of view of their participation (from 9.32 per cent to 8.16 per cent).

From the above review of demographic and economic variables some of which consist of the main variables of the macro-model, we are lead to the conclusion that the economy of Mexico, in the period 1960-1970, continued to develop at a high level. The development of supply of labour is at a lower level than the growth of output and it is a favourable point as regards the employment problem. Furthermore, the increase of industrial sector of economy with a rate of growth of 8.9 per cent in relation to the increase of the demand for labour consists of also satisfactory points of the Mexican economy. We will not enter to other figures of population and economic development of Mexico, because the scope of this section is to give a general picture of certain demographic and economic variables related to the model to be applied.

124/ United Nations, ECLA, op. cit. pp. 211-219.
125/ United Nations, Yearbook of National Accounts Statistics, 1971, Vol. III, International tables. United Nations, New York, 1971.

Table 6.2.1.2

THE DEVELOPMENT OF GROSS DOMESTIC PRODUCT, ITS COMPOSITION AND RATE OF GROWTH BY MAJOR SECTORS IN THE PERIOD 1960-1970

(In million pesos at 1960 prices)

n/n	Sector	Years							Average rate of growth		
		1960	1962	1964	1965	1966	1968	1970	1960-65	65-70	60-70
1.	Agriculture	23 970	25 339	28 669	30 222	30 740	32 558	34 730	4.74	2.82	3.78
	Index of change	100.00	105.71	119.60	126.08	128.24	135.83	144.89			
	1 : 4	15.93	15.33	14.38	14.23	13.54	12.48	11.63			
2.	Industrial[a/]	43 933	48 783	61 980	66 508	72 909	87 167	102 390	8.65	9.01	8.89
	Index of change	100.00	111.04	141.08	151.39	165.95	198.41	233.06			
	2 : 4	29.19	29.51	31.08	31.32	32.11	33.41	34.28			
3.	Services	82 608	91 188	108 741	115 590	123 388	141 176	161 580	6.95	6.93	6.94
	Index of change	100.00	110.39	131.63	139.93	149.37	170.90	195.60			
	3 : 4	54.89	55.16	54.54	54.44	54.35	54.11	54.09			
4.	Gross domestic product	150 511	165 310	199 390	212 320	227 037	260 901	298 700	7.12	7.07	7.09
	Index of change	100.00	109.83	132.48	141.07	150.84	173.34	198.46			

Source: United Nations, Statistical Bulletin for Latin America. Vol. IX, N°1-2, June, 1972. New York, 1972.

a/ Includes mining and quarrying; manufacturing; construction; electricity, gas, water and sanitary services.

Table 6.2.1.3

THE USES OF NATIONAL RESOURCES AND THEIR RATES OF GROWTH IN THE PERIOD 1960-1970

(In thousand million pesos at 1960 prices)

Uses of resources	Years					Average rate of growth		
	1960	1963	1966	1968	1970	1960-1966	1966-1970	1960-1970
1. Consumption	123.4	144.8	181.5	215.5	246.4	6.64	7.94	7.16
Index of change	100.00	117.34	147.08	174.64	199.68			
1 : 5	72.84	73.54	73.07	75.01	74.51			
a. Private	113.9	131.6	164.9	195.9	224.8	6.36	8.05	7.04
a : 1	92.30	90.88	90.85	90.90	91.23			
b. Public	9.5	13.2	16.6	19.6	21.6	9.75	6.80	8.56
b : 1	7.70	9.12	9.15	9.10	8.77			
2. Gross fixed investment	25.5	29.1	38.8	48.7	57.3	7.25	10.24	8.43
Index of change	100.00	114.12	152.16	190.98	224.71			
2 : 5	15.05	14.78	15.62	16.95	17.32			
3. Exports	15.8	18.0	21.7	23.1	27.0	5.43	5.62	5.50
3 : 5	9.32	9.14	8.74	8.04	8.16			
4. Changes in stock	4.7	5.0	6.4	a/	a/	5.28	-	-
4 : 5	2.77	2.54	2.58					
5. Total	169.4	196.9	248.4	287.3	330.7	6.59	7.42	6.92
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)			

Source: United Nations, Yearbook of National Account Statistics 1972, New York, 1974.
Note: a/ Included in private consumption.

Finally, we can say that the quantitative information for these variables in the period 1960-1970 which was considered as sample period, will allow us, by means of the model, to see their development in the post sample period 1971-1975 and to compare their values -estimated and real values.

6.2.2 Statistical estimates of the structural equations of the model

a) Ordinary least squares (OLS) method

n/n	Statistical estimates	$\bar{R}^2$ (1)	d^2/S^2 (2)
1.	$Y_t = -709\,946 + \underset{(13.9550)}{72.3489}\, L_t^e + \underset{(0.6468)}{1.8519}\, K_t$	0.994	1.14
2.	$L_t^e = -\,87.671 - \underset{(0.0000178)}{0.0000777}\, Y_t + \underset{(0.00202)}{1.02059}\, L_{t-1}^e$	0.999	2.48
3.	$L_t^a = 6938.03 + \underset{(0.001350)}{0.124146}\, P_t$	0.999	2.42

b) Two-stage least squares (TSLS) method

n/n	Statistical estimates	$\bar{R}^2$ (1)	d^2/S^2 (2)
1.	$Y_t = -711\,144 + \underset{(13.8765)}{72.4704}\, L_t^e + \underset{(0.64316)}{1.84637}\, K_t$	0.994	1.13
2.	$L_t^e = -\,81.410 - \underset{(0.0000365)}{0.0000719}\, Y_t + \underset{(0.00413)}{1.01994}\, L_{t-1}^e$	0.999	2.58
3.	$L_t^a = 6938.03 + \underset{(0.001350)}{0.124146}\, P_t$	0.999	2.42

6.2.3 Statistical analysis of the parameters estimates

The analysis of the statistical estimates will be based on the same statistical criteria and tests developed in the previous section, during the application of the model in the case of Chile. Thus, the sign of the regression coefficients corresponds to the economic theory.126/ The coefficient of multiple determination, $\bar{R}^2$, is more than 99.0 per cent in both statistical methods (OLS and TSLS) of parameters estimations. The results obtained as regards the criterion of the "F" distribution for testing the $\bar{R}^2$ say that this coefficient is statistically significant in all equations of the model. The statistical reliability of the estimated structural parameters has also been ascertained by the testing of standard errors-criterion t-student at a level of 5 per cent or less. Furthermore, the traditional test of the Von Newmann's ratio was applied for the existence of autocorrelation. From the previous section it comes that the value of d^2/s^2 of the second and third equation of the system are between the lower and upper bound (1.20 and 3.19 for a sample of eleven observations) in both statistical methods of parameters estimates. This means that the value of random variable, e_t, in our sampling period is not correlated with its own preceding values. This cannot be said for the first equation of the model, in which the value of Von Newmann's ratio is smaller than 1.20 and consequently it shows positive autocorrelation, as the same happens in the case of Chile. Autocorrelation of the term, e_t, may be observed for many reasons, as for instance, in the omitted explanatory variables, misspecification of the mathematical form of the equation, interpolation in the statistical observations etc.127/

Here, it probably seems that the positive autocorrelation can be attributed to the specification of the form of the equation concerned and to the economic growth of the economy because, as Professor Fox says, most economic variables tend to grow in periods of growth.128/ In the lower part of diagrams 6.2.4.1-3 in which the observed and estimated values of the endogenous variables of the model as well as the deviations in percentage of the aforementioned values and the influence of the predetermined variables are given, the successive values of the e_t's do not change sign frequently, a fact that means that autocorrelation is positive.

126/ The sign appearing in the variable, national output, Y_t, of the second equation of the model does not agree with the economic theory. The amount of this parameter estimate can be considered very small and consequently, its influence on the endogenous variable of the equation is imperceptible. Therefore, this slight divergence in the entire model is without any particular importance.

127/ Koutsoyiannis, A., Theory of Econometrics. The MacMillan Press Ltd. 1973. pp. 197-198.

128/ Fox, R. Intermediate Economic Statistics. John Wiley and Sons, New York, 1968. p. 199.

In the previous section 6.1.4 we said that the absence of multicollinearity is a necessary prerequisite for the estimation of the model. Moreover, we explained that the seriousness of the effects of multicollinearity seems to depend on the over-all correlation coefficient, $R^2_{X_i \cdot X_j}$ as well as on the partial correlation coefficients, $r_{yx_i \cdot x_j}$. Here, we will also use the aforementioned coefficients, as we did in the case of Chile, for testing the presence or absence of multicollinearity in the structural equations of the model. Thus, firstly, we computed the over-all correlation coefficient, $R^2_{X_i \cdot X_j}$ to test the existence or not of multicollinearity.

Table 6.2.3.1

THE INTERCORRELATION COEFFICIENTS OF THE EXPLANATORY VARIABLES IN EACH EQUATION OF THE SYSTEM

Equations of the system	Relation	R^2 OLS	R^2 TSLS	Pre-assigned critical level
1st	L^e on K	0.98	0.98	0.70
2nd	Y on L^e_{t-1}	0.99	0.99	

From table 6.2.3.1 one may see that the values of the simple intercorrelation coefficient, $R^2_{X_i \cdot X_j}$, are higher than the value of the pre-assigned critical level, 0.70. Therefore, we can say that all the explanatory variables are seriously multicollinear. Secondly, we completed the partial coefficients, $r_{y\,x_i \cdot x_j}$, to test the null hypothesis that r=0 by t-student test. Since the theoretical $t_{0.01}$ value with n-3=11-3=8 degrees of freedom is 3.35, we reject the null hypothesis with exception of the coefficient, $\hat{r}_{12.3}$, of the second equation, accepting the alternative that there is significant relationship between the explained and each of the explanatory variables in each equation of the model.129/ On the other hand, the application of Fisher test as regards multicollinearity, did not change the conclusion mentioned previously. Finally, the standard errors are statistically considered satisfactory and consequently, the presence of linear relationships among the explanatory variables did not affect their size.

129/ If there is $r \neq 0$, the t-student test is not indicated completely because its sample distribution is assymmetrical (Drakatos, C., op. cit., p. 40), however, it is frequently assumed in applied econometric research (Pavlopoulos, P., op. cit., pp. 82-84).

Table 6.2.3.2

THE PARTIAL CORRELATION COEFFICIENTS BETWEEN THE EXPLAINED AND EACH OF THE EXPLANATORY VARIABLES IN EACH EQUATION

Equations of the system	Correlation coefficients	Estimated value of r by TSLS	Computed value of t-student test	Theoretical value of t-student at one percent level
1^{st} equation	$\hat{r}_{12.3}$	0.88	7.69	
	$\hat{r}_{13.2}$	0.71	4.43	
2^{nd} equation	$\hat{r}_{12.3}$	-0.57	1.69	3.35
	$\hat{r}_{13.2}$	0.99	27.96	
3^{rd} equation	$\hat{r}_{12}$	0.99	29.70	

Identifiability also creates estimation problems in a model. Therefore, it is judged necessary to identify the equations of the model in order to see the difficulties as regards the parameters estimates. For this reason, we will apply the two conditions mentioned in Chapter 4, section 5.4. Applying the counting rule $(G - H) \geqslant n-1$ we see that the inequality sign holds: $4 \geqslant 3$, hence all the structural equations are over-identified. The sufficient condition is satisfied since we construct at least one non-zero determinant of order $n-1=3$. Thus, we evaluate the following determinants whose values, on the basis of the statistical estimates, are:

Determinants	Numerical values OLS	Numerical values TSLS	
$A_1 = b_2c_1$	0.12670	0.12662	for the first equation
$B_1 = a_2c_1$	0.22991	0.22922	for the second equation
$C_1 = a_2b_1$	-0.00014	-0.00013	for the third equation
$C_2 = - b_2$	-1.0206	-1.0199	for the third equation

Hence, we conclude that the sufficient condition is satisfied for all the equations of the model, i.e. they are identified.

Summarizing the above results which refer to the statistical validity of the equations of the model, we can say that they are the best fitting to the empirical data and they are indicated for making forecasts. Finally, in the diagrams 6.2.4.1-3, the observed and estimated values of the endogenous variables of the model, their deviations (in percentage) and the influence of the explanatory variables of each equation of the system on the basis of the TSLS estimates, are given.

6.2.4 Elasticities

As it is known, the quantitative analysis of the elasticity is based on the sign and its size. The sign shows the direction of the variation of the dependent variable caused by the explanatory variables and its size shows how much. Here we will focus in the analysis of these two points without entering in more details.

From table 6.2.4.1 it comes that the elasticities coefficients drawn have the sign indicated by economic theory. Regarding the size, the average elasticity of employed labour force, L_t^e, is 3.94 per cent, i.e. over-elastic. The average elasticity of the employed labour force lagged one year, L_{t-1}^e, is equal to unity, i.e. elastic, whereas the elasticities of the remaining explanatory variables, gross capital formation, K_t, and population, P_t, are under-elastic. Furthermore, we see that the short-run elasticities vary at different time points, a fact that means that the influence of each explanatory variable on the endogenous variable of the equation was not the same in the years of the sampling period 1960-1970.

6.2.5 A further discussion of the estimates

In the first equation of the model, the coefficient of multiple determination, $\bar{R}^2$, as a measure of goodness of fit of empirical data is slightly lower than the second and third equation in both statistical methods. The Von Newmann's criterion, d^2/S^2, indicates the presence of autocorrelation in the first equation and the absence in the two last equations of the model by OLS and TSLS. The variation of the endogenous variables is very small between the OLS and TSLS. This is because the values of parameters estimates are approximately the same in both methods. The same can be said as regards the standard errors. Examining the problem of identification of the model in the section 2.3 of the present chapter, we said that it is over-identified. For such a model, the method of TSLS yields more satisfactory results than any of the other statistical methods and consequently it is appropriate for the estimation of parameters. Furthermore, the method of TSLS is more general than the OLS, because it takes into account the influence on the dependent variables of all the predetermined variables of the model.130/ Of course, the TSLS method requires a large number of observations for the estimation of parameters. The eleven observations of the variables of the model applied can be considered adequate.

130/ Koutsoyiannis, A., Theory of Econometrics. The MacMillan Press Ltd., London, 1973. pp. 382-383.

Table 6.2.4.1

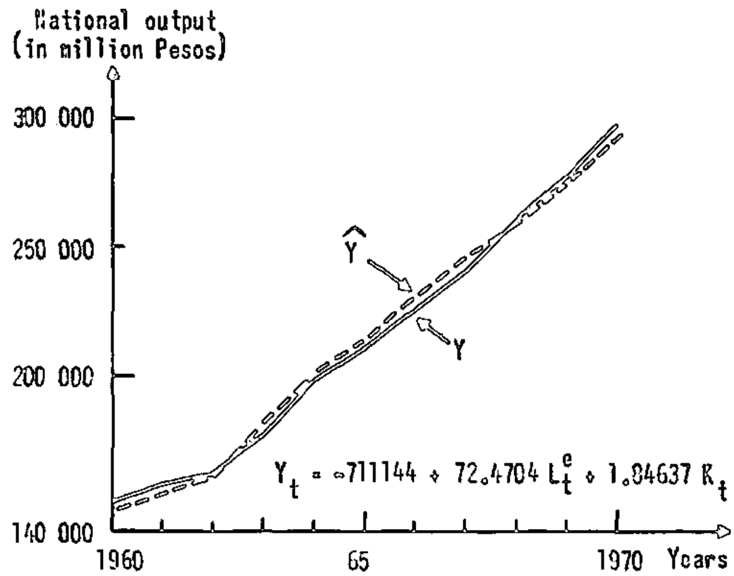
ELASTICITIES WITH RESPECT TO THE EXPLANATORY VARIABLES OF THE EQUATIONS OF THE SYSTEM BY OLS AND TSLS

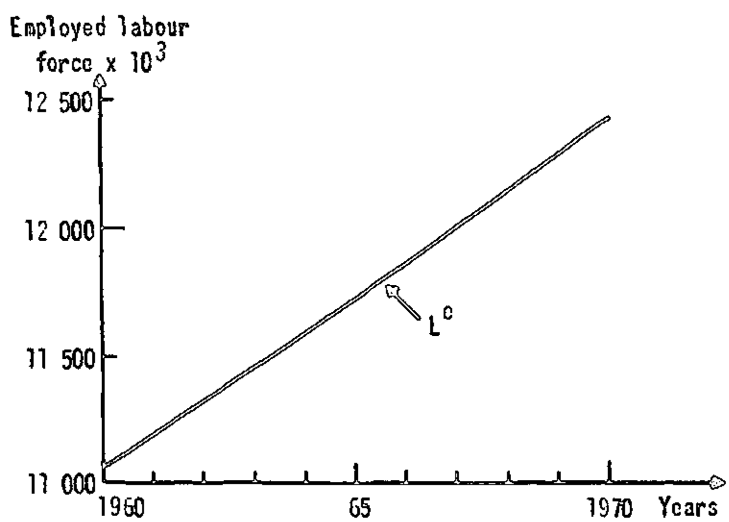
Equation	Variable	Average elasticity	Point elasticities					
			1960	1962	1964	1966	1968	1970
First	Employed labour force	3.94 (3.95)	5.32 (5.33)	4.96 (4.97)	4.21 (4.21)	3.78 (3.79)	3.37 (3.37)	3.01 (3.01)
First	Gross capital formation	0.35 (0.35)	0.37 (0.37)	0.32 (0.33)	0.37 (0.37)	0.37 (0.37)	0.35 (0.34)	0.36 (0.35)
Second	Employed labour force lagged one year	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)
Third	Total population	0.43 (0.39)	0.39 (0.39)	0.40 (0.40)	0.42 (0.42)	0.44 (0.44)	0.45 (0.45)	0.46 (0.46)

<u>Note</u>: In parenthesis the elasticities by TSLS are included.

Diagram 6.2.4.1

FIRST EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE NATIONAL OUTPUT, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM

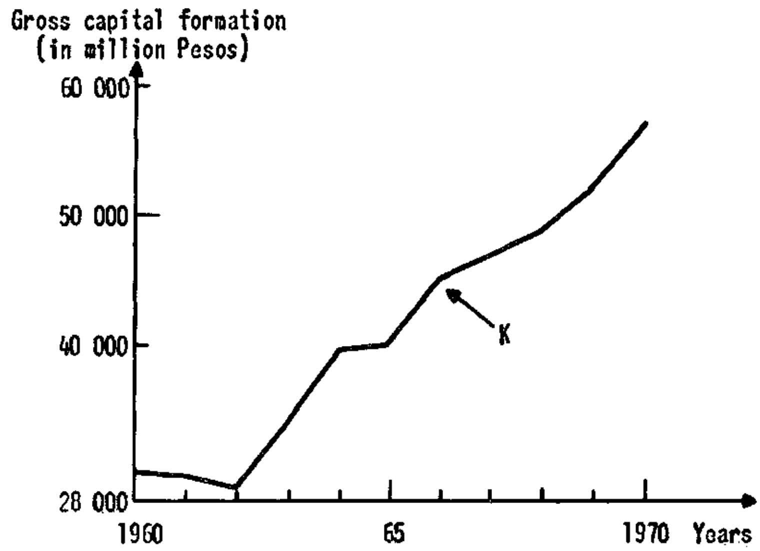




(continued)

Diagram 6.2.4.1 (concluded)

FIRST EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE NATIONAL OUTPUT, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM



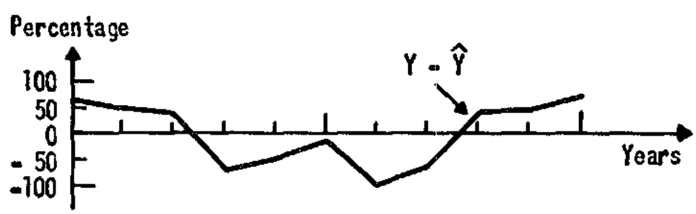
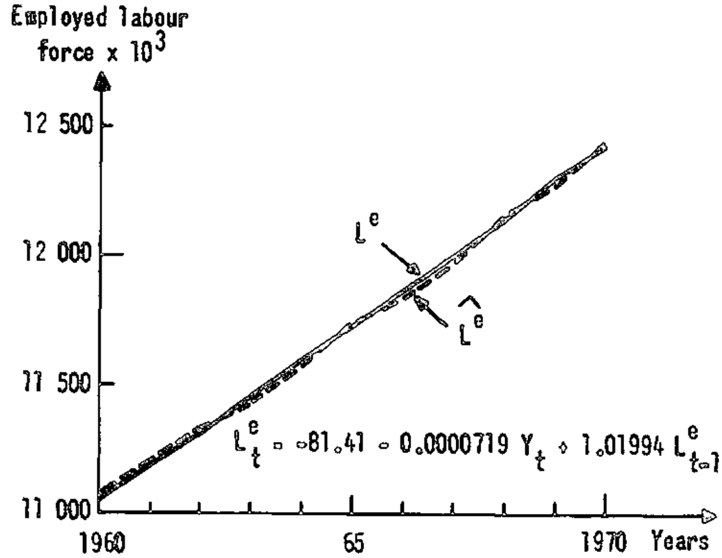
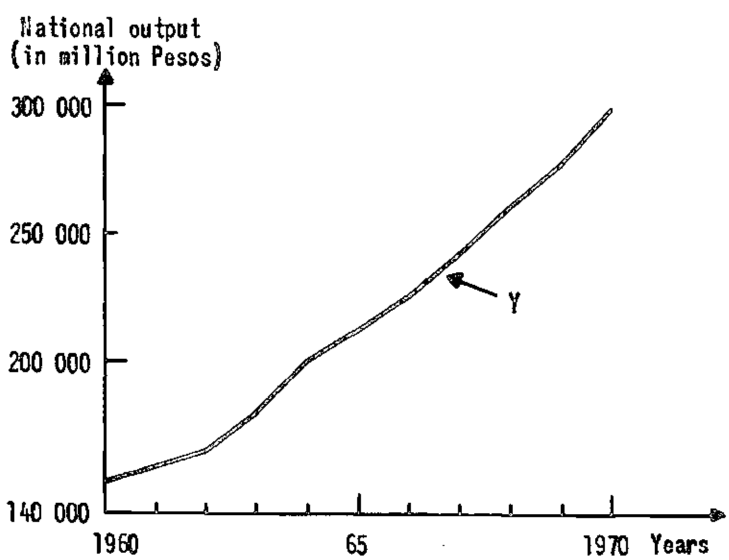


Diagram 6.2.4.2

SECOND EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE EMPLOYED LABOUR FORCE, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM

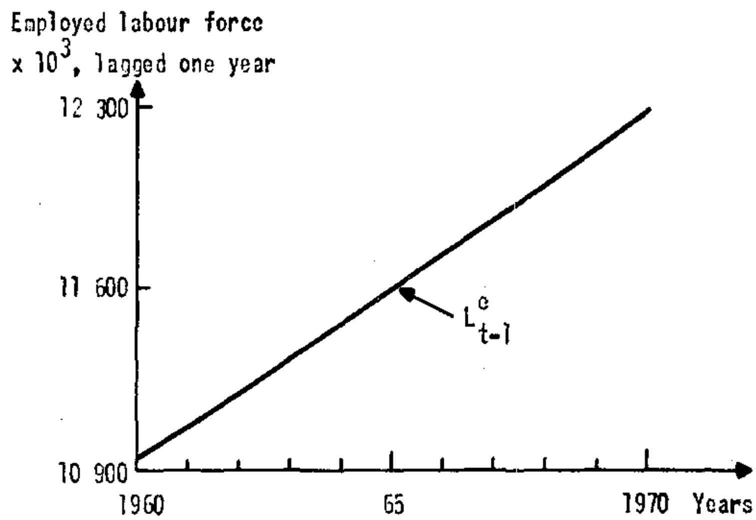




(continued)

Diagram 6.2.4.2 (concluded)

SECOND EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE EMPLOYED LABOUR FORCE, THEIR DEVIATIONS IN PERCENTAGE AND THE INFLUENCE OF THE EXPLANATORY VARIABLES OF THE SYSTEM



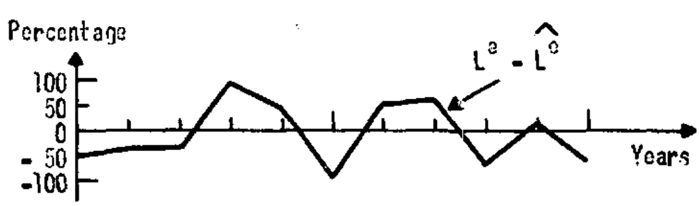
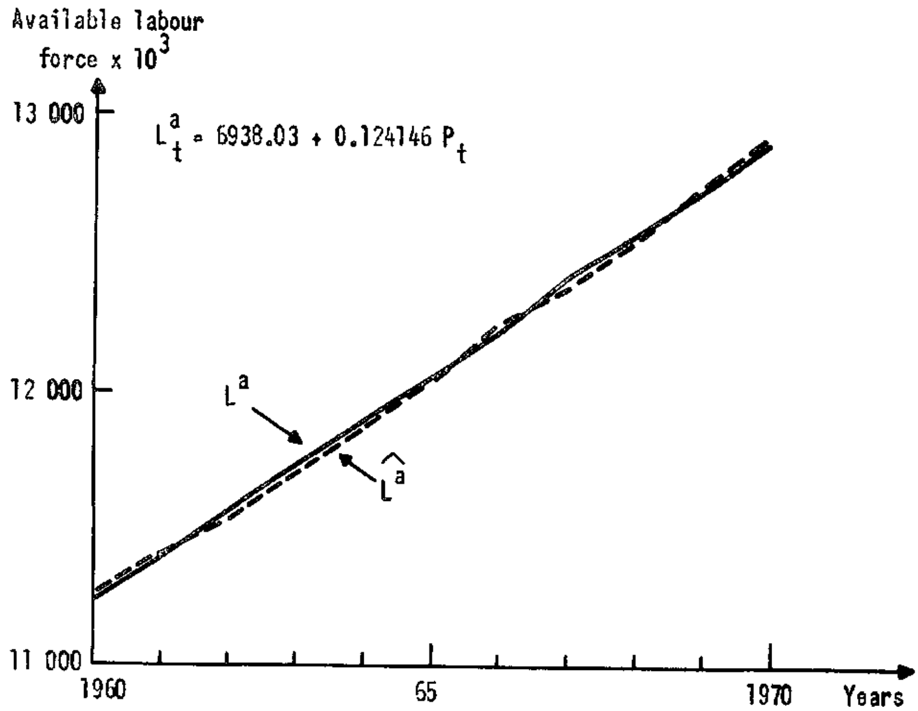
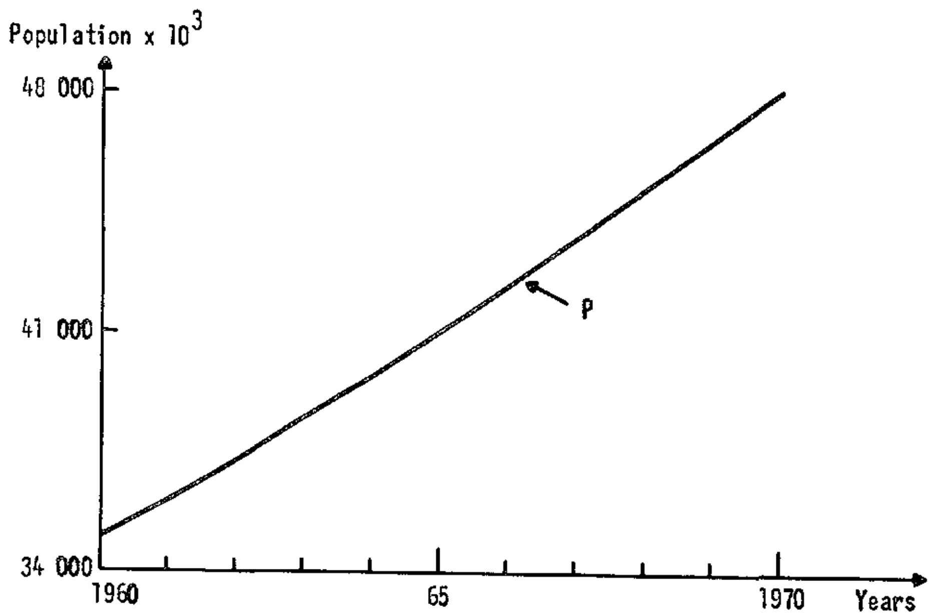


Diagram 6.2.4.3

THIRD EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE AVAILABLE LABOUR FORCE, THEIR DEVIATIONS AND THE INFLUENCE OF THE EXPLANATORY VARIABLE OF THE SYSTEM

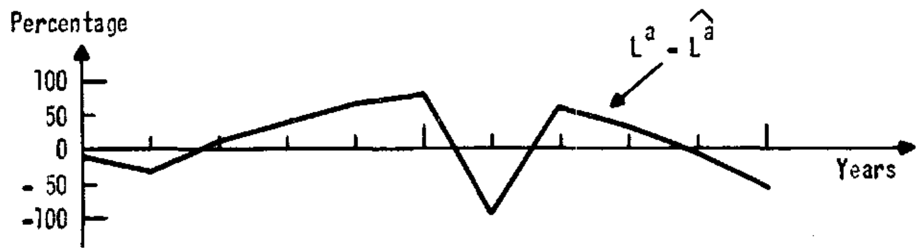




(continued)

Diagram 6.2.4.3 (concluded)

THIRD EQUATION OF THE SYSTEM: OBSERVED AND ESTIMATED VALUES OF THE AVAILABLE LABOUR FORCE, THEIR DEVIATIONS AND THE INFLUENCE OF THE EXPLANATORY VARIABLE OF THE SYSTEM



7. THE DEMOGRAPHIC SUB-MODEL. CONSUMPTION FUNCTION

7.1 Quantitative and qualitative population changes131/

It is known that the economic and social structure of a country mainly depends on the structure of its population and the targets of socio-economic plans are determined in accordance with the quantitative and qualitative population changes. Based on these population changes the demographic and socio-economic policy of a country is also determined. Therefore the knowledge of the population size and its changes for given periods of time-year-are indispensable elements for the determination of the targets of socio-economic development of a country and the formulation of the demographic and economic policy indicated. Furthermore, the estimation of certain demographic parameters for instance, nuptiality, fertility, mortality, etc. requires to know the population situation of a country in certain time-periods-years. Furthermore, we also know that population censuses are usually undertaken in each decade and consequently, the assessment of the population changes of a country is necessary for a given period of time-year.

More specifically, the population size is one of the predetermined -demographic- variables of the model and the working mechanism of the model requires that the population evolution be determined for each year. On the other hand, the enumeration of the economically active population, if the "labour force" approach is applied, is realized during the population census. Consequently, the evaluation of the population changes for the years between two succesive censuses will allow us to enumerate, on the basis of some demographic and economic factors, the quantitative and qualitative positions of the labour force, which is also another variable of the model, for the same years.

The estimation of quantitative and qualitative changes of the population can be achieved by techniques, logistic and mathematical.132/ Here, we could be able to apply a method and to take into consideration all the demographic factors, migratory movement, composition of population (urban-rural) etc. mentioned in Chapter 3, section 2 and in the schematic representation of the demographic sub-model, for the estimation of the population changes in certain periods of

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131/ By the term "quantitative" population changes we refer to the size of population and its distribution according to region of residence -urban and rural. The qualitative positions of the population are the structure by age and sex of the total population of a country and by region. A similar to above explanation of these two terms can be given as regards the economically active population

132/ Konidaris, D., Demographic Analysis. Kloukinas, S. Publising Co., Athens, 1961. pp. 19-30.

time. But, this effort on the one hand is not included in the purposes of this work; on the other hand, the population statistics for the empirical analysis of the model of Chile and Mexico are available.133/

7.2 Numerical model in the entire economic-demographic model

An economic-demographic model usually contains a great number of variables. Some variables are connected by relationships in the sense of cause-effect and they may consist of the structural equations of an econometric model. The estimates of the parameters of these relationships from statistical observations can be made by applying one of the various statistical techniques (OLS - TSLS, etc.). Other variables are related by simple relationships, identities, etc., where, as it is known, the problems of quantitative estimations are confronted differently. As regards the identities, it is necessary to mention that a) The formulation of identities in the demographic area of the model is more easy. This is obvious, because, the variety of the demographic features allows the classification of the population variables in many categories by means of which the identities can be easily derived.134/ b) It is probable that certain identities of demographic variables may be equations of the main model-system of the equations. On the other hand, the demographic variables usually enter in the main model, both in its structural equations and in its identity by their size.

Finally, a system of equations, which will consist of the main model, cannot include all the economic and demographic variables of the entire economic-demographic model for technical reasons. From the schematic view of the economic-demographic model, Figure 1, in which all the variables are illustrated, it comes that the number of variables exceeds the fifteen variables whereas the number of variables included in the main model is seven variables. From the above we can say that a) the estimation of certain demographic variables will be made out of the system of equations, b) the estimation of the structure by age and sex of these variables will be mainly made by applying demographic techniques and c) the estimation of some demographic variables by size both for forecasting purposes of the main model and comparative reasons, requires the analysis of some socio-demographic factors which cause changes in their size. In the latter case the analysis and the evaluation of the influence of these socio-demographic factors can be made by applying a numerical model.

133/ Instituto Nacional de Estadísticas. Chile, XIV Censo de Población y III de Vivienda, abril, 1970. Muestra de Adelanto de Cifras Censales, Santiago, 1971.
Oficina de Planificación Nacional, División de Recursos Humanos.
Dirección General de Estadística - México, IX Censo General de Población, 1970. Resumen General Abreviado, México, D.F., 1972.

134/ For instance, labour force, which consists of a part of a population of the country, is classified in two categories, employment and unemployment. Furthermore, each of these categories is classified as employed or unemployed labour force by sector of the economy, region, etc.

Thus, by the numerical model described in Chapter 5 and whose application will be made in the next section, we will evaluate the influence of a few socio-demographic factors that affect the size and the structure by age and sex of the demographic variable labour force. In continuation, we will try to make a quantitative and qualitative estimation of this demographic variable, in the projected year 1975. This is the role of the numerical model in the over-all economic-demographic model and from this point of view, it can be considered a supplementary model.

7.3 Numerical model

7.3.1 Descriptive method of application of the model. Comparative purposes of the model and its demographic variables used

In the macro-model applied, the labour force, L^a, is one of the endogenous variables of the model and consequently, it can be estimated in the forecasting period 1971-1975, by means of the model. In addition to this estimation of the labour force, an effort will be made for the same scope, i.e., to estimate the labour force of Chile and Mexico, in the projected year 1975, by the application of the numerical model. The estimation of the labour force by using the model will refer to the school age population,135/ i.e., of the age-groups 12-24.

The application of the model, from the theoretical point of view, is based on the definition of the economically active and inactive population. By this definition, the students of all levels of education, who mainly belong to the age-groups 12-24 are not included in the labour force, i.e. they are considered inactive persons from economic aspect. This, which we also said in Chapter 5, section 2, means that a part of the non-school population, after the substraction of these economically inactive persons, participates in the economic life of a country. Hence, the problem that comes, is the estimation of that part of non-school population which will engage in the economic activities of the country in the coming years. By the numerical model, we can estimate this part of the population which will consist of the labour force in each age of the school population in a forecasting period of time. Thus, the method of applying the model is a) the assessment of the school population of an age, P_i^s, in the projected year 1975. So, the remaining part of this age population is the non-school population, $(P_i - P_i^s)$; b) the estimation of that part of non-school population that participates in the economic activities of the country, $\bar{e}(P_i - P_i^s)$,

135/ The labour force participation rates of the age-groups 12-24 derived from a census year, cannot be used for the estimation of the labour force of the same age-groups (12-24 years) in a forecasting period of time. This is obvious, because as we said in Chapter 5, some factors will cause quantitative and structural changes in these age-groups in the forecasting period and whose changes, of course, will lead to the increase or decrease of the size of the labour force in a forecasting period of time and consequently, the participation rates of the census year will be modified.

in the same projected year (1975). The estimation of this part of non-school population which will also consist of the labour force, $\bar{e}(P_i - P_i^s)$,can be made by the substraction of the part of the economically inactive population, P_{2i}^n which, of course, should have been estimated in the year 1975, from the non-school population, $(P_i - P_i^s)$. The computation of the labour force participation rates, $\frac{\bar{e}(P_i - P_i^s)}{P_i}$, in the year 1975, since we know the size of the labour force and the population, can be made easily. Here, as a conclusion from the above description of the method of application of the model, we can say that the educational characteristics of an age of the age-groups 12-24 are mainly used for the estimation of the size of labour force and the labour force participation rates, i.e. the model is based on the educational characteristics for the estimation of the labour force and the rates in a forecasting period of time.

Furthermore, we observe that, although the aforementioned method of application of the model is the indicated method -relationship (1), Chapter 5, section 3- for the estimation of the labour force, $\bar{e}(P_i - P_i^s)$,and its participation rates, $\frac{\bar{e}(P_i - P_i^s)}{P}$, in a forecasting period of time, however, this estimation of the labour force will be an under-estimation. This is because all the active persons are not included in this estimation of the labour force, $\bar{e}(P_i - P_i^s)$. Indeed, some persons, as it is known, engage partly in economic activities and partly in non-economic activities of a country. These persons, with dual status, or activities, should be included in the active population in accordance with international recommendations. This also happens in the case of the students. A part of the students engage in economic activities of a country, that is, it belongs to the labour force. Therefore, the estimation of students with dual activities, P_i^{s+w}, must be added to the estimation of the labour force, $\bar{e}\ (P_i - P_i^s)$. Hence, the model, relationship (1) of Chapter 5, section 3, must be completed by the working students, P_i^{s+w}. Thus, the final form of the model can be written as follows: $\bar{e}(P_i - P_i^s) + P_i^{s+w}$, i.e. the estimation of the labour force in a projected year will consist of that part of non-school population which participates in the economic activities of the country, $\bar{e}(P_i - P_i^s)$, plus the working students, P_i^{s+w}. The computation of the labour force participation rates will be made by the relationship

$$e_i' = \frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i} \qquad (1)$$

The estimation of the working students, P_i^{s+w}, in a forecasting period of time can be made on the basis of the census situation of the school population (proportion of the working students to students who do not engage in the economic activities of the country) of a census year and some assumptions as regards the expected development of the working students in the coming years. About these assumptions, the factors to be taken into account for their formulation, etc., we refer to in section 3.3 of the present chapter, in which the model is applied.

Certainly, as regards the estimation of the labour force by the model, it would be better to refer to the urban and rural areas separately. This is because the size both of the school population and the labour force varies between these two areas. Furthermore, the population movements (urbanization, interregional, towards the capital, etc.) cause changes of some critical age-groups to which the school population and the labour force belong. But, the introduction of new demographic variables in the model will make its computation more complicated, whereas the process will be the same and consequently, from the point of view of working of the model, it will not add anything else. On the other hand, the model will be used for comparative purposes, on the one hand, with the macro-model applied and on the other hand, with the institutions that have made the estimation of the labour force in the projected year 1975 in which the size of the labour force is estimated totally.

Finally, as we said previously, the estimation of the labour force will allow us to see the ability of these two models -macro and numerical- as concerns the estimation of labour force in a projected period of time. On the other hand, the numerical results obtained by these two models will be compared with the estimation of the labour force made by CELADE and ILO. Of course, it is expected that the differences between the estimations from the two models and from these centres will not be significant. This is obvious, because, on the other hand, the estimation of the labour force will refer to some age-groups, 12-24, and only the school age population changes will be taken into account and on the other hand, the projected period of five years, as a short period of time, eliminates the possibilities of springing up of errors.

The labour force statistics of the countries, Chile and Mexico, as well as the participation rates of their labour force during the census year 1970, are included in table 5 of Appendix I.

Figure 2 presents the numerical model diagrammatically. More specifically, we present the classifications of an age of the school population in accordance with educational and economic characteristics adjusted to the requirements of the model and to the available statistical data of Chile and Mexico. Thus, in the upper part of the diagram, the educational characteristics of population and school age are included and in the lower part, the classifications of the same school age from the economic point of view are noted. These classifications consist of the variables used of model whose symbols are given at the end of this section. The diagrammatical form of the model will facilitate the reader of the present work to understand better the computational procedures which are required by the model for the estimation of the size of the labour force in a forecasting period of time and the labour force participation rates. For this reason, a copy of the census schedule -questionnaire- of the census year, from which the statistical data of educational and economic characteristics of an age of school population come, is also included in Appendix I.

Finally, we re-write the demographic variables of the model as they have been symbolized previously and they are to be used during the application of the model in the cases of Chile and Mexico.

a) The variables based on the educational characteristics.

1. P_i^s : School population, age i

2. $P_i - P_i^s$: Non-school population, age i

3. P_i^{s+w} : School population which also engages in economic activities, age i

4. P_i^{s-w} : School population which does not engage in economic activities, age i

5. $\bar{e}(P_i - P_i^s)$: The part of the non-school population which participates in economic activities, age i

6. $e_i = \dfrac{\bar{e}(P_i - P_i^s)}{P_i}$: Labour force participation rates, age i

7. $\bar{e}(P_i - P_i^s) + P_i^{s+w}$: The part of the non-school population - labour force in which the working students are included, age i

8. $e_i' = \dfrac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i}$: Labour force participation rates, age i

9. $P_i^{(s+w)'}$: School population which also engages in economic activities, age i (new assumption)

10. $\bar{e}(P_i - P_i^s) + P_i^{(s+w)'}$: The part of the non-school population - labour force, age i in which the working students are included (new assumption as regards the working students).

11. $e'' = \dfrac{\bar{e}(P_i - P_i^s) + P_i^{(s+w)'}}{P_i}$: Labour force participation rates, age i (new assumption as regards the working students)

b) The variables based on the economic characteristics

1. P_i : Population, age i

2. P_{1i}^n : Economically inactive population - school population which does not engage in economic activities, age i

3. P^n_{2i} : Economically inactive population - (The remaining part of the economically inactive population, after the substraction of the school population which does not engage in economic activities), age i

4. $P_i-(P^n_{1i}+ P^n_{2i})$: Labour force, age i

5. $\frac{P_i-(P^n_{1i}+ P^n_{2i})}{P_i}$: Labour force, participation rates, age i.

The variables 7 and 8 or the variables 10 and 11 of the educational characteristics are the same with the variables 4 and 5 of the economic characteristics respectively.

7.3.2 School age population and labour force

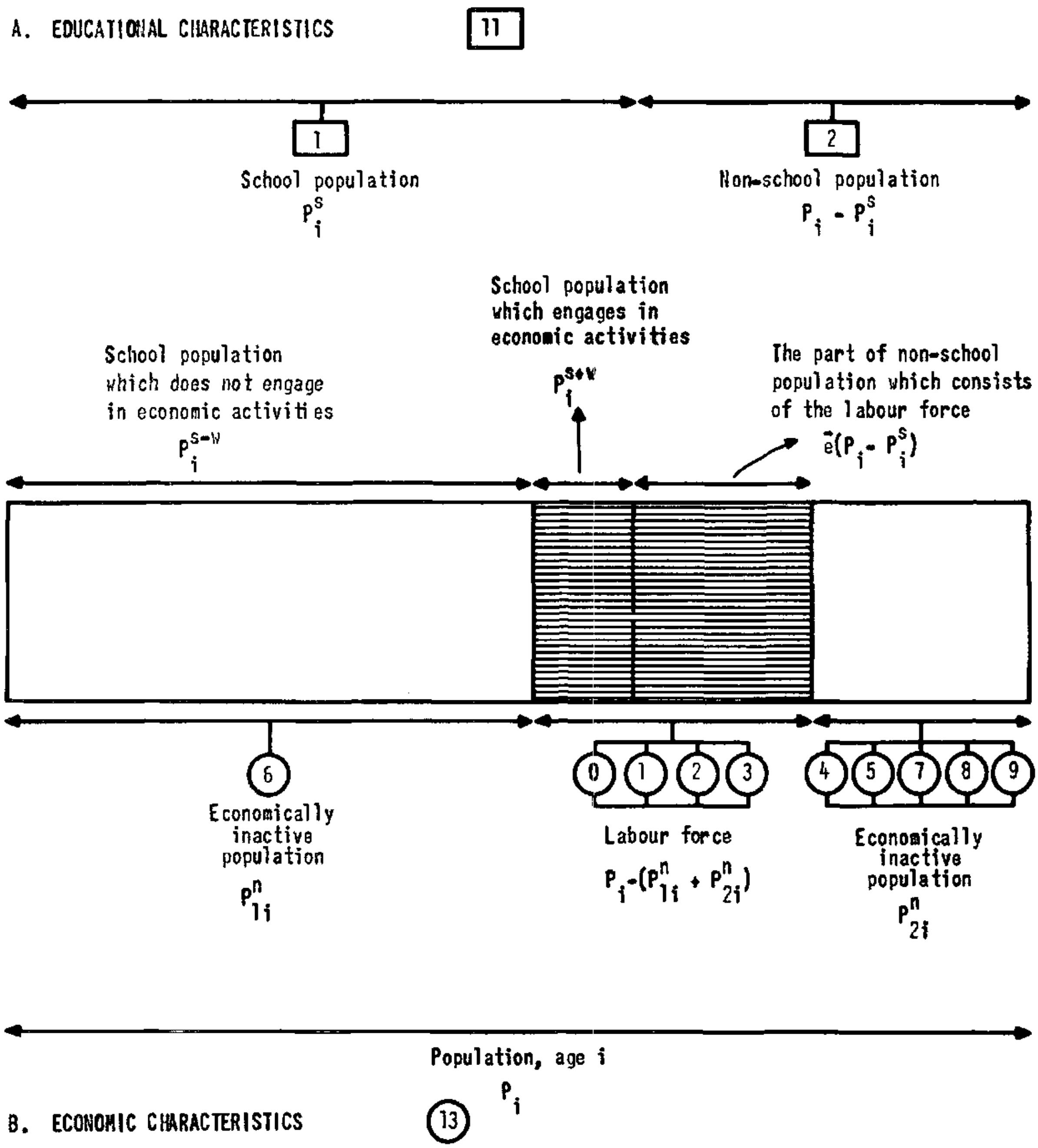
In this section we will refer to the influence of the school population changes on the labour force of the age-groups 12-24, the educational system of Chile and Mexico in which the numerical model will be applied and the school population situation from the point of view of its size and its structure by age and sex of these countries in a census year.

The school population consists of the greater part of the age-groups 12-24 and as it is known, it undergoes considerable changes in the size and the composition by age and sex in a period of time for many reasons. Certainly, these school population changes will surely cause quantitative and structural changes of that part of population of the age-groups 12-24 which will participate in the economic life of the country in a future period of time. Therefore, the school population development as well as the changes of the age-groups 12-24 caused by the school population changes, should be taken into account for the estimation of the labour force of the aforementioned age-groups (12-24 years) in a forecasting period of time. The development of the school population and their influence on the labour force of the age-groups 12-24, are taken into consideration by the numerical model which, as we saw in the previous section 3.1 of the present chapter, is based on the educational characteristics of the age-groups (12-24 years) for the estimation of their labour force. Of course, the expected development of school population in a forecasting period of time, will be based on some assumptions. The existent situation of school age population of a census year, the educational system of the country, the expected improvements of socio-economic conditions, some specific factors and the "standards" as regards the school population of other countries that are at a stage of economic development as Chile and Mexico, to which the numerical model will refer, are the main important factors which will be taken into account for the formulation of these assumptions.136/ The assessments both of the school population development, and the changes of the age-groups 12-24 caused by the school population changes will allow us to apply the numerical model for estimation of the labour force of these age-groups (12-24 years) in the coming years. Furthermore, the

136/ Specific factors are the number of students enrolled, the number of students in attendance and in withdrawal by each year, etc.

Figure 2

NUMERICAL MODEL



Note: Classifications of population, age i, P_i, in accordance with educational and economic characteristics on the basis of the census schedule in the year 1970.

assessments of the school population in a projected period of time will help us to formulate the assumption as regards the development of the working students in the same projected period of time, who, as we said in the previous section 3.1 consist of an important factor which should be included in the model for a more exact estimation of the labour force. For these reasons it is necessary, on the one hand, to give a general picture of the educational system of these two countries, Chile and Mexico and, on the other hand, to illustrate numerically the existent situation of their school population in the last census year, 1970.

7.3.2.1 In the case of Chile

Public education in Chile includes three cycles of studies, the primary eight years obligatory education, the intermediary four-years education and the higher education which ranges from four to seven years. In addition to the aforementioned cycles, there is also professional training which includes educational institutions which provide this kind of education. University education enrolls graduates from secondary education, following examinations, whereas professional education -lower level than university- enrolls students with or without examinations. Both the first and second cycle of studies are provided gratis. The same can be said for higher and professional education.

The "static" situation of the school population and its distribution by age and sex in the census year 1970 is given in table 7.3.2.1.1. From the analysis of this situation we can be led to some conclusions as to the participation of school population of the age-groups 12-24 which in continuation will facilitate us to formulate the assumptions as regards the expected development of school population in the projected period of time. So we have a) The age-group 12-14; the number of students of elementary -obligatory- education is 577 thousands and it consists of 88.55 per cent of this age-group population.137/ The proportion of females in the school population is less than the proportion of males (86.65 per cent and 90.44 per cent respectively). The same is observed in all the ages of this group. b) The age-group 15-19; in this age-group, students of obligatory and mainly of intermediary education are included. The number of students is 440 thousands and it covers 51.54 per cent for males and 46.37 per cent for females. The proportion of school population is less than one half of the population of this age-group. c) The age-group 20-24; the number of students is relatively small (91 thousands) and it represents only 12.36 per cent of the total population of these years.

As a conclusion we can say that the participation rates of school population of the group 12-14 years approach the level of a developed country and consequently, further improvements of these rates should not be expected. As regards the age-group 15-19, the proportions of school population by age and sex to the total population are at a relatively low level and consequently, there are margins for a further improvement of these proportions. Finally, for the age-group 20-24, the rates of school population are low and consequently, the same can be said as for the age-group 15-19, that there are wide margins for the increase of the number of students in the coming years.

137/ The minimum age limit of a person to be counted as economically active is 12 years of age, in Chile.

Table 7.3.2.1.1

THE STRUCTURE BY AGE AND SEX OF THE SCHOOL POPULATION OF THE COUNTRY IN THE CENSUS YEAR 1970

Age	School population			School population to the total population (percentage)		
	Male	Female	Total	Male	Female	Total
12	111 080	108 840	219 920	93.99	93.12	93.56
13	97 820	92 680	190 500	91.99	88.72	90.37
14	86 880	80 240	167 120	84.73	77.27	80.98
12-14	295 780	281 760	577 540	90.44	86.65	88.55
15	71 620	65 160	136 780	76.34	65.69	70.86
16	57 360	54 280	111 640	63.52	56.81	60.07
17	46 100	41 960	88 060	49.50	45.11	47.30
18	31 740	29 680	61 420	35.36	33.48	34.43
19	21 300	21 280	42 580	28.17	26.09	27.09
15-19	228 120	212 360	440 480	51.54	46.37	48.91
20	16 820	15 440	32 260	22.57	17.97	20.11
21	11 340	9 960	21 300	16.32	13.43	14.83
22	10 180	7 380	17 560	14.12	9.48	11.71
23	7 580	4 800	12 380	10.44	6.42	8.40
24	5 360	3 120	8 480	7.86	4.20	5.95
20-24	51 280	40 700	91 980	14.37	10.52	12.36
Total	575 180	534 820	1 110 000	51.05	45.71	48.33

Source: Instituto Nacional de Estadísticas. Chile, XIV Censo Nacional de Población y III de Vivienda, abril 1970, Muestra de Adelanto de Cifras Censales, Total País, Santiago, 1971.

7.3.2.2 In the case of Mexico

The education in Mexico is similar to the education in Chile from the point of view of basic cycles of studies, university and professional training and consequently, we do not have to say anything else than in the case of Chile.138/ Here, we will focus on the presentation of the school population situation in the census year 1970. Thus, in table 7.3.2.2.1 the school population by age-groups and sex as well as the proportions of these age-groups to their total population are included.139/

Table 7.3.2.2.1

SCHOOL POPULATION BY AGE-GROUP AND SEX AND ITS PROPORTION TO THE POPULATION IN THE CENSUS YEAR 1970

Age	School population			School population to the total population (percentage)		
	Male	Female	Total	Male	Female	Total
12-14 years	1 292 177	1 098 887	2 391 064	67.39	59.68	63.61
15-19 years	956 906	720 873	1 677 779	34.96	27.32	31.21
20-24 years	225 027	107 795	332 822	11.66	5.13	8.25

Source: Dirección General de Estadística, IX Censo General de Población, 1970. Resumen General, México D.F., 1972.

From the above table it comes: a) The number of students of the age-group 12-14 is 2 391 thousands and it consists of 63.61 per cent of population of this age-group. The male students are 1 292 thousands (67.39 per cent) and the female students 1 098 thousands (59.68 per cent).140/ b) The number of students of the age-group 15-19 is 1 677 thousands and it covers the 31.21 per cent. The proportion of males and females is 34.96 per cent and 27.32 per cent respectively. Finally, as regards the age-group 20-24, the number of students is very small (333 thousands), which consists of only 8.25 per cent (11.66 per cent for males and 5.13 for females). Based on the existent situation of school population in the census year 1970 we can say that the participation rates of school population are at low level and consequently, there are wide margins for them to be increased. Of course, the

138/ The primary obligatory education is six years.

139/ The minimum age limit of a person to be counted as economically active is also 12 years of age, in Mexico.

140/ In the countries of Latin America, although school attendance by individuals aged 6-14 years is obligatory, on the basis of existing legislation, however, the withdrawals of individuals of this age-group from education are large for many reasons. (Elizaga, J.C. and Mellon, R., Aspectos Demográficos de la Mano de Obra en América Latina, CELADE, Series E, N° 9, Santiago de Chile, 1971. pp. 75-76).

prevailing favourable economic conditions of the country141/ and their expected further improvements in the coming years in conjunction with the improvement of other factors related to the education, will surely contribute to the increase of educational level of people and consequently, we can assume that school population rates and particularly the age-groups 12-19 will tend to approach the "standards" that there are in the rapid developing countries.

7.3.3 Assumptions as regards the development of the school age population (percentage). Estimation of the labour force and its participation rates (age-groups 12-24) in the projected year 1975

In this section we begin with the assumptions regarding the expected development of the school age population in the projected year 1975. These assumptions will refer to each age-group -and by sex- of the school age-groups 12-24 of Chile and Mexico.142/ As we mentioned in the previous section, the assumptions will be based on the existent situation in the census year 1970, from the point of view of the number of students by age and sex as the statistical data are tabulated in tables 7.3.2.1.1 and 7.3.2.2.1, the factors affecting the size and the structure by age and sex of the school age population and the "standards" as regards the school population of other developing countries. Furthermore, we will try to estimate, on the one hand, that part on non-school age population which will participate in the economic activities of the countries, Chile and Mexico and on the other hand, its participation rates. Thus, we have,

7.3.3.1 In the case of Chile

i) The school age-group 12-14: we accept the assumption that the participation rates of this school age-group as a whole will be, in the projected year 1975, at the same level approximately, as they were in the census year 1970, that is, 91 per cent for males and 87 per cent for females.

ii) The school age-group 15-19: the expected improvement of the socio-economic conditions and the need of the completion of the two basic cycles of studies for any effort made of obtaining a job, will have as a result the increase of the number of the students of this age-group of both sexes. Therefore, the acceptance of the assumption that the participation rates of this school age population will be 54 per cent for males and 48 per cent for females, is within the reasonable limits.

iii) The school age-group 20-24: Many factors affect the school population of this age-group and they cause considerable changes to its size and its structure by age and sex. Therefore, before formulating the assumptions as regards the development of the school population of the group 20-24 years in the coming years, it is necessary to refer to these factors, their influence on this school age-group as well as the difficulties that there are for their

141/ The rate of growht was 7.1 per cent during the period 1960-1970 and in accordance with estimations made by the Economic Commission for Latin America/United Nations, this rate will be kept in the projected period 1970-1980.

142/ Statistical data for enumeration of the labour force are also tabulated by age-group and sex.

quantitative assessment. Thus, a great part of the males, and particularly the ages 20-22 are in the armed forces of the country for the accomplishment of their obligatory service. Of course, a number of these individuals are students who do not continue their studies for this reason and for a period of time as their military service continues. The duration of the obligatory military service fluctuates between one and two years.143/

This situation -obligatory military service- has as a result the decrease of the number of the male-students in attendance at the ages 20-22. Statistical data for the enumeration of this number of students by age who are serving in the armed forces and the duration of the military service have not been tabulated. The non-availability of such statistical data does not allow us to assess the number of students who will serve in the armed forces in a future period of time. This, of course, will lead us to an over-estimation of the school population (percentage) of this age-group, 20-22 years, in the projected year 1975.

Furthermore, family conditions cause difficulties as regards the continuation of the studies in a part of this age-group students and mainly for females.144/ This means that the factor "family conditions" affects downwards the participation rates of this school age population.

Unfortunately, the census data, the only available and used data, do not mention these cases of the students, i.e. the females by age who have withdrawn from education due to family conditions (marriage, children, etc.) and consequently, an assessment of the number of the students who will withdraw from education for this reason in a forecasting period, cannot be made. From table 7.3.2.1.1 we observe that the number of females decreased from 15.4 thousands to 3.1 thousands in the ages 20 and 24. Of course, the census data give the "static" situation of the school age population and consequently we do not know its development in a period of time as the statistical analysis requires. Furthermore, as we said previously, we do not have any statistical evidence on the basis of which we can attribute a part of or entirely the decrease of this number of the students to the factor "family conditions". However, it can be said that family conditions have surely been responsible for a part of this considerable decrease of the number of students and particularly of the number of females.

Certainly, the decrease of the number of this age-group students can also be attributed to many other factors. The most important ones are the completion of the studies at the age 23 and the withdrawal of students from the education for reasons of failure in the examinations, health, emigration, etc. and whose quantitative assessment is not also possible because of the lack of statistical data.

As a conclusion, we can say that the most important factors which influence considerably the development of the size of school age population and that cause changes in its structure by age and sex are "military service" and "family

143/ The duration of the military service and the facilities provided by the state to the students as regards their obligatory military service vary from one country to another.

144/ Family conditions are mainly the marriage and the children. It is known that the greater frequency of marriages for females is observed in the age-groups 20-24 and 25-29.

conditions". The non-evaluation of the influence of the aforementioned factors imposes us to be cautious as regards the accuracy of the assumptions adopted, which will refer to the expected changes of the school population, and their realization in a forecasting period of time. It is obvious that any deviation between what is realized and what is assumed will reflect the estimation to be made on the basis of the assumption both of that part of the non-school population which will participate in the economic activities of the country - labour force and labour force participation rates of the age-group 20-24. Of course, all the already mentioned restrictive factors of high level education as time goes and socio-economic conditions of Chile and Mexico improve, will be eliminated, but this will happen in a long period of time. In a period of five years (1971-1975) the already noted percentages of this school age population (20-24 years group) are not expected to be improved significantly. Therefore, we will accept that the percentages of this school age-group 20-24 will not be more than 13 per cent for males and 10.50 per cent for females at the end of this short period, 1971-1975.

Thus, the estimation of that part of non-school population based on the assumptions by age and sex and who will participate in the economic activity of the country, $\bar{e}(P_i - P_i^s)$, in the projected year 1975 is made in table 3 of Appendix I, of which a composite figure is given in the following table.

Table 7.3.3.1.1.

THE NUMERICAL VALUES OF THE COEFFICIENTS FOR THE COMPUTATION OF THAT PART OF NON-SCHOOL POPULATION - LABOUR FORCE IN THE PROJECTED YEAR 1975

Age-groups by sex		P_i	P_i^s		$P_i - P_i^s$		$\bar{e}(P_i - P_i^s)$	
			Absolute	Per cent	Absolute	Per cent	Absolute	Per cent
12-24	Male	1 383 272	700 154	50.62	683 118	49.38	593 254	42.89
	Female	1 374 040	633 239	46.09	740 801	53.91	262 241	19.09
	Total	2 757 312	1 333 393	48.36	1 423 919	51.64	855 495	31.03

Finally, the participation rates of the labour force by age and sex of the groups 12-24 years for the year 1975 were computed by the ratio, $e_i = \frac{\bar{e}(P_i - P_i^s)}{P_i} 100.$

The numerical results obtained are included in the following table 7.3.3.1.2.

Table 7.3.3.1.2

PARTICIPATION RATES OF THE LABOUR FORCE OF THE AGE-GROUPS 12-24 AND BY SEX IN THE YEAR 1975

Age-groups	By sex		
	Male	Female	Total
12-14	3.88	2.50	3.19
15-19	39.14	16.69	27.95
20-24	79.33	35.51	57.47

Although we followed the process indicated by the numerical model for the estimation both of that part of non-school population which also consists of the labour force in the year 1975 and the labour force participation rates in the same year (1975), however, their numerical values estimated must be less than the real values. Indeed, as we explained in section 3.1 of this Chapter, the application of the model for the estimation of labour force, $\bar{e}(P_i - P_i^s)$, leads to an under-estimation of the size of the labour force, because the persons with dual activities, who in the case of school population are the students who also engage in the economic activities of the country, P_i^{s+w}, are not included in the labour force.145/ Therefore, the working students who are also active persons, from economic point of view, even though this number of students is very small, must be also added to the size of the labour force estimated for the projected year 1975.146/ Statistical data for this part of students with dual activities have been tabulated separately in the census year 1970 and consequently, the new estimation of the size of the labour force in which the students who participate in the economic life of the country will be included, does not create difficulties.

The students by age and sex, who engage in the economic activities of the country, P_i^{s+w}, and the students who are considered by definition as economically inactive population, P_i^{s-w}, are included in the following table.

145/ Statistical data of the census year 1970 have been tabulated by the educational characteristics which are required for the estimation of the labour force on the basis of the modified form of the model - relationship (1) of section 3.1 of the present chapter.

146/ The student with dual activities are mainly of the age-groups 15-19 and 20-24.

Table 7.3.3.1.3

CLASSIFICATION OF SCHOOL AGE POPULATION IN ECONOMICALLY ACTIVE AND IN NON-ECONOMICALLY ACTIVE PERSONS AND ITS DISTRIBUTION BY AGE-GROUPS AND SEX DURING THE CENSUS YEAR 1970

Age-groups by sex		School population		Relation of P_i^{s+w}/P_i^{s-w} (percentage)
		P_i^{s-w}	P_i^{s+w}	
15-19	Male	216 040	12 080	5.59
	Female	207 180	5 180	2.50
	Total	423 220	17 260	4.08
20-24	Male	34 940	16 340	46.77
	Female	33 120	7 580	22.89
	Total	68 060	23 920	35.15

Source: Latin American Demographic Centre (CELADE). Data Bank. 5 per cent sample. 1970 Census of Chile.

Thus, in order to include the number of the students who will also engage in the economic activities of the country in the estimation of the labour force in the projected year 1975, a) we accept the following assumption: the computed ratio (percentage) of the students who engage in economic activities of the country to the students who are considered as inactive persons, from the economic point of view, i.e., P_i^{s+w}/P_i^{s-w} . 100, of the age-groups 15-24 in the census year 1975, mentioned in the above table 7.3.3.1.3, will not change in the projected year 1975; b) we evaluate, on the basis of this assumption, the number of the students who will be active persons in the year 1975. In continuation, we are led to the new estimations of the labour force by the use of the aforementioned relationship of the model, in which the part of the students who will engage in the economic activities of the country is included. The new estimations of the size of the labour force by age-groups and sex and the labour force participation rates in the projected year 1975, are presented in table 7.3.3.1.4.

From table 7.3.3.1.4 it comes that the labour force of the age-groups 12-24 will amount to 907 thousand persons (628 thousand males and 279 thousand females) in the projected year 1975. This size of the labour force will consist of 32.88 per cent of the corresponding ages of the total population in the same year 1975 (45.41 per cent of males and 20.27 per cent of females). The labour force of the age-groups (12-24 years) was 793 thousand persons (558 thousand males and 235 thousand females) in the census year 1970 (table 3 of Appendix I). Comparing the size of the labour force in these two years (1970 and 1975) we observe that it will experience an increase of 14.38 per cent during the period 1970-1975 (the increase of the active males and females will be 12.54 per cent and 18.72 per cent respectively). On the other hand, the school population was 1 100 thousand

Table 7.3.3.1.4

THE LABOUR FORCE BY AGE-GROUP AND SEX AND ITS PARTICIPATION RATES IN THE PROJECTED YEAR 1975

Age-groups by sex		P_i	$\bar{e}(P_i - P_i^s) + P_i^{s+w}$	$\frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i}$
	Male	369 779	14 347	3.88
12-14	Female	366 455	9 161	2.50
	Total	736 234	23 508	3.19
	Male	560 084	235 236	42.00
15-19	Female	556 338	100 141	18.00
	Total	1 116 422	335 377	30.04
	Male	453 409	378 597	83.50
20-24	Female	451 247	169 218	37.50
	Total	904 656	547 815	60.56
	Male	1 383 272	628 180	45.41
12-24	Female	1 374 040	278 520	20.27
	Total	2 757 312	906 700	32.88

students in the census year 1970 and it will reach 1 333 thousand students in 1975, that is, it will increase by 20.1 per cent in the period 1970-1975 (table 3 of Appendix I). Of course, the assumption as regards the number of students who will participate in the economic life of the country in the year 1975 may be considered a pessimistic assumption. The number of students with dual activities is expected to be greater in the year 1975 than the number of students in the census year 1970. The improvements of socio-economic conditions that are expected to take place in the coming years will create employment opportunities. Furthermore, facilities provided by schools to working students, and the educational policy which aims at helping poor students to continue their studies, will surely lead to a further increase of the number of working students in the year 1975. Based on these thoughts, we can formulate a more realistic assumption as regards working students in relation to non-working students in the projected year 1975. So we accept:

Age-group	New assumption	
	Male	Female
15 - 19	6.00	3.00
20 - 24	52.00	25.00

The estimations of the labour force and its rates on the basis of the new assumption as regards working students in the year 1975 are included in the following table.

Table 7.3.3.1.5

LABOUR FORCE BY AGE-GROUP AND SEX AND ITS PARTICIPATION RATES IN THE PROJECTED YEAR 1975

Age-groups by sex		P_i	$\bar{e}(P_i - P_i^s) + P_i^{(s+w)'}$	$\dfrac{\bar{e}(P_i - P_i^s) + P_i^{(s+w)'}}{P_i}$
	Male	560 084	236 427	42.21
15-19	Female	556 338	100 623	18.09
	Total	1 116 422	337 050	30.19
	Male	453 409	381 653	84.17
20-24	Female	451 247	169 852	37.64
	Total	904 656	551 505	60.96

Although, as it comes from table 7.3.3.1.5, the size of the labour force of the age-groups 15-24 and the participation rates experienced a slight increase if we compare with the estimations of the size of the labour force and the rates which are included in the previous table 7.3.3.1.4, however, these estimations of labour force with the new assumption as regards the number of the working students in the year 1975 seem to be more real. In this section it is necessary to say that the process -numerical model- for the estimation of labour force and its participation rates in the year 1975, has been also followed for the estimation of the labour force and its participation rates in the census year 1970. This is, of course, as an example, for the verification of the reliability of the model. This process gave the same numerical results as they derived from the enumeration of the labour force and the computation of its rates during the census year 1970 and which have been tabulated in the Statistical Books of the National Statistical Institute of the country. 147/

7.3.3.2 In the case of Mexico

The improvement both of the socio-economic conditions and the factors which affect the educational level of people, will surely contribute to the increase of the number of students of all cycles of studies. It is expected that the school population and particularly the age-groups 12-14 and 15-19 will approach the level of school population of other developing countries at the end of this decade (1970-1980). Based on this general assumption as regards the development of school population in the coming years 1970-1980, we formulate the assumptions for each age-group as follows:

147/ They are also included in table 3 of Appendix I.

i) The school age population 12-14: We assume that the participation rates of this school age population will experience an increase of 12.50 per cent in the projected year 1975 and they will approach the level of 77 per cent for males and 66 per cent for females.

ii) The school age population 15-19: It is assumed that the proportions of school population to the total population of this age-group will increase from 31.21 per cent in the census year 1970 to 34.50 per cent in the projected year 1975 (38.00 per cent for males and 31.00 for females).

iii) The school age population 20-24: Any prediction for the school population rates meets many difficulties in this age-group. This is because many factors as we explained in the case of Chile affect the age-group 20-24 and whose quantitative evaluation on the purpose of formulating a more correct assumption as regards the development of this school population in the year 1975, seems to be a very difficult task due to the lack of statistical data up to now. Therefore, we must be very cautious as regards the accuracy of the assumption adopted and its realization in the projected year 1975.

In spite of these difficulties, we accept the assumption that the percentages of this school age-group 20-24 will reach 12.50 per cent for males and 6.50 per cent for females in the year 1975, on the basis of what we said at the beginning of this section and the expected increase of the number of students of the first and second cycle which will be made in the period 1971-1975.

Thus, the assessments of non-school population, $(P_i - P_i^s)$, on the basis of the assumptions as regards the school population developments and in continuation, the estimations of that part of non-school population which will consist of the labour force, $\bar{e}(P_i - P_i^s)$, by age-group and sex in the projected year 1975, are included in table 4 of Appendix I. Both the assessments of non-school population, $(P_i - P_i^s)$, and the estimations of labour force, $\bar{e}(P_i - P_i^s)$, for the age-groups 12-24 as a whole are given in the following table 7.3.3.2.1.

Table 7.3.3.2.1

NON-SCHOOL POPULATION AND LABOUR FORCE BY AGE-GROUP AND SEX IN THE PROJECTED YEAR 1975

Age-groups by sex		P_i^s	P_i		$P_i - P_i^s$		$\bar{e}(P_i - P_i^s)$	
			Absolute	Percent	Absolute	Percent	Absolute	Percent
	Male	8 242 806	3 335 271	40.46	4 907 535	59.54	3 539 577	42.94
12-24	Female	7 956 537	2 596 082	32.63	5 360 455	67.37	1 187 368	14.92
	Total	16 199 343	5 931 353	36.61	10 267 990	63.39	4 726 945	29.18

Furthermore, the computations of the labour force participation rates by age-group and sex were made by the ratio $e_i = \frac{\bar{e}(P_i - P_i^s)}{P_i}$ and they are included in the following table 7.3.3.2.2.

Table 7.3.3.2.2

THE PARTICIPATION RATES OF THE LABOUR FORCE BY AGE-GROUP AND SEX IN THE PROJECTED YEAR 1975

Age-groups	Male	Female	Total
12-14	3.00	2.00	2.51
15-19	44.00	16.00	30.25
20-24	75.50	24.50	50.41
12-24	42.94	14.92	29.18

As we explained in more detail during the application of the model in the case of Chile, the estimation of the labour force, $\bar{e}(P_i - P_i^s)$, and consequently the estimation of its participation rates, $e_i = \frac{\bar{e}(P_i - P_i^s)}{P_i}$, are under-estimations because the part of the students which participates in the economic activities of the country, P_i^{s+w}, is not included in the aforementioned estimations.

In other words, the estimation both of the labour force and the labour force participation rates must consist of that part of non-school population which engages in economic activities of a country plus the working students who also engage in economic activities of a country, that is, $\bar{e}(P_i - P_i^s) + P_i^{s+w}$, and

$$e_i' = \frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i}$$

Unfortunately, statistical data as regards the students who also engage in economic activities of the country have not been tabulated by the National Statistical Institute of the country or other centre, during the census year 1970. Therefore, we estimated this number of students with dual activities on the basis of the available census data. The estimations of the number of students of the age-groups 15-24 who also work (working students), P_i^{s+w}, and the number of students who do not participate in the economic life of the country (inactive persons), P_i^{s-w}, in the census year 1970, are included in the next table 7.3.3.2.3.

Table 7.3.3.2.3

WORKING STUDENTS AND STUDENTS WHICH ARE CONSIDERED ECONOMICALLY INACTIVE PERSONS BY AGE-GROUP AND SEX IN THE YEAR 1970

Age-groups by sex		School population P_i^{s-w}	P_i^{s+w}	Relation of P_i^{s+w} / P_i^{s-w} (percentage)
	Male	1 244 299	47 878	3.85
12-14	Female	1 014 629	84 258	8.30
	Total	2 258 928	132 136	5.85
	Male	818 708	138 198	16.88
15-19	Female	558 883	161 990	28.98
	Total	1 377 591	300 188	21.79
	Male	108 554	116 473	107.29
20-24	Female	81 782	26 013	31.81
	Total	190 336	142 486	74.86

From table 7.3.3.2.3 we see that students participation in the economic activities of the country is too high and consequently, it is believed that a further increase of the number of working students would not be expected in the projected year 1975. Thus, for making the estimation of the labour force, $\bar{e}(P_i - P_i^s) + P_i^{s+w}$, in the projected year 1975, a) we accept the assumption that the ratio computed (percentage) of working students to students who do not work (inactive persons from economic point of view), $P_i^{s+w}/P_i^{s-w} \cdot 100$, of the two age-groups 15-19 and 20-24 will be the same in the year 1975 as it was formulated in the census year 1970, b) we evaluate the working students in the year 1975, on the basis of the aforementioned assumption and the development of school population. In continuation, we add to the labour force estimations, $\bar{e}(P_i - P_i^s)$, the estimations of students with dual activities, P_i^{s+w}, and so we have the estimations of the labour force in which working students are included, $\bar{e}(P_i - P_i^s) + P_i^{s+w}$. Finally, we compute the labour force participation rates, $e_i' = \frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i}$, in the year

1975 within, of course, the expected population development in this projected year (1975).148/ Both labour force estimations and computations of labour force participation rates in the year 1975, are included in table 7.3.3.2.4.

Table 7.3.3.2.4

LABOUR FORCE BY AGE-GROUP AND SEX OF THE YEARS 12-24 AND ITS PARTICIPATION RATES IN THE PROJECTED YEAR 1975

Age-groups by sex		P_i	$\bar{e}(P_i - P_i^s) + P^{s+w}$	$\frac{\bar{e}(P_i - P_i^s) + P_i^{s+w}}{P_i}$
	Male	2 278 469	133 443	5.86
12-14	Female	2 193 092	154 881	7.06
	Total	4 471 561	288 324	6.45
	Male	3 275 715	1 621 059	49.49
15-19	Female	3 159 250	725 543	22.97
	Total	6 434 965	2 346 602	36.47
	Male	2 688 622	2 203 863	81.97
20-24	Female	2 604 195	678 873	26.07
	Total	5 292 817	2 882 736	54.47
	Male	8 242 806	3 958 365	48.02
12-24	Female	7 956 537	1 559 297	19.60
	Total	16 199 343	5 517 662	34.06

148/ The process followed by numerical model for the labour force estimations, i.e. the estimation of the labour force, $\bar{e}(P_i - P_i^s)$, plus the estimation of working students, P_i^{s+w}, in the census year 1970 gives the enumeration of the labour force in this census year 1970 derived by the National Statistical Office of the country on the basis of the census schedule. The enumeration of the labour force in the census year 1970 has been tabulated in the statistical books of the Institute and it is also included in table 4 of Appendix I.

From table 7.3.3.2.4 it comes that the labour force of the age-groups 12-24 will be 5 517 thousand persons (3 958 thousand males and 1 559 females) in the projected year 1975. This size of labour force will consist of the 34.06 per cent (48.02 per cent of males and 19.60 per cent of females) of the total population in the same projected year (1975). The labour force by age-groups and sex will experience the following changes in the forecasting period 1971-1975:
a) The labour force of the age-group 12-14 will follow a downwards trend in accordance with the assumption adopted as regards the school population development in the year 1975. b) The labour force of the age-group 15-19 will be increased by 22.24 per cent (18.58 per cent for males and 31.21 per cent for females). Of course this increase of labour force can be considered small in relation to the population development and it can be attributed to the increase of the school population which is expected to take place in the year 1975.
c) The labour force of the age-group 20-24 will be increased from 2 042 thousand persons to 2 882 thousand persons (41.15 per cent). The expected changes of this age-group (20-24 years) of school population in the year 1975, according to the assumption, will not be significant and consequently, the increase of labour force will be mainly determined by the population development in this projected year (1975). Finally, the labour force participation rates by age and sex of the age-groups 12-24 in the census year 1970 (table 5 of Appendix I) have been modified in the projected year 1975. This is obvious, because both the labour force and population experienced quantitative and structural changes in the projected period 1971-1975.

7.3.4 Labour force statistics of Chile and Mexico in the projected year 1975. Comparisons

In the previous section, 3.3, we made by the application of the numerical model, the labour force estimations of Chile and Mexico in the projected year 1975. Furthermore, we computed the labour force participation rates of these countries in the same projected year (1975). On the other hand, the International Labour Office (ILO), the Latin American Demographic Centre (CELADE) and the National Planning Office (ODEPLAN) have also made estimations of the labour force of Chile and Mexico -ODEPLAN only for Chile- and their labour force participation rates in the year 1975. In this section, apart from the presentation of the estimations of the labour force of the age-groups 12-24 made by ILO, CELADE and ODEPLAN in the projected year 1975, an effort will be made to compare the numerical results obtained by the model as regards the development of the labour force in the year 1975, with the labour force estimations made by the aforementioned centres.149/

The labour force estimations in the year 1975 made by the numerical model are based on the enumeration of the labour force in the census year 1970 which was made by the National Statistical Institutes of Chile and Mexico (Instituto

149/ The enumeration of the labour force in the census year 1970 of Chile and Mexico made by ILO, CELADE and the National Statistical Institutes of the countries (INE and DGE) are included in tables 6 and 7 of Appendix I, whereas the labour force estimations in the year 1975 made by ILO, CELADE and numerical model are included in tables 8 and 9 of Appendix I.

Nacional de Estadística (INE) and Dirección General de Estadística (DGE) respectively). On the other hand, the computation of the labour force participation rates was based on the population forecasts made by CELADE in the year 1975 and this is because the National Statistical Institutes have not made population forecasts in the year 1975. Furthermore, the National Statistical Institutes have not estimated the size of labour force in the year 1975. Therefore, possibilities of making comparisons with the labour force estimations made by the numerical model and the computed labour force participation rates, from this point of view of National Statistical Institutes, do not exist. As regards the labour force estimations made by ILO and CELADE, they cannot be also compared with the estimations of the labour force derived by the use of the numerical model. This is because the estimations of the labour force in the year 1975 made by ILO and CELADE, are not based on the same enumeration of the labour force in the census year 1970 which was made by the National Statistical Institutes of Chile and Mexico, and it consists of the basis for the labour force estimations made by the model. Furthermore, the enumeration of the labour force in the census year 1970 also differs between the two centres, ILO and CELADE. As a conclusion we can say that comparisons with the results obtained by the numerical model and by ILO and CELADE as regards the labour force estimations in the year 1975, cannot be made. The same can be said for the labour force participation rates in the year 1975 computed by ILO and CELADE.150/ So we see that the possibilities of making comparisons with the numerical results of the model are limited.

The case of ODEPLAN estimations is offered for making comparisons with the estimations made by the model. This is because, on the one hand, ODEPLAN uses approximately the same enumeration of the labour force in the census year 1970 as INE and, on the other hand, the variable school population is taken into account for labour force estimations of the age-groups 12-24 made by ODEPLAN. Moreover, the numerical results both of ODEPLAN and the numerical model, can be almost considered to be very close. The labour force estimations by age-group and sex of Chile and its labour force participation rates made by ODEPLAN and the numerical model, in the year 1975, are included in table 7.3.4.1 for comparative purposes.

Thus, from table 7.3.4.1 it comes that the deviations, as regards the estimations of the labour force of Chile in the year 1975, made by the model and by projections of ODEPLAN cannot be considered significant. The same can be said for the labour force participation rates computed by the model and ODEPLAN. Finally, in the case of Chile, there is another possibility of making comparisons with the results of the numerical model. This possibility refers to the labour force participation rates computed by CELADE. As we said previously, the population forecasts in the year 1975 made by CELADE, were also used for the computation of participation rates made by the model and consequently, from this point of view, even though we must be very cautious as to the conclusions derived, it is indicated to compare the labour force participation rates in the year 1975 computed by the numerical model and CELADE. In the following table 7.3.4.2. we present the labour force participation rates computed by the numerical model and CELADE.

150/ The population forecasts in the year 1975 for Chile and Mexico made by ILO and CELADE also differ (tables 6 and 7 of Appendix I).

Table 7.3.4.1

LABOUR FORCE ESTIMATIONS BY AGE-GROUP AND SEX FOR CHILE
IN THE YEAR 1975

Age-groups by sex		Labour Force				Participation rates	
		Numerical model	ODEPLAN	Deviations		Numerical model	ODEPLAN
				Absolute	Percent		
12-14	Male	14 347	14 877	- 530	- 3.69	3.88	3.80
	Female	9 161	6 067	3 094	33.77	2.50	1.60
	Total	23 508	20 944	2 564	10.91	3.19	2.72
15-19	Male	235 236	232 376	2 860	1.22	42.00	40.60
	Female	100 141	89 392	10 749	10.73	18.00	15.80
	Total	335 377	321 768	13 609	4.06	30.04	28.27
20-24	Male	378 597	407 047	-28 450	- 7.51	83.50	82.90
	Female	169 218	157 989	11 229	6.64	37.50	32.00
	Total	547 815	565 036	-17 221	- 3.14	60.56	57.38
12-24	Male	628 180	654 300	-26 120	- 4.16	45.41	44.97
	Female	278 520	253 448	25 072	9.00	20.27	17.62
	Total	906 700	907 748	- 1 048	- 0.12	32.88	31.37

Source: ODEPLAN-UNFPA, Programa de Estudio para la Planificación Nacional y Regional de Chile, Proyección de la Población Económicamente Activa, según Sexo y Edad para las Regiones de Chile 1970-1985. Documento N° 2, Santiago, noviembre 1973 (Trabajo realizado por el experto demógrafo Juan Chakiel).

Table 7.3.4.2

LABOUR FORCE PARTICIPATION RATES BY AGE-GROUP AND SEX FOR CHILE IN THE YEAR 1975

Age-groups	Participation rates					
	Numerical model			CELADE		
	Male	Female	Total	Male	Female	Total
12-14	3.88	2.50	3.19	5.40	2.43	3.93a/
15-19	42.00	18.00	30.04	57.55	27.58	42.56
20-24	83.50	37.50	60.56	90.56	38.75	64.68
12-24	45.41	20.27	32.88	55.90	25.28	40.65

Source: Corporación de Fomento de la Producción, Perspectivas de Crecimiento de la Población Chilena 1970-1985. Publicación N° 10-A-70, Santiago de Chile, 1970.

a/ 10-14 years.

From table 7.3.4.2 it comes that, although the size of population by age-group and sex in the year 1975 is the same approximately, for the computation of participation rates for Chile by the numerical model and CELADE, however, the deviations of their participation rates can be considered significant and consequently we cannot be led to conclusions.151/

In the case of Mexico, the possibilities of making comparisons with the results obtained by the application of the numerical model are very limited. This is because the only available statistical data as regards the development of labour force in the projected year 1975 are the labour force projections made by CELADE,152/ which are included in table 9 of Appendix I. Unfortunately, deviations of the labour force estimations between the numerical model and CELADE can be considered significant and consequently, their presentation will not add anything. The reasons for these deviations of the labour force estimation in the year 1975, can be attributed on the one hand, to the different basis of the enumeration of the labour force in the census year 1970, as we said previously, and on the other hand, to the different method from the point of view of variables which should be taken into account for the estimation of the labour force of the age-groups 12-24.

151/ The size of the labour force estimated by the numerical model and CELADE in the year 1975, differs too much (table 8 of Appendix I).

152/ Alvarado, Ricardo, México: Proyección de la Población Total, 1960-2000 y de la Población Económicamente Activa, 1960-1985. CELADE, Series C, N° 114, Santiago de Chile, 1969.

7.4 Empirical estimates of the consumption function in the cases of Chile and Mexico

In the basic hypothesis of the model regarding the consumption function, Chapter 3, section 8, we determined the factors, economic and demographic, which can enter in the function, as explanatory variables. However, the entering in our consumption function of all the determinative factors for its statistical estimation is not possible. This is because, for some factors, there were not statistical data available in the period under consideration (1960-1970) while for other factors, the statistical results of the estimated consumption equation were not considered satisfactory. The second case mainly happened in the equations in which population variables were used. In our effort to improve the statistical results of these equations by using per capita variables instead of explicit population variables, we met many difficulties as regards the use of population data on Chile and Mexico. The inadequate accuracy of the population data of these countries raised the problem of exact measurement of income per inhabitant.153/ For the same reason we also gave up our effort to use the rural-urban composition of the population. On the other hand, the entering of the variables agricultural and urban income, as the variable income distribution, and variables which would cover in some manner the absence of population variables, rural and urban population from the function under study, did not give satisfactory results from the economic point of view. Finally, for the factor past standards of living, the consumption lagged one year will be used. Thus, on the basis of statistical data available, the variables gross national product, GNP, or gross domestic product, GDP, and consumption lagged one year, C_{t-1}, will be introduced in the consumption function for its statistical estimation for Chile and Mexico and for the 1960-1970 period.

In table 7.4.2 we present the tested regression equations in their linear form. From this table it is observed that i) The coefficient of determination, $\bar{R}^2$, adjusted for the degrees of freedom is more than 95 per cent in all equations. This means that the fitting regressions have explained a very high percentage of the total variance in the dependent variables. The application of the "F" distribution as a criterion for testing the statistical significance of this coefficient at a level of 5 per cent or less showed that the applied regression equations from such point of view, can be considered statistically significant. ii) The values of standard errors of estimates on the basis of the criterion of t-student at a level of 5 per cent or less show the reliability of these parameters estimates. iii) The results of the Von Newmann's criterion for testing autocorrelation can be also considered satisfactory. iv) The amount of coefficient b in the equations numbered by 1 and 2b shows clearly the importance of the variable, national income, in relation to the variable, the past standards of living in these equations. Based on the analysis of the aforementioned statistical results we are led to the conclusion that the equations included in table 7.4.2 are the best fitting regressions and they can be used for forecasting.

153/ The difficulties for using the population data on Chile and Mexico inside and outside the sample period, will be mentioned in the next two Chapters, 8 and 9, in more details.

Furthermore, the analysis of the estimates of the applied consumption equations will also be made on the basis of the existing economic theory. Thus, consumption theory requires that the following conditions as regards the marginal propensity to consume, dC/dY, and the income elasticity, $dC/dY \cdot Y/C$, should be fulfilled by a consumption equation.154/

i) $0 < dC/dY < 1$

i.e. the marginal propensity to consume is positive and less than unity.

ii) $0 < dC/dY \cdot Y/C < 1$

i.e. the income elasticity is also positive and less than unity.155/

The numerical results on both the marginal propensity to consume and the income elasticity as they derived from the estimates of the applied equations, are included in table 7.4.1. From these results we ascertain that the aforementioned conditions for the applied regression equations are fulfilled and consequently, these equations are in agreement with the consumption theory.

154/ Keynes, J., The General Theory of Employment, Interest and Money. Harcourt, Brace and Co., New York, 1935. p.96.

155/ From the inequality $0 < dC/dY \cdot Y/C < 1$

it comes $dC/dY \Big/ C/Y < 1$

and $dC/dY < C/Y$

i.e. the marginal propensity is less than the average propensity to consume (Drakatos, C., Econometrics: Applications. Kloukinas, S., Publishing Co., Athens, Greece, 1973. p. 159).

Table 7.4.1

MARGINAL PROPENSITY TO CONSUME AND INCOME ELASTICITY
OF THE CONSUMPTION EQUATIONS TESTED

Number of equation	Country	Marginal propensity to consume	Income elasticities			
			1960	1964	1968	1970
1	Chile	0.60	0.83	0.83	0.80	0.82
2[a]	Mexico	0.74	0.99	0.99	0.99	0.99
2[b]	Mexico	0.54	0.69	0.72	0.69	0.70

The variables of the consumption function as they have been mentioned previously with their symbols are given hereunder:

C : Consumption expenditure, at constant prices (in million Escudos or Pesos)

GNP : Gross National Product, at constant prices (in million Escudos)

GDP : Gross Domestic Product, at constant prices (in million Pesos)

C_{t-1} : Consumption expenditure lagged one year, t-1, at constant prices (in million Escudos or Pesos).

Table 7.4.2

STATISTICAL ESTIMATES OF THE CONSUMPTION EQUATION IN THE CASES OF CHILE AND MEXICO

$^n/_n$	Country	Statistical estimates	$\bar{R}^2$	d^2/s^2
1	Chile	$C_t = -802.42 + 0.609704\ GNP + 0.249487\ C_{t-1}$	0.992	1.61
		(0.099786) (0.130878)		
2[a]	Mexico	$C_t = -841.96 + 0.746945\ GDP$	0.996	1.65
		(0.012897)		
2[b]	Mexico	$C_t = -4931.16 + 0.548494\ GDP + 0.350856\ C_{t-1}$	0.998	2.36
		(0.137783) (0.190981)		

Note: For the statistical estimates of the equation (1) we used 14 observations, i.e., the eleven observations of the sampling period 1960-1970 and the observations for the years 1959, 1971 and 1972.

8. FORECASTS

8.1 In general

Forecasting, as Professor Herman Wold says, is "a more or less successful prediction of the future on the basis of the observed regularities in the past, i.e. the inference from the past in the future".156/ Scientists have begun to make serious efforts to look ahead in time recently, in the socio-economic area. Thus, during the last three decades, a great number of forecasting techniques have been developed in this scientific area.157/ In socio-economic sciences, a forecast does not deal with isolated events; it is rather an estimate of some quantities at one or several future points in time, as for instance, population or economic magnitudes.

In this chapter we will try to apply the model in its forecasting form which is presented in section 4 of this chapter for making forecasts as regards the development of some economic and demographic variables beyond the period of observations. The accuracy of the forecasting of the economic and the demographic variables, which are considered as endogenous variables in the model, depends upon many factors. The most important are the statistical significance of the model, the specification of the model which means in the broad sense how successfully it explained the past, the realization of the assumptions adopted as regards the expected development of the exogenous variables of the model and the "elongation" of the period of forecasting.

Certainly, the forecasting of demographic and economic magnitudes by a model is not an easy task. This is because such models have many limitations. These limitations, as we explained during the construction of the model, refer to the formulation of the model due to technical difficulties, lack of statistical data required, specification of the model, etc. In addition to the aforementioned difficulties, unforeseen international and local political events and situations influence the population and economic development of a country and consequently, they eliminate the forecasting ability of a model.158/

8.2 The importance of the ability of a model to explain the past and the future

It is known that a model presents a theory. The applied model presents a theory of economic-demographic behaviour in the aggregate for Chile and Mexico and for the period 1960-1970. The testing of this theory consists of the ability of the model. This ability of the model to explain the theory which it includes should refer both to the past and the future. Consequently, we can say that

156/ Wold, H., Time as the Realm of Forecasting. University of Uppsala, Sweden, 1966. pp. 2-4.

157/ Wold, H., Econometric Model Building (Forecasting by the Chain Principle). North-Holland Publishing Company, Amsterdam, 1964. p. 5

158/ By the term "forecasting ability" of a model we mean the ability of the model, without undergoing structural changes in a post sample period and under the condition of *ceteris paribus* to forecast.

the testing of the theory, which is presented by the model, inside and outside of the sample period is the ability of the model to predict and to forecast.159/ In other words this can be said as follows: the performance of the model should cover both the sampling period and the coming years. From this point of view, we see the importance and the usefulness of the ability of a model to explain the past and the future. Of course, the predictive ability of a model consists of the basic prerequisite of the model in order to be applied in a forecasting period. For this reason, the testing of the ability of the model in the sample period, i.e. whether it explained satisfactorily the past, must precede the application of the model for sets of observations outside the sample. Furthermore, socio-economic planning has the need for statistical data of some demographic and economic magnitudes in a future period. The expected development of the demographic and economic variables can be determined by the model in which such variables are included. As a conclusion, from the aforementioned examination of the ability of a model, we can say that it is of great importance both for the testing of the theory which presents and for the purposes of economic planning.160/ The approach to testing the predictive and forecasting ability of the model is included in the relevant sections of the present chapter.

8.3 Bias in estimates of the values of endogenous variables of the model

As we said in the previous section 2, the forecasting ability of a model presupposes its success to explain the past. In this section, we will test the ability of the model applied to explain the theory which it presents within the sample period 1960-1970.

Already, we fitted the model to the empirical data and we also analysed the statistical results obtained. Although, the qualitative and quantitative significance of the model, i.e. the indicated sign of parameters, the reliability of the parameters estimates, the satisfactory testing of auto-correlation and identification etc. point out that the relationships of economic and non-economic variables which consist of the equations of the model, can be considered the appropriate ones, however, we cannot say that the model explained successfully the past. In order to say this, it is necessary to test the predictive ability of the model which, as we said in section 2, refers to inside of sample period. More specifically, we will test whether the model has any apparent tendency to over or under-estimate the values of endogenous variables of the model in the sample period 1960-1970.

The approach to testing for a significant bias in estimate of endogenous variables of the model in the sampling period 1960-1970 is the consideration of the linear relationship between the actual and predicted values of these variables of the model.161/

159/ The terms "predictions" and "forecasts" refer to the inside and outside of the sample periods respectively.

160/ Wilson, A., Regional Forecastings (On Some Problems in Regional Modelling). Butterworth Publishing Co., London, 1971. pp. 179-181.

161/ Ball, R.J., "The Prediction of Wage-rate Changes in the United Kingdom Economy. 1957-1960". The Economic Journal, Vol. LXXII, N° 285. March 1962. pp. 31-32.

This relationship can be written as follows:

$$A_t = a + b\,P_t + e_t \qquad (1)$$

where

A_t : Actual values of endogenous variables, at time t

P_t : Predicted values of endogenous variables, at time t

a : Constant

b : Regression coefficient of predicted values of endogenous variables

e_t : Residual of the relationship, at time t.

If a = 0, b = 1 and e_t = 0 for all t, then all the predictions will be perfect. Therefore, we must test the aforementioned composite hypothesis for all the equations of the model and for both the applied methods of estimation (OLS and TSLS) of their parameters. The results of the estimated relationship of the actual on the predicted values on the basis of the statistical estimates derived by OLS and TSLS methods for each equation of the model and for both countries Chile and Mexico are given in tables 8.3.1 and 8.3.2. In the first column, the endogenous variables of the model are mentioned, the second and the third columns give the statistical estimates for a and b with their standard errors in parenthesis; the fourth, the coefficient of determination, $\bar{R}^2$, adjusted for degrees of freedom and the fifth, the ratio of the mean squared successive difference to the variance residuals -the Von Newmann's ratio.

Table 8.3.1

STATISTICAL ESTIMATES OF THE RELATIONSHIP (1) IN THE CASE OF CHILE

Variables	OLS				TSLS			
	$\hat{a}$	$\hat{b}$	$\bar{R}^2$	d^2/s^2	$\hat{a}$	$\hat{b}$	$\bar{R}^2$	d^2/s^2
Y_t	249.103	0.988 (0.033)	0.989	1.37	0.203	0.999 (0.033)	0.989	1.05
L^e	-0.005	1.000 (0.018)	0.996	2.71	-0.010	1.000 (0.020)	0.996	1.54
L^a	-0.012	1.000 (0.014)	0.998	2.70	-0.012	1.000 (0.014)	0.998	2.70

Table 8.3.2

STATISTICAL ESTIMATES OF THE RELATIONSHIP (1) IN THE CASE OF MEXICO

Variables	OLS				TSLS			
	$\hat{a}$	$\hat{b}$	$\bar{R}^2$	d^2/S^2	$\hat{a}$	$\hat{b}$	$\bar{R}^2$	d^2/S^2
Y_t	-0.144	1.000 (0.022)	0.994	1.14	0.270	0.999 (0.021)	0.994	1.13
L^e	-0.2539	1.000 (0.001)	0.999	2.60	-0.082	1.000 (0.001)	0.999	2.40
L^a	0.075	0.999 (0.010)	0.999	2.42	0.075	0.999 (0.010)	0.999	2.42

From the statistical results of the regression equations included in tables 8.3.1 and 8.3.2 it seems easy to conclude that these equations can be considered statistically significant. Furthermore, we test the aforementioned composite hypothesis a=0 and b=1 for each regression equation by the application of the following test:

$$\frac{Q_1}{Q_2} = \frac{1/_{S^2}\ n(\hat{a}-a)^2 + 2n\bar{P}(\hat{a}-a)\ (\hat{b}-b) + P_t^2\ (\hat{b}-b)^2}{n\ \hat{S}^2 /\ S^2} \qquad (2)$$

This test, which was also used by R.J. Ball in his research mentioned previously, is based on the assumptions of normality in the errors and the independence of the variables of the regression used. It is also assumed that the ratio $\frac{Q_1}{Q_2} \cdot \frac{n-2}{n}$ is distributed as "F" distribution with 2 and n-2 degrees of freedom. Thus, we computed the values of the F test on the basis of the statistical estimates of the relationship (1) derived by OLS and TSLS methods and we compared them with the critical values of the F test at the level of significance of 5 per cent. For this level of significance an equation of the model gives unbiased predictions if the computed value of F for that equation is smaller than the theoretical value of the F test, i.e. the perfect predictions of an equation of the model require the acceptance of the null hypothesis of the F test. For all the regressions of the actual on the predicted values the computed values of the F test were found smaller than the critical value of F 4.26 with degrees of freedom 2 and 9.

Therefore, we accept the null hypothesis of the F test, i.e. we accept the composite hypothesis for a = 0 and b = 1 of the regression equations of the actual on the predicted values of the endogenous variables of the model. The acceptance of this hypothesis as we said previously, means that these regression equations show lack of bias at the level of significance of 5 per cent. Furthermore, the acceptance of this hypothesis is in agreement with the estimated values of these parameters.162/ Indeed, as it seems from tables 8.3.1 and 8.3.2, the values of a and b approach to be equal to zero and to unity with an exception of the first equation. In the case of the first equation, we also observe that the value of the Von Newmann's ratio, d^2/s^2, gives the evidence of the presence of the first serial correlation, a fact that casts doubts on the validity of the F test as far as this equation is concerned whereas the assumption of non-autocorrelation in the errors is satisfactorily met for the next two equations. From the above examination of the equations of the model we can say that the model as a whole explained successfully the theory it presents in the past.

The predictive ability of the model which, in other words, reflects the specification of the model in the sample period 1960-1970, allows us to apply the model for purposes of forecasting. The forecasting ability of the model will be tested in section 5.2 of the present chapter. The predictive ability of the model can be also observed diagrammatically. Thus, in a scatter diagram, we plot the predicted percentage changes of each endogenous variable of the model against the actual ones. If the points of predicted and actual changes of an equation are dispersed around the line of perfect predictions, which is the line of 45°, then the predictions of that equation are perfect. Points above or below the line of perfect predictions indicate over or under-estimation of the changes, that is, biased predictions. Consequently, from such a scatter diagram we can see quickly the aforementioned ascertainment regarding the predictive ability of the model. In diagram 8.3.1, as an example, we present the second and the third equation of the model respectively and on the basis of the TSLS estimates in the case of Chile. From this diagram we observe clearly that the computed slope of the regression line of the second and the third regression equation (A = bP), b, is unity, i.e. it coincides with the line of perfect predictions and the points of the predicted and actual changes (percentages) are very close to this line, a fact that means that the second and the third equations of the model show lack of bias, a conclusion to which we were led by the testing of composite hypothesis. Finally, the construction of the relevant scatter diagram in the case of Mexico will show, of course, the fact that the equations of the model in this case are also unbiased, i.e. the same conclusion which was derived by the testing of composite hypothesis.

8.4 Mathematical form of the model for forecasting

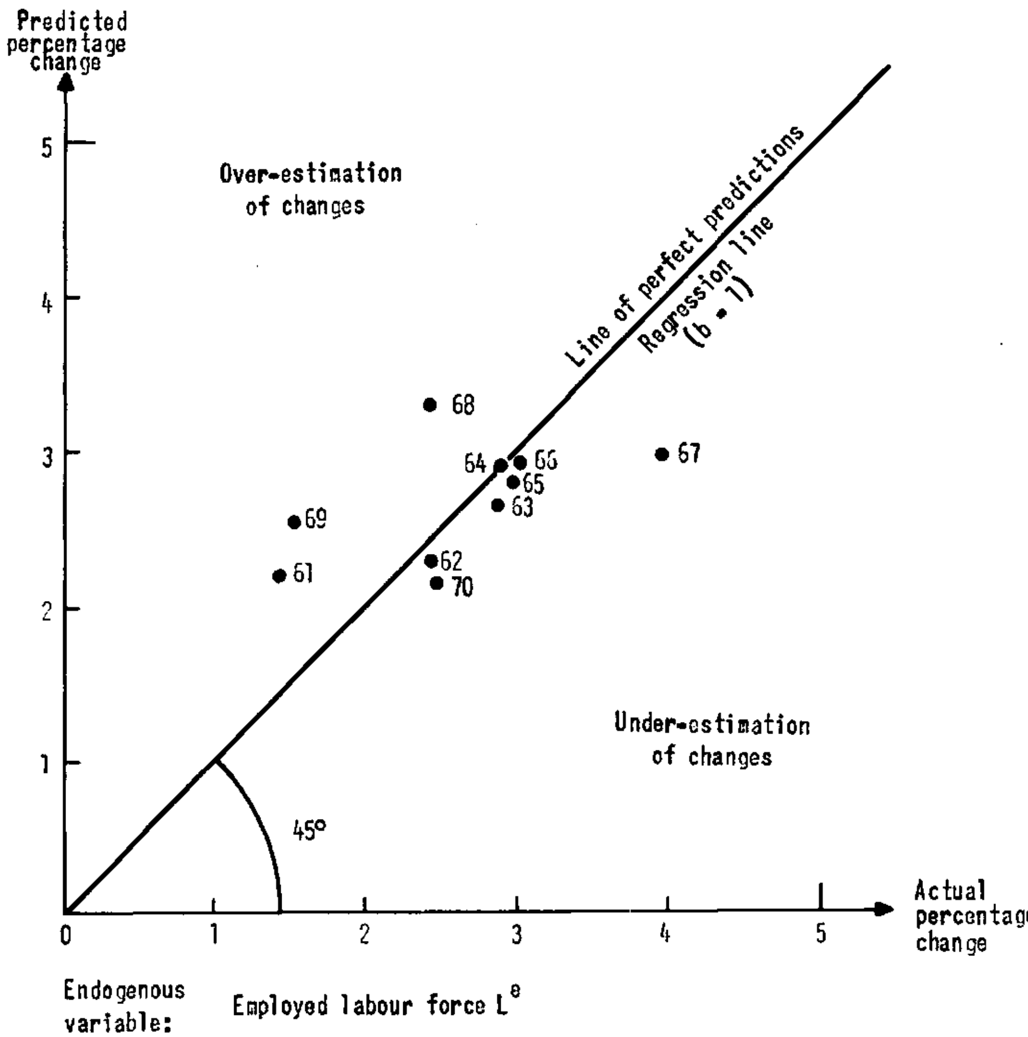
In Chapter 4, we described the structure form of the model and we derived its reduced form which, as we said in that chapter, is indicated for forecasting purposes. Furthermore, we estimated the structural coefficients of the model on the basis of the empirical observations. In general, a system of estimated structural equations can be written as follows:

$$Y_{it} = \hat{B} Y_{it} + \hat{C} Z_{it} \qquad \text{Structural form} \qquad (1)$$

162/ It is known that the economic relationships are not deterministic relationships but they are stochastic ones and consequently we should not expect perfect predictions, that is, a = 0 and b = 1 exactly.

Diagram 8.3.1

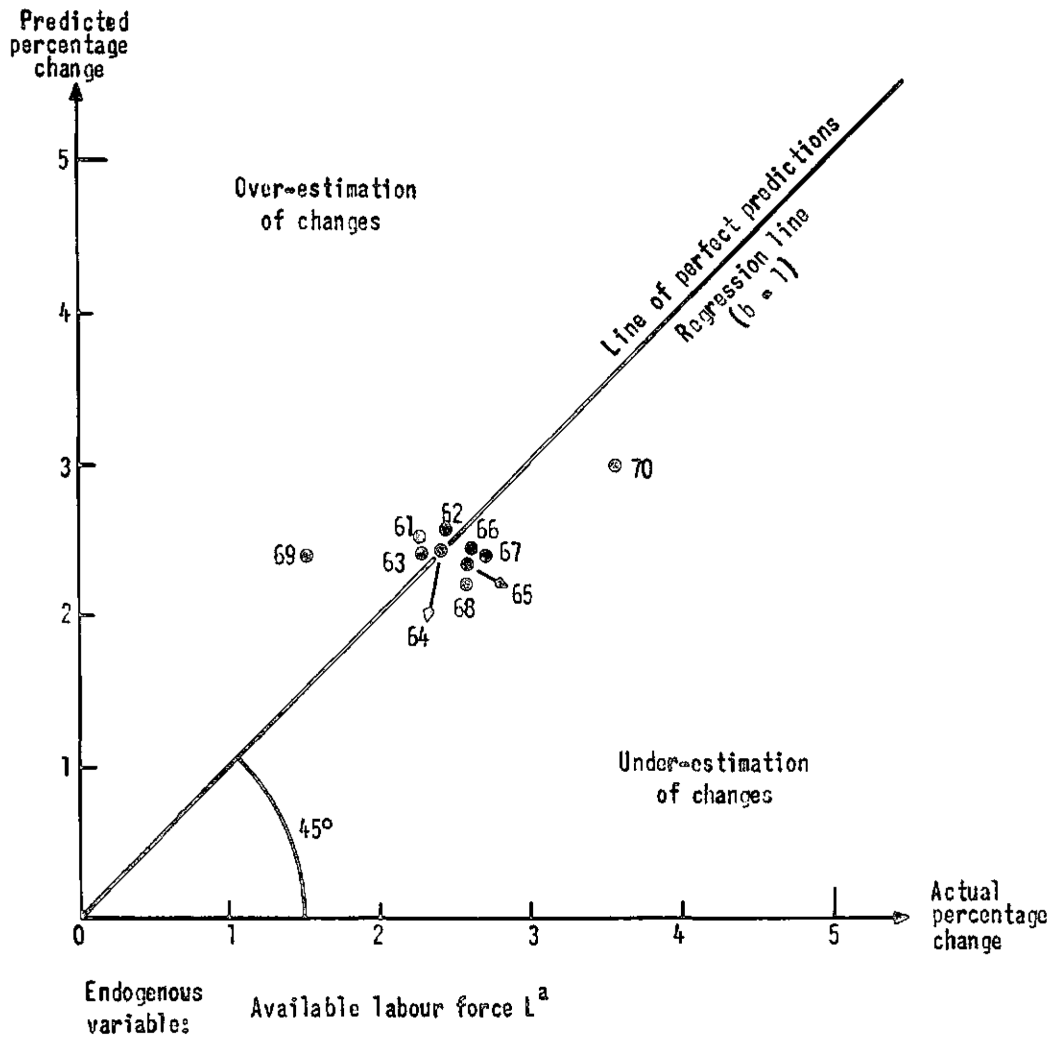
THE PERCENTAGE CHANGES OF PREDICTED AND ACTUAL VALUES OF THE SECOND AND THIRD EQUATION OF THE MODEL IN THE CASE OF CHILE



(continued)

Diagram 8.3.1 (concluded)

THE PERCENTAGE CHANGES OF PREDICTED AND ACTUAL VALUES OF THE SECOND AND THIRD EQUATION OF THE MODEL IN THE CASE OF CHILE



We solve this system of estimated equations with respect to Y_{it}. To do this we follow the mathematical procedure mentioned in Chapter 4.

So we have:

$$Y_{it} = (I - \hat{B})^{-1} \hat{C} Z_{it} \qquad \text{Reduced form} \qquad (2)$$

and

$$Y_{it} = \hat{W} Z_{it} \qquad (3)$$

in which

$$\hat{W} = (I - \hat{B})^{-1} \hat{C}$$

where

$$Y_{it} = \begin{bmatrix} Y_{1t} \\ Y_{2t} \\ \vdots \\ Y_{nt} \end{bmatrix} \text{ endogenous variables} \qquad Z_{it} = \begin{bmatrix} Z_{1t} \\ Z_{2t} \\ \vdots \\ Z_{nt} \end{bmatrix} \text{ predetermined variable}$$

and $\hat{B}$, $\hat{C}$ matrices of estimated coefficients.

The unknown in the above equation (3) is the vector Y_{it} of endogenous variables. By this equation we can make forecasts as to the endogenous variables, Y_{it}, in a projected period of time, if the values of the predetermined variables, Z_{it}, are given in that projected period.

Furthermore, the mathematical computation of the expression $\hat{W} = (I - \hat{B})^{-1} \hat{C}$ of the equation (3) which is necessary for the estimation of this equation is the following: We compute the inverse matrix $(I-\hat{B})^{-1}$ and then we multiply it by the matrix $\hat{C}$. As it is known, the computations of the inverse matrix $(I-\hat{B})^{-1}$ take place as follows. First, we find the determinant of $(I-\hat{B})$, $\left|I-\hat{B}\right|$, and then we calculate the adjoint matrix of $(I-\hat{B})$, adj. $(I-\hat{B})$, which is the matrix of co-factors of the transpose of $(I-\hat{B})$. Finally, we divide the adjoint matrix $(I-\hat{B})$ by the determinant $\left|I-\hat{B}\right|$

That is,

$$\frac{1}{\left|I-\hat{B}\right|} \text{ adj. } (I-\hat{B})$$

So we have

$$\hat{W} = \frac{1}{\left|I-\hat{B}\right|} \text{ adj. } (I-\hat{B}) \hat{C}$$

and

$$Y_{it} = \frac{1}{\left|I-\hat{B}\right|} \text{adj. } (I-\hat{B})\ \hat{C}\ Z_{it} \qquad (4)$$

The estimates of the coefficients of the model, $\hat{B}$ and $\hat{C}$, are different. This is because they have been made by different statistical methods (OLS and TSLS). Consequently, the values of the endogenous variables, Y_{it}, to be obtained by the aforementioned forecasting technique in a proyected period of time will be different, even though the forecasting procedure will be the same.

Specifically, for the economic-demographic model used we can present the forecasting form as follows: The sampling period for estimation of the structural coefficients of the model and for Chile and Mexico is 1960-1970 whereas the projected period is 1971-1975. In accordance with what we said previously, the equation (3) for the year 1971 can be written as follows:

$$Y_{i\ 1971} = \hat{W}\ Z_{i\ 1971} \qquad (5)$$

$$Y_{i\ 1971} = \frac{1}{\left|I-\hat{B}\right|} \text{adj. } (I-\hat{B})\ \hat{C}\ Z_{i\ 1971} \qquad (6)$$

where

$$Y_{i\ 1971} = \begin{bmatrix} Y_{1\ 1971} \\ Y_{2\ 1971} \\ Y_{3\ 1971} \\ Y_{4\ 1971} \end{bmatrix} \text{ endogenous variables} \qquad Z_{i\ 1971} = \begin{bmatrix} Z_{1\ 1971} \\ Z_{2\ 1971} \\ Z_{3\ 1971} \end{bmatrix} \text{ predetermined variables}$$

and $\hat{B}$, $\hat{C}$ matrices of the reduced form coefficients which have been estimated on the basis of the observations of the sampling period 1960-1970.

8.5 Post sample period 1971-1975

8.5.1 Exogenous variables: Expected development

From the mathematical form of the forecasting model it comes that the working of this model for making forecasts in a year of the post sample period 1971-1975, requires the entering of the values of its exogenous variables of the same projected year. Hence, for making forecasts by the model we must know the expected development of the exogenous variables of the model in these coming years (1971-1975). Here, we will deal with the estimation of the values of the exogenous variables of the model in the forecasting period 1971-1975. These estimations will be based on some assumptions. The trend which the exogenous variables of the model experienced in the sample period 1960-1970 and the expected demographic and economic development of Chile and Mexico, will be taken into account for the formulation of these assumptions. It is necessary to repeat here what we said elsewhere in this work that the demographic development is expected to follow a slight downwards trend in the decade 1970-1980 whereas the economic perspectives, in accordance with the economic plans of Chile and Mexico and the estimations made by the Economic Commission for Latin America/United Nations, are expected to be favourable in the same projection period (1970-1980). Thus, i) for the population variable, P_t : As we said during the application of the numerical model in Chapter 7, population projections for the period 1971-1975 have not been made by the Statistical Institutes of Chile and Mexico (INE and DGE) whose data were used for the statistical estimation of the model inside the sample period (1960-1970). On the other hand, the population projections made by CELADE cannot be used for reasons which we explained in the aforementioned Chapter 7. Therefore, in the model we use the extrapolations of the population of Chile and Mexico which we made on the assumption that the population of these countries will develop at a rate of growth of 1.78 per cent and 3.25 per cent respectively in the post sample period (1971-1975). These rates of growth are derived by the population projections made by CELADE and, of course, they are smaller than the rates observed in the sample period 1960-1970. ii) for the gross capital formation, K_t : The actual values of this variable in the semi-post sample period 1971-1973 are given and, of course, these values will be used in the model for making forecasts. As regards the values of this variable in the years 1974 and 1975, they have been estimated on the basis of a slight increase of the trend which it experienced in the period 1960-1973. Thus, the rates of growth of 4.30 per cent and 9.20 per cent for Chile and Mexico respectively were taken into consideration for the estimation of the gross capital formation in the projected semi-period 1974-1975. Finally, for the employed labour force lagged one year, L^e_{t-1}, the forecasts of this variable made by the model, will be the estimations of this variable which will enter to the forecasting model.

The expected developments of the exogenous variables of the model in the post sample period 1971-1975 on the basis of the aforementioned assumptions for Chile and Mexico are included in tables 8.5.1.1 and 8.5.1.2 respectively.

8.5.2 Endogenous variables: Forecasts

The forecast values of the endogenous variables of the model as they have been calculated by the forecasting model for the post sample period 1971-1975, and for Chile and Mexico are given in tables 8.5.2.1 and 8.5.2.2, respectively. These forecast values must be judged on the basis of a criterion which will inform us on the ability of the model to explain the theory which it presents in the future. The criterion for accepting a model from this point of view, is the accuracy with which it produces the forecast values of the endogenous variables, economic and demographic variables, which are contained in the model. For the ascertainment of the degree of accuracy of the ex-post values produced by the applied model we will compare the forecast values with the actual ones of the endogenous variables of the model. For this reason, we compute the deviations between the forecast values and actual ones of those endogenous variables, whose statistical data as regards their actual values are in the forecasting period 1971-1975 and furthermore we will construct a scatter diagram for the presentation of forecast and actual changes. Thus, we will see the performance of the model outside the sample period more quickly.

Table 8.5.1.1

THE VALUES OF THE EXOGENOUS VARIABLES IN THE POST SAMPLE PERIOD 1971-1975 IN THE CASE OF CHILE

Post sample period 1971-1975	Variables		
	K_t	L^e_{t-1}	P_t
1971	3 851a/	2 994	9 011
1972	3 912a/	3 070	9 171
1973	3 352b/	3 145	9 334
1974	3 496	3 186	9 500
1975	3 646	3 233	9 669

a/ Actual values: ODEPLAN, Cuentas Nacionales de Chile 1965-1972. Santiago de Chile, 1974.
b/ Provisional data: ECLA/U.N., Estudio Económico de América Latina 1973. Santiago de Chile, 1974.

Table 8.5.1.2

THE VALUES OF THE EXOGENOUS VARIABLES IN THE POST SAMPLE PERIOD 1971-1975 IN THE CASE OF MEXICO

Post sample period 1971-1975	Variables		
	K_t	L^e_{t-1}	P_t
1971	57 300a/	12 424	49 792
1972	63 600a/	12 568	51 411
1973	70 700b/	12 714	53 081
1974	77 204	12 861	54 807
1975	84 307	13 009	56 588

a/ Actual values: ECLA/U.N., Estudio Económico de América Latina 1973. Santiago de Chile, 1974.
b/ Provisional data: ECLA/U.N., op. cit.

Table 8.5.2.3

THE DEVIATIONS OF FORECAST VALUES AND ACTUAL ONES OF THE ENDOGENOUS VARIABLES OF THE MODEL IN THE CASE OF CHILE

	Variables									
	Y					L^a				
Years	Actual values	Deviations: Actual and forecast values				Actual values	Deviations: Actual and forecast values			
		Absolute		Per cent			Absolute		Per cent	
		OLS	TSLS	OLS	TSLS		OLS	TSLS	OLS	TSLS
1971	23 364	897	904	3.84	3.87					
1972	23 689	495	509	2.09	2.15					
1973	22 718	-370	-324	-1.63	-1.43	3 162a/	-227	-227	-7.18	-7.18
1975						3 326b/	-217	-217	-6.52	-6.52

Source: i) ODEPLAN, Cuentas Nacionales de Chile, 1965/1972. Santiago de Chile, 1974.
ii) ECLA/U.N., Estudio Econômico de América Latina 1973. Santiago de Chile, 1974.
a/ Interpolations of the labour force estimates made by the numerical model and ODEPLAN.
b/ Labour force estimates, in the year 1975, on the basis of the numerical model for age-groups 12-24 and ODEPLAN for age-groups 25-60 and more than 60 years.

From the data of the above table it comes the following: i) for the variable national output, Y_t: The deviations of forecast values and actual ones in the years 1972 and 1973 are 2.1 per cent and 1.50 per cent respectively. These small deviations allow us to say that the forecast values of the main variable of the model, national output, Y_t, are with reasonable accuracy. Furthermore, we observe that the results of the OLS method are better than the TSLS method in the first two projected years (1971 and 1972) whereas in the year 1973, the TSLS method gives result of smaller deviation from the actual value. ii) for the variable, labour force, L_t^a: Statistical data of the actual values of this variable do not exist for the years of the post sample period 1971-1975. Therefore the labour force estimates made by the application of the numerical model and ODEPLAN will be compared with the forecast values. These estimations are given by five years. Thus, the deviation (forecast value and estimation) in the projected year 1975 is minus 6.52 per cent. Although this percentage deviation seems to be a little high, however, for population magnitudes, as for instance, the enumeration of the labour force, whose estimations among the Centres (CELADE, ILO, etc.) and the Statistical Institutes differ considerably, the deviation (6.52 per cent) is considered to be within reasonable limits. Finally for the employed labour force, L_t^e, there are neither actual values nor estimations in the projected years and consequently the results derived by the model as regards the development of this variable in the period 1971-1975 will be without comments.

In the case of Mexico and in the following table 8.5.2.4 only the variable, national output, Y_t, is presented. For the other two variables of the model, labour force, L_t^a, and employed labour force, L_t^e, the only available statistical data for the post sample period 1971-1975 are the forecast values.

Table 8.5.2.4

THE DEVIATIONS OF FORECAST VALUES AND ACTUAL ONES OF THE ENDOGENOUS VARIABLE, NATIONAL OUTPUT, Y, IN THE CASE OF MEXICO

		Variable			
		Y			
		Deviations: Actual and forecast values			
Years	Actual values	Absolute		Percent	
		OLS	TSLS	OLS	TSLS
1971	306 700	1 222	1 213	0.40	0.40
1972	329 800	2 118	2 126	0.64	0.64
1973	354 500	3 048	3 075	0.86	0.87

Source: ECLA/U.N., Estudio Económico de América Latina 1973. Santiago de Chile, 1974.

The deviations in percentages of the forecast values and actual ones of the variable, national output, Y_t, in the semi-post sample period 1971-1975 are smaller than one per cent and consequently, these results can be considered much satisfactory. Furthermore we see that the results of the statistical methods OLS and TSLS are the same in both years of the forecasting period, 1971-1975.

From the above examination of the forecast values, their comparisons with the actual values etc., we can say that the degree of accuracy with which the model produces the forecast values can be considered satisfactory. This fact allows us to conclude that the test of the theory which is presented by the model can be also made outside the sample period. On the other hand, such deviations are expected by a model as the present one. This is because the applied model is a statistical model which is based on probability calculations. In other words, our forecasts are probabilistic and not exact estimations. Furthermore, the coefficient estimates of the equations of the system come from samples of finite sizes which, as it is known, create errors (sampling errors). Finally, the values of exogenous variables in the forecasting period 1971-1975 are estimates and not the actual values, a fact which will surely cause deviations between forecast and actual values.

The aforementioned ascertainment as regards the forecasting ability of the model can be also seen by inspecting the diagram 8.5.2.1. In this diagram, the endogenous variables of the first and third equations of the model for Mexico and Chile are presented respectively.163/ The forecast values of both the variables, national output, Y, and available labour force, L^a, are close to the perfect forecasts. Finally, the forecast values of the unemployed labour force, L^u, as they derive from the identity of the model both for Chile and Mexico and for the 1973-1975 period are included in table 8.5.2.5. In the same table, the ratio (percentage) of unemployment to the labour force in parenthesis is also included. Unfortunately, we cannot make comparisons with the aforementioned values because actual data of these demographic variables are not also available for the projected period 1971-1975 as this also happens for the variable employed labour force, L^e, and consequently, we cannot see the forecasting ability of the model from this point of view.

Table 8.5.2.5

THE FORECAST VALUES OF UNEMPLOYMENT FOR CHILE AND MEXICO FOR THE 1973-1975 PERIOD

(in thousands)

Country	Unemployment		
	1973	1974	1975
Chile	207(6.11)	239(6.90)	267(7.54)
Mexico	667(4.39)	733(5.33)	805(5.77)

Note: Forecast values on the basis of the TSLS estimates.

163/ The national output in Chile experienced abrupt changes in the forecasting period 1971-1973 and of course, such changes cannot be foreseen by a model as the present one. For this reason, we do not present this variable, national output, Y, in the diagram 8.5.2.1.

Table 8.5.2.1

THE FORECAST VALUES OF THE ENDOGENOUS VARIABLES OF THE MODEL IN THE POST SAMPLE PERIOD 1971-1975 IN THE CASE OF CHILE

Variables	Forecast									
	1971		1972		1973		1974		1975	
	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS
Y	22 467	22 460	23 194	23 180	23 088	23 042	23 628	23 560	24 219	24 132
L^e	3 070	3 070	3 145	3 144	3 186	3 182	3 233	3 226	3 284	3 276
L^a	3 240	3 240	3 314	3 314	3 389	3 389	3 465	3 465	3 543	3 543

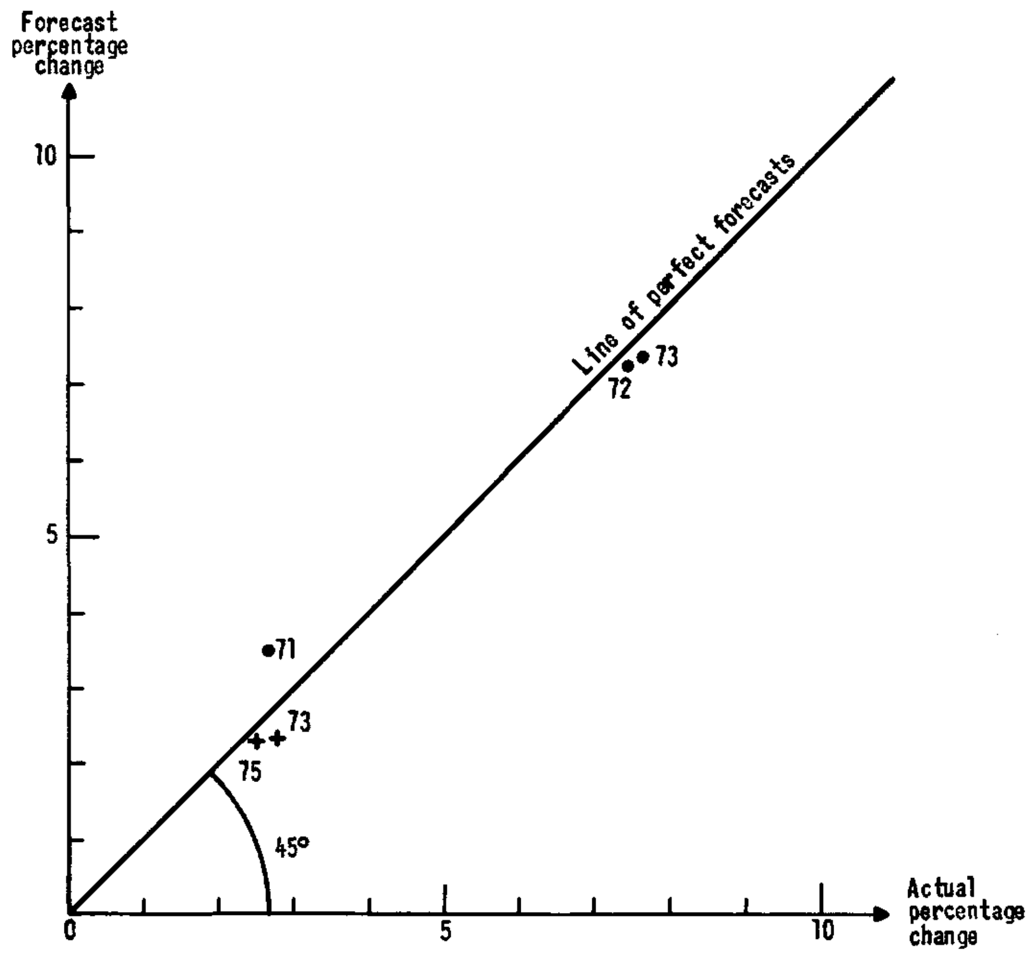
Table 8.5.2.2

THE FORECAST VALUES OF THE ENDOGENOUS VARIABLES OF THE MODEL IN THE POST SAMPLE PERIOD 1971-1975 IN THE CASE OF MEXICO

Variables	Forecast									
	1971		1972		1973		1974		1975	
	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS
Y	305 478	305 487	327 682	327 674	351 452	351 425	374 208	374 169	398 160	398 108
L^e	12 568	12 568	12 714	12 714	12 861	12 861	13 009	13 009	13 158	13 158
L^a	13 120	13 120	13 320	13 320	13 528	13 528	13 742	13 742	13 963	13 963

Diagram 8.5.2.1

THE PERCENTAGE CHANGES OF FORECAST AND ACTUAL VALUES OF THE FIRST AND THE THIRD EQUATION OF THE MODEL FOR THE COUNTRIES MEXICO AND CHILE RESPECTIVELY



Endogenous variables :
- • National output, Y, (Mexico)
- + Available labour force, L^a, (Chile)

8.6 Consumption expenditure in the extrapolation period 1971-1975

In this section an effort will be made to forecast the level of consumption expenditures in Chile and Mexico for the 1971-1975 period. The method to be followed for making these forecasts is the functional extrapolation. By this forecasting method, the dependent variable -consumption expenditure- of the equation will be predicted on the basis of the selected regression equations mentioned in Chapter 7, section 4, and certain assumptions as far as the development of the determinative factors are concerned. Thus, for the variables, gross national product, GNP, or gross domestic product, GDP, we assume that their values in the post sample period 1971-1975, will be formulated at the same level as the forecast values produced by the macro-model.164/ For the variable consumption lagged one year, C_{t-1}, we will use the forecast values of the consumption produced by the consumption equation in a projected year, as the variable, C_{t-1}, which will enter in the equation for making forecasts in the next year.

Of course, all the above assumptions would be applied, provided that the following basic prerequisites regarding the realization of correct forecasts by regression equation are fulfilled: i) the determinative factors, national income and income distributions will continue exercising the same influence on the explained variable of the equation under consideration, ii) the determinative factors will develop in the post sample period 1971-1975 in accordance with our assumptions, iii) other factors affecting the consumption expenditure more than those factors which have been defined during the sample period 1960-1970 and are included in the estimated equation will not appear in the forecasting period 1971-1975.

Finally, a comparison of the forecast values of the consumption expenditure produced by the regression equation with the actual ones and the values which have been estimated by the Economic Commission for Latin America/United Nations will be realized.

In tables 8.6.1 and 8.6.2 we present the expected development of the determinative factors of the consumption function on the basis of the aforementioned assumption and the forecast values of the consumption expenditure produced by the applied equations with their deviations from the actual ones, respectively, in the period 1971-1975.

From table 8.6.2 it appears that i) in the case of Chile: the deviation between the forecast value and the actual one is minus 1.17 per cent in the year 1973. This small deviation (1.17) allows us to say that the forecast value produced by the relevant equation numbered by 1, is with reasonable accuracy. ii) In the case of Mexico: The noted deviation between forecast value produced by the equation 2^a and actual one for the semi-period 1971-1973 can be considered

164/ The macro-model gives the forecast values of GDP at market prices, and therefore, these values will be modified by these changes of net income from abroad for obtaining GNP at market prices. Analogous modifications will be made for the values of GDP, at market prices in order to include the changes of subsidies and indirect taxes for obtaining GDP at factor cost.

Table 8.6.1

THE VALUES OF THE DETERMINATIVE FACTORS IN THE PERIOD 1971-1975

n/n	Country	Variable	1971	1972	1973	1974	1975	Monetary Unit
1	Chile	GNP			22 511	23 037	23 614	in million Escudos
2	Chile	C_{t-1}			17 707	17 340	17 569	in million Escudos
3	Mexico	GDP	305 478	327 682	351 452	374 208	398 160	in million Pesos
4	Mexico	GDP	291 427	312 609	335 285	356 994	379 845	in million Pesos
5	Mexico	C_{t-1}	224 800	233 787	248 559	266 179	284 628	in million Pesos

negligible (on average for the 1971-1973 period it is 0.42 per cent) and consequently, we can say that this equation, 2^a, produces correct forecasts. For the equation 2^b we observe that the deviation between forecast values and actual one decreased from minus 2.27 (1971) to minus 1.36 per cent (1973). Based on the noted small deviation (1.36) and the trend which this deviation experienced in the period 1971-1975 for further decrease, we can say what we argued for the previous equation, 2^a, i.e. it produces correct forecasts. Moreover, the importance of the ability of this equation, 2^b, to forecast, increases anymore, because it contains two explanatory variables, gross domestic product, GDP, and consumption lagged one year, C_{t-1} and thus it can be considered more complete than the equation 2^a from the point of view of number of variables and the explanation of the dependent variable, C_t.

8.7 Per capita income in the projected period 1971-1975

In an economic-demographic model, the direction which is followed as regards the investigation of its economic and demographic variables defines the nature of the model, whether it is a model of economic growth or population growth. By the present model, we estimated the influence of population changes on the growth of national output and we made forecasts for the development of its main variables in the coming years. Therefore, the applied model can be considered a model of economic growth as this we also said in Chapter 2, section 1. In such models, the quantitative determination of the level of the economic growth, for the countries in which they are applied, must consist of the final aim. On the other hand, the measuring of the degree of economic growth can be made by the computation of some indicators on the basis of the data produced by these models. In Chapter 2, section 3, we said that the most suitable indicator for measuring the degree of economic growth is the per capita income. The computation of the per capita income -it

Table 8.6.2

THE FORECAST VALUES OF THE CONSUMPTION EXPENDITURE IN THE CASES OF CHILE AND MEXICO FOR THE 1971-1975 PERIOD

Year	Consumption Expenditure										
	Chile				Mexico						
	Actual value	Equation 1			Actual value	Equation 2a			Equation 2b		
		Forecast value	Deviations			Forecast value	Deviations		Forecast value	Deviations	
			Absolute	Per cent			Absolute	Per cent		Absolute	Per cent
1971					228 600a/	227 333	1 267	0.55	233 787	-5 187	-2.27
1972					244 800a/	243 918	882	0.36	248 559	-3 759	-1.54
1973	17 140b/	17 340	-200	-1.17	262 600b/	261 673	927	0.35	266 179	-3 579	-1.36
1974						278 671			284 268		
1975						296 562			303 149		

Source: ECLA/U.N., Estudio Económico de América Latina 1973. Santiago de Chile, 1974.
a/ Actual values
b/ Provisional data.

appears at the top of the schematic form of the model, Figure 1,- for Chile and Mexico, in the projected period 1971-1975 is also one of the purposes of the present economic-demographic model.

This computation was based on the forecast values produced by the model and the population estimations mentioned in section 5.1 of the present chapter and its results are included in table 8.7.1.

Table 8.7.1

PER CAPITA INCOME OF CHILE AND MEXICO IN THE PROJECTED PERIOD 1971-1975

Year	Per capita income							
	Chile a/				Mexico a/			
	Computed by		Deviations		Computed by		Deviations	
	Insti-tutes	Applied model	Abso-lute	Percent	Insti-tutes	Applied model	Abso-lute	Percent
1971	2 362 b/	2 493	-131	-5.55	5 903 c/	6 135	-232	-3.93
1972	2 353 b/	2 529	-176	-7.48	6 145 c/	6 374	-229	-3.73
1973		2 474			6 394 c/	6 621	-227	-3.55
1974		2 487				6 828		
1975		2 505				7 036		

a/ Monetary unit: Escudos at 1965 prices (Chile) and Pesos at 1960 prices (Mexico).

b/ Actual value: ODEPLAN, Cuentas Nacionales de Chile, 1965-1972. Santiago, 1974.

c/ Provisional data: i) ECLA/U.N., Estudio Económico de América Latina 1973. Santiago, 1974.
ii) CELADE, Boletín Demográfico N° 13. Santiago, 1974.

In spite of the international acceptance of the per capita income as indicator of determination of the level of economic growth, however, it does not give the true picture of the degree of economic growth of a country. This is because the estimations both for the national output and population which are required for the computation of this indicator are not the correct ones. In the cases of Chile and Mexico, the population data used for the computation of per capita income of these countries by the model and the Institutes differ considerably. The observed deviations between the values of the per capita income computed by the model and Institutes can be attributed to the aforementioned reason, and therefore, we do not comment these numerical values from the point of view of making comparisons.

9. GENERAL REMARKS. CONCLUSION

9.1 Remarks on the equations of the system

9.1.1 National production function

The economic theory of production is usually stated for the micro-production function, i.e. for the firm. But, in most recent work on economics, the tendency has been to apply the production function to broad sectors of the economy, as for instance, the manufacturing sector, the agricultural sector, and the national economy as a whole.165/ The application of the production function at the national level of the economy of a country is subject to many restrictions.166/ This is obvious. The technological progress, the prevailing comparative conditions, the structural changes of an economy that take place in a period of time, etc. are important factors which influence the changes of the explained variable, national output, of the function and whose factors cannot be defined statistically. As a result, it is that these specific factors -inputs- are not taken into account during the formulation of the national production function as explanatory variables and consequently they are not to be estimated empirically in a grossly production function as the present one.167/ In addition to these difficulties, as regards the quantitative measurement of some important factors of the function mentioned previously, the use of time series imposed us a further more difficulties for the entering of some of these input variables in the functional relationship.168/ Finally, the aforementioned restrictions and difficulties regarding the application of the production function increased any more in the present case that the national production function is an equation of an interdependent system of linear equations which, as we said in Chapter 4, has limitations from mathematical point of view.

For these reasons, our national production function contains two variables as inputs, labour and capital. For these variables, we used, on the one hand, the number of workers as a measure for labour -many studies use this measure- instead of the measure of man hours which is the appropriate one, and on the other hand,

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165/ Klein, L. and Goldberger. A., An Econometric Model of the United States, 1929-1952. North Holland Publishing Co. Amsterdam, 1964. Urbisala, H. and Brufman, J., Modelo Econométrico para República Argentina. Universidad de Buenos Aires, 1968.

166/ Walters, A., An Introduction to Econometrics. MacMillan and Co, Ltd., London, 1970. pp. 308-310.

167/ If the production function refers to the national economy as a whole, the factor land is effectively held constant. Furthermore, as regards the factor of the gradual technological progesss, the linear form of the function did not allow us to introduce a time trend.

168/ The technology presents the most formidable difficulty with the time series data. More details for the statistical problems of the use of time series mentioned in Chapter 5, section 2.

the end-of-year stock of capital formation in the case of capital input variable.169/ In spite of these restrictions and weaknesses of the national production function, -since we try to use macro-economic magnitudes, it is obvious that we will meet such difficulties as regards the aggregative relationships170/- we attempted to introduce it in a macro-model of an interdependent system of equations and to estimate it on the basis of real statistical data of a less-developed economy, that is, for Chile and Mexico. Of course, the restrictions of the macro-production function itself and the difficulties both for its introduction in an interdependent system of linear equations and for its statistical estimation, will reflect the numerical results of the empirical estimates. On the other hand, these results will lead us to a sure conclusion both on the ability of the model to describe adequately the economic-demographic relationships to which it refers and the statistical validity of this model to be used for an empirical analysis.

Having in mind all the restrictions and difficulties, the statistical results derived from the application of the model in Chile and Mexico, should be expected to be statistically limited and consequently, their interpretation should be analogous. But, in this aspect, the results obtained were considered favourable from economic and statistical point of view and the statistical validity of equations of the system was proved by the statistical criteria. Here, we will repeat some findings as regards the statistical results and particularly the elasticities of national output per factor input of the function concerned. This is because the signs and the sizes of these coefficients mainly explain the economic-statistical hypotheses for the estimated function. Thus, on the average for the entire sampling period, the elasticity of the variable of labour is 1.33 per cent in the case of Chile and 3.94 per cent in the case of Mexico, i.e. it is over-elastic, a fact that means that labour input shows increasing returns to scale. The average elasticity of the variable capital is smaller than unity for the same period 1960-1970. In other work of aggregative production function this elasticity is also estimated at the same level as above. Finally, the sign both of elasticities of the factors, labour and capital, is positive and the standard errors of these coefficients are small.171/ Therefore, we can say that the empirical estimates of the national production function as an equation of the interdependent system of the equations can be considered satisfactory, a fact that allows the model, from this point of view, its statistical working mechanism and its use for predictions under certain constraints.

169/ Statistical data as regards the capital of the private sector of the economy for the countries to which the model is applied would be probably available whereas the obtaining of such data for the public sector of the economy was not possible. On the other hand, the application of the model for the private sector of the economy of the above countries was also not possible due to the lack of statistical data regarding the labour input variable of the aggregate production function.

170/ Solow, R., "Technical Change and the Aggregate Production Function". Review of Economics and Statistics. 1957, N° 3.

171/ In many empirical estimates of highly aggregative production function, the sign of capital is often found negative.

9.1.2 Demand for labour equation

A demand for labour function must include all those factors which influence it. Thus, it will be possible that the empirical results derived from the estimation of the function be used for making predictions for purposes of policy formulation. Wages and national output can be considered the basic economic determinative factors of demand for labour. The first one, wages, will facilitate us to exercise the policy indicated as regards the rates of wages and salaries, whereas, as it is known, an increase of the national output will create more jobs, that is, it will increase the demand for labour, of course, under the prerequisite that the supply of labour is not increasing as rapidly as output.172/ But, the entering of "wages" variable in such a function is not indicated both for the sampling period and post sampling period due to the general inflation that there is in all countries and particularly in Chile and because of which, the money wages rates show an upwards trend. Moreover, the fluctuations of Chilean economy in conjunction with the high inflation did not allow the application of the common method of payment of fixed wages. Although there is a legal minimum wage, however, its rate changed many times during the period under study for the aforementioned reasons.173/ Finally, the gap of differences from the point of view of earnings among the groups of workers in the same sector of the economy and between the sectors of the economy is wide and consequently, the existence of the difficulties for the entering of the "wages" variable as an explanatory variable in the demand for labour function for purposes of policy formulation, increase anymore in the cases of the countries to which the macro-model is applied. 174/

It should also be remembered that the choice of the functional form of the demand for labour equation is defined by the limitations of the model. This means that they did not provide us with the possibility of using various functional forms of the equation with different statistical properties and statistical data. Indeed, the entering of more than the two main determinants, output and employed labour force lagged one year, had as result either to leave the regression coefficients of these variables, standard errors of parameters and Von Newmann's ratios unaffected or to show a wide difference of over-all results of whose the economic and statistical interpretation was not possible. The main impression that emerges from the statistical estimates of this equation and the statistical analysis of the results obtained in the cases of Chile and Mexico is that they

172/ The rate of growth of labour force was 2.48 per cent and 1.38 per cent for Chile and Mexico respectively in the sampling period 1960-1970 whereas the rate of growth of the national output for these countries was 4.43 per cent and 7.09 per cent respectively at the same period of time (1960-1970).

173/ To all these factors must be also added the magnitude of unemployment (6.0 per cent in Chile and 4.0 per cent in Mexico for the same census year 1970) and the labour mobility (interregional and towards the capital) as restraining factors of determining of fixed wage rates.

174/ A detailed analysis of the differences in earnings in the case of Mexico and in the construction industry was made by Germidis, D., Labour Conditions and Industrial Relations in the Building Industry in Mexico. Development Centre, O.E.C.D. Paris, 1974. pp. 67-69 and 128-133.

can be considered statistically satisfactory and they correspond to the economic hypotheses adopted. Finally, for the probable question of disaggregating of the function in the sectors of the economy, the answer is the same as in the national production function, i.e. the lack of statistical data regarding the explained and explanatory variables of the equation and other variables of the model.

9.1.3 Supply of labour equation

The third function of the system is the supply of labour force. As we said in Chapter 3, section 4, the supply of labour depends mainly upon demographic factors. In the present study, it is defined as a function of the population size. Although this function does not give a complete picture of the structure by age and sex of the labour force, however, it allows us to estimate the supply labour size which consists of an endogenous variable of the model. It is known that for a complete estimation of the labour supply it would be necessary to take into consideration the participation rates as another determinative factor of the supply labour function. But, the entering of this factor, in the function under study by which the labour force size is estimated, on the one hand, would not change the estimates for the size of labour considerably; on the other hand, it would create doubts about the equation as a structural equation of the system. Furthermore, we would meet serious problems for the empirical estimates of the equation due to its non-identification in the entire macro-model. Finally, another important factor is the composition of the population -by age and sex- but also, this factor as it is obvious, cannot enter to the formulated functional relationship.

For these reasons, that is, the omission of important factors, as explanatory variables of the supply of labour equation as well as the lack of real statistical data on this demographic dimension, for the years between two successive censuses, we applied the numerical model for a future exact estimation of the labour force in the post sample period 1971-1975. Finally, the equations supply of labour and demand for labour consist of the laws of labour market. Thus, high employment leads to the decrease of the unemployed labour force and low employed labour force represents high excess of supply, i.e. high unemployment. These demographic variables of the labour market are included in the identity of the model by means of which unemployment can be determined since the estimates of the two variables, demand and supply of labour, are given.

9.2 Notes on the consumption function

In Chapter 8, section 6, we made forecasts as regards the development of consumption on the basis of the rate of national output growth produced by the macro-model in the post sample period 1971-1975. Although the national income growth can be considered the most important factor of the future growth of consumption, however, many other factors, as they are mentioned in Chapter 3, section 9, affect its development. Some of the factors are at the same time correlated with national income. The effects of these factors cannot easily be isolated by using time series data. This is because of presence of time trend in them, which causes an intercorrelation over time and its elimination, as we said in Chapter 4, section 5.2, is not possible in certain cases. Therefore, the consumption equation with the only explanatory variable, national income, will give valid forecasts under the prerequisite that all the time trends remain unchanged. But, it is not easy to adopt this prerequisite for many reasons and consequently, both the estimates of the applied consumtpion function and its forecast values must be accepted with some caution. Furthermore, the ommission of other variables from the consumption function, due to the fact that the statistical data of these variables were not available or the results obtained were not satisfactory from statistical and economic point of view, makes the estimated equation more biased. Finally, the use of cross section data for the estimation of the consumption function for probable extraction of some of the aforementioned difficulties of time series data on the one hand, was not easy for Chile and Mexico and on the other hand, such a detailed analysis of this function is not included in the purposes of this work.

In spite of these disadvantages regarding the problems of bias of the estimated consumption equation, since it includes the main factor, national income, -it presents about 84 per cent and 82 per cent of national income for Chile and Mexico respectively-, it can be used by the economic policy makers who are mainly interested in estimating future levels of target variables as it is the consumption. Finally, the entering of the consumption function in the model as one of its equations was not possible for technical reasons which we explained elsewhere in this work and therefore the treatment of this function was made by a single regression equation separately from the model.

9.3 A review of findings and conclusions

In this section we will refer to the main findings of the present work as they come from the application of the models in the cases of Chile and Mexico both in sampling period 1960-1970 and in the post sample period 1971-1975. Thus:

1. From the application of the macro-model we ascertained that the existing interrelationships between economic and demographic factors can be expressed in an interdependent system of equations which can be estimated on the basis of real data.

2. From the numerical results -interpreted from the statistical and economic points of view- obtained by the application of this model both in the sampling period 1960-1970 and in the projected period 1971-1975 we ascertained the ability of the model to explain the theory which it presents in the past and in the coming years.

3. From the application of the macro-model we estimated the contribution of the mainly demographic variables in the increase of national output as otherwise, it was the direction of investigation of the economic and demographic variables -Chapter 1, section 2- of the present model.

4. From the forecast values of the national output produced by the macro-model and the population estimations made by extrapolations of given statistical data we computed the per capita income for Chile and Mexico for the 1971-1975 period and thus we saw the level of economic growth that those countries will reach in the aforementioned projected period (1971-1975) on the basis of the expected economic and demographic developments.

5. From the application of the numerical model as it was completed by the author of the present work, we estimated the qualitative composition (age and sex) of the labour supply, which is one of the main variables of the macro-model, in the projected year 1975. Thus, in addition to the size of the available labour force, predicted by the macro-model, we have also its structure by age and sex fpr the 1975 year. Furthermore, the labour supply estimations made by these two models allowed us to ascertain their ability to be used for forecast purposes.

6. From the application of the consumption function we saw how the consumption expenditure, which is another main variable of an economic-demographic model, will be developed in the post sample period 1971-1975 for planning purposes.

7. Based on the aforementioned ascertainments we can say that i) the purposes of the present work as they have been defined in Chapter 1, section 3, have been accomplished; ii) the present economic-demographic model gives a complete picture of the interaction of economic and demographic variables for Chile and Mexico; iii) this model, by means of the interdependent system, numerical model and single regression equations from which it consists of, can be used for long-term planning because it has the ability for making forecasts as regards the development of target economic and demographic variables in a future period. In spite of the aforementioned attainments of the present model, improvements both in the interdependent system and numerical model from the point of view of entering new variables, revising of equations, extension of their application as for instance, industrial sector of economy, urban area etc. can be made if statistical data are available, even though, the working mechanism of the model will not be changed.

9.4 Epilogue

Today, an effort is made by many scientists to relate the economic and demographic factors by the construction of various models. This is because, as we said in Chapter 4, section 1, the interrelation between demographic and economic growth has been proved and consequently the policy for the socio-economic development of a country must take into account all the factors, demographic and economic. On the other hand, a correct allocation of the economic and human resources in the frame of national accounts can be made only by the investigation of the existing relationships between these factors and estimation of their interactions. Such an effort was made by the author of the present work to investigate some relationships between economic and demographic variables by the construction of an economic-demographic model, which consists of an interdependent system, a numerical model and few single regression equations for Chile and Mexico. These countries are at the stage of rapid economic development and prepare long-term plans and consequently they need such data referring to the existing relationships between economic and demographic variables and to the expected development of target economic and demographic variables in the coming years.

The results obtained, which consist of the measure of success of this effort, allow us to say that the over-all effort made for the construction and the application of this economic-demographic model for Chile and Mexico, in which adequate statistical data both economic and demographic were not available for the period under study, 1960-1975, can be considered successful.

APPENDIX I

Table 1

DATA USED TO ESTIMATE THE VARIABLES OF THE MODEL AND THE CONSUMPTION FUNCTION IN THE CASE OF CHILE DURING THE SAMPLING PERIOD 1960-1970

$^{n}/_{n}$	Year t	Y^{65} (in million Escudos) (1)	L^{e} (in thousands) (2)	L^{a} (in thousands) (3)	L^{u} (in thousands) (4)	K^{65} (in million Escudos) (5)	L^{e}_{t-1} (in thousands) (6)	P (in thousands) (7)	C^{65}_{t} (in million Escudos) (8)
1	1960	14 059	2 317	2 494	177	2 401	2 285	7 374	10 132
2	1961	14 929	2 349	2 553	204	2 753	2 317	7 510	10 827
3	1962	15 672	2 406	2 614	208	2 679	2 349	7 649	11 242
4	1963	16 412	2 475	2 675	201	3 027	2 406	7 790	11 673
5	1964	17 099	2 546	2 739	192	2 884	2 475	7 934	12 312
6	1965	17 956	2 623	2 804	181	3 254	2 546	8 080	12 563
7	1966	19 221	2 703	2 877	174	3 442	2 623	8 229	13 935
8	1967	19 670	2 812	2 952	140	3 132	2 703	8 381	14 413
9	1968	20 241	2 879	3 029	149	3 370	2 812	8 535	14 859
10	1969	20 915	2 921	3 075	154	3 730	2 879	8 693	15 232
11	1970	21 691	2 994	3 185	191	4 052	2 921	8 853	15 816

Sources:
1. Oficina de Planificación Nacional, Cuentas Nacionales de Chile, 1960-1971. Santiago, 1972 (mimeographed).
2. Oficina de Planificación Nacional, División de Recursos Humanos.
3. Dirección de Estadística y Censos, XIII Censo de Población. Santiago, Chile, 29 de noviembre de 1960.
4. Instituto Nacional de Estadísticas, XIV Censo de Población y III de Vivienda. Abril de 1970. Muestra de Adelanto de Cifras Censales. Santiago de Chile, 1971.

Note: The variables numbered from 1 to 7 and from 7 to 10 refer to the macro-model and the consumption function respectively.

Table 1 (Continued)

Year t	GNP^{65} (in million Escudos) (9)	C^{65}_{t-1} (in million Escudos) (10)
1960	13 828	9 312
1961	14 686	10 132
1962	15 373	10 827
1963	16 130	11 242
1964	16 775	11 673
1965	17 547	12 312
1966	18 610	12 563
1967	18 974	13 935
1968	19 534	14 413
1969	20 201	14 859
1970	21 195	15 232

Source: Table 1.

Table 2

DATA USED TO ESTIMATE THE VARIABLES OF THE MODEL AND THE CONSUMPTION FUNCTION IN THE CASE OF MEXICO DURING THE SAMPLING PERIOD 1960-1970

$^n/_n$	Year t	Y^{60} (in million Pesos) (1)	L^e (in thousands) (2)	L^a (in thousands) (3)	L^u (in thousands) (4)	K^{60} (in million Pesos) (5)	L^e_{t-1} (in thousands) (6)	P (in thousands) (7)	C^{60}_t (in million Pesos) (8)
1	1960	150 500	11 071	11 253	182	30 200	10 945	34 923	113 900
2	1961	157 900	11 199	11 409	210	29 800	11 071	36 068	117 800
3	1962	165 300	11 329	11 566	237	28 900	11 199	37 251	123 900
4	1963	178 500	11 461	11 726	265	34 100	11 329	38 473	131 600
5	1964	199 400	11 594	11 889	295	39 600	11 461	39 735	146 300
6	1965	212 300	11 728	12 053	325	40 200	11 594	41 039	157 200
7	1966	227 000	11 864	12 220	356	45 200	11 728	42 835	164 900
8	1967	241 300	12 002	12 389	387	46 800	11 864	43 775	178 200
9	1968	260 900	12 141	12 560	419	48 700	12 002	45 211	195 900
10	1969	277 400	12 282	12 734	452	52 100	12 141	46 693	205 900
11	1970	298 700	12 424	12 910	486	57 300	12 282	48 225	224 800

Sources:
1. United Nations, Yearbook of National Account Statistics 1971. New York, 1973.
2. Dirección General de Estadística, VIII Censo General de Población 1960. México, D.F., 1964.
3. Dirección General de Estadística, IX Censo General de Población 1970. México., D.F., 1972.
4. ECLA/U.N., Producto Interno Bruto de los Países de América Latina. E/CN.12/L.51, Santiago, 1970.

Note: The variables numbered from 1 to 7 and from 8 to 10 refer to the macro-model and the consumption function respectively.

Table 2 (Continued)

Year t	GDP^{60} a/ (in million Pesos) (9)	C^{60}_{t-1} (in million Pesos) (10)
1960	144 177	107 600
1961	150 071	113 900
1962	158 552	117 800
1963	172 348	123 900
1964	191 209	131 600
1965	203 211	146 300
1966	216 157	157 200
1967	229 551	164 900
1968	246 209	178 200
1969	261 697	195 900
1970	284 118	205 900

Source: Table 2.
a/ At factor cost. This variable was used for equation 2^b.

Table 3

DATA USED AS REGARDS THE COEFFICIENTS OF THE NUMERICAL MODEL TO COMPUTE THE PART OF NON-SCHOOL POPULATION - LABOUR FORCE BY AGE-GROUPS AND SEX IN THE CASE OF CHILE DURING THE YEARS 1970 AND 1975

Year / Age-groups by sex		P_i	P_i^s Absolute	P_i^s Percent	$(P_i - P_i^s)$ Absolute	$(P_i - P_i^s)$ Percent	$\bar{e}(P_i - P_i^s) + P_i^{s+w}$
1970							
12-14	Male	327 060	295 780	90.44	31 280	9.56	14 220
	Female	325 180	281 760	86.65	43 420	13.35	5 940
	Total	652 240	577 540	88.55	74 700	11.45	20 160
15-19	Male	442 640	228 120	51.54	214 520	48.46	187 200
	Female	457 960	212 360	46.37	245 600	53.63	75 080
	Total	900 600	440 480	48.91	460 120	51.09	262 280
20-24	Male	417 202	51 280	12.29	365 922	87.71	356 642
	Female	416 919	40 700	9.76	376 219	90.24	153 639
	Total	834 121a/	91 980	11.03	742 141	88.97	510 281b/
1975							
12-14	Male	369 779	336 499	91.00	33 280	9.00	14 347
	Female	366 455	318 816	87.00	47 639	13.00	9 161
	Total	736 234	655 315	89.01	80 919	10.99	23 508
15-19	Male	560 084	302 445	54.00	257 639	46.00	235 236
	Female	556 338	267 042	48.00	289 296	52.00	100 141
	Total	1 116 422	569 487	51.01	546 935	48.99	335 377
20-24	Male	453 409	61 210	13.50	392 199	86.50	378 597
	Female	451 247	47 381	10.50	403 866	89.50	169 218
	Total	904 656	108 591	12.00	796 065	88.00	547 815

Source: 1. Instituto Nacional de Estadîsticas, Chile, XIV Censo Nacional de Población y III de Vivienda. Abril 1970. Muestra de Adelanto de Cifras Censales, Total País. Santiago, 1971.

2. CELADE, Boletîn Demográfico N° 15, Año VII. Santiago de Chile, January 1975.

a/ CELADE population forecasts.

b/ Estimates on the basis of population forecasts made by CELADE.

Table 4

DATA USED AS REGARDS THE COEFFICIENTS OF THE NUMERICAL MODEL TO COMPUTE THE PART OF NON-SCHOOL POPULATION - LABOUR FORCE BY AGE-GROUPS AND SEX IN THE CASE OF MEXICO DURING THE YEARS 1970 AND 1975

Year Age-groups by sex		P_i	P_i^s Absolute	P_i^s Percent	$(P_i - P_i^s)$ Absolute	$(P_i - P_i^s)$ Percent	$\bar{e}(P_i - P_i^s) + P_i^{s+w}$
1970							
12-14	Male	1 917 337	1 292 177	67.39	625 160	32.61	245 939
	Female	1 841 408	1 098 887	59.68	742 521	40.32	93 676
	Total	3 758 745	2 391 064	63.61	1 367 681	36.39	339 615
15-19	Male	2 737 386	956 906	34.96	1 780 480	65.04	1 367 051
	Female	2 639 110	720 873	27.32	1 918 237	72.68	552 630
	Total	5 376 496a/	1 677 779	31.21	3 698 717	68.79	1 919 681b/
20-24	Male	1 930 300	225 027	11.66	1 705 273	88.34	1 536 418
	Female	2 102 041	107 795	5.13	1 994 246	94.87	505 872
	Total	4 032 341	332 822	8.25	3 699 519	91.75	2 042 290
1975							
12-14	Male	2 278 469	1 754 421	77.00	524 048	23.00	133 443
	Female	2 193 092	1 447 441	66.00	745 651	34.00	154 881
	Total	4 471 561	3 201 862	71.61	1 269 699	28.39	288 324
15-19	Male	3 275 715	1 244 772	38.00	2 030 943	62.00	1 621 059
	Female	3 159 250	979 368	31.00	2 179 882	69.00	725 543
	Total	6 434 965	2 224 140	34.56	4 210 825	65.44	2 346 602
20-24	Male	2 688 622	336 078	12.50	2 352 544	87.50	2 203 863
	Female	2 604 195	169 273	6.50	2 434 922	93.50	678 873
	Total	5 292 817	505 351	9.55	4 787 466	90.45	2 882 736

Source: 1. Dirección General de Estadística, IX Censo General de Población, 1970. Resumen General. México, D.F., 1972.
2. CELADE, Boletín Demográfico Nº 13. Santiago de Chile, January 1974.

a/ CELADE population forecasts.
b/ Estimates on the basis of population forecasts made by CELADE.

Table 5

LABOUR FORCE BY AGE AND SEX AND ITS PARTICIPATION RATES FOR CHILE AND MEXICO IN THE CENSUS YEAR 1970

Age	Chile a/						Mexico a/					
	Labour Force			Participation rates			Labour Force			Participation rates		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
12-14	14 220	5 940	20 160	4.35	1.83	3.09	245 939	93 676	339 615	12.83	5.09	9.04
15-19	187 200	75 080	262 280	42.29	16.39	29.12	1 367 051	552 630	1 919 681	49.94	20.94	35.23
20-24	356 642	153 639	510 281	85.48	36.85	61.18	1 536 418	505 872	2 042 290	79.59	24.07	50.65
25-29	279 940	91 380	371 320	95.12	28.58	60.47	1 427 290	292 410	1 719 700	90.60	17.35	52.74
30-34	232 840	66 420	299 260	96.32	24.95	58.92	1 198 340	205 400	1 403 740	93.22	15.67	54.07
35-39	237 740	63 100	300 840	96.39	23.60	58.53	1 164 755	201 441	1 366 196	94.29	15.78	54.39
40-44	207 680	53 140	260 820	94.99	23.09	58.11	901 332	157 624	1 058 956	93.94	16.19	54.77
45-49	155 860	38 180	194 040	92.75	21.11	55.62	778 971	132 355	911 326	93.88	16.39	55.67
50-54	126 240	29 520	155 760	87.18	18.48	51.14	544 203	95 748	639 951	92.27	15.90	53.69
55-59	100 780	20 420	121 200	80.74	14.76	46.06	454 437	77 295	531 732	90.61	15.15	52.55
60-64	73 740	11 840	85 580	71.19	10.46	39.47	388 344	65 861	454 205	86.09	14.11	49.49
65 +	73 440	12 840	86 280	40.25	5.55	20.85	604 719	101 855	706 574	70.38	10.93	39.44
Not stated	19 740	9 960	29 700	32.67	16.77	24.79	---	---	---	---	---	---
Total	2 066 062	631 459	2 697 521	69.51	19.94	43.94	10 611 799	2 482 167	13 093 966	71.35	16.39	43.62

Sources: 1. Instituto Nacional de Estadîsticas, Chile, XIV Censo Nacional de Población y III de Vivienda. Muestra de Adelanto de Cifras Censales. Abril 1970. Total Paîs. Santiago, 1971.

2. Dirección General de Estadística, IX Censo de Población 1970. Resumen General. Mêxico, D.F., 1972.

a/ Labour force estimations for the age-groups 15-19 and 20-24 of Mexico and Chile respectively, on the basis of the population forecasts made by CELADE.

Table 6

POPULATION AND LABOUR FORCE BY AGE-GROUPS AND SEX FOR CHILE IN THE CENSUS YEAR 1970

Age-groups	Population								
	INE			ILO			CELADE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
12-14	327 060	325 180	652 240	342 300	341 800	684 100	342 300	341 800	684 100
15-19	442 640	457 960	900 600	500 000	499 000	999 000	500 000	499 000	999 000
20-24	356 960	387 000	743 960	417 000	424 000	841 000	417 000	424 000	841 000
12-24	1 126 660	1 170 140	2 296 800	1 259 300	1 264 800	2 524 100	1 259 300	1 264 800	2 524 100
	Economically Active Population								
12-14	14 220	5 940	20 160	20 000	7 000	27 000a/	34 200	14 000	48 200a/
15-19	187 200	75 080	262 280	262 000	98 000	360 000	295 000	129 700	424 700
20-24	296 400	123 720	420 120	368 000	141 000	509 000	378 700	155 400	534 100
12-24	497 820	204 740	702 560	650 000	246 000	896 000	707 900	299 100	1 007 000

Source:
1. Instituto Nacional de Estadísticas, Chile, XIV Censo Nacional de Población y III de Vivienda, 1970. Muestra de Adelanto de Cifras Censales. Total País. Santiago de Chile, 1971.
2. International Labour Office, Labour Force Projections 1965-1985. Part III, Latin America. Geneva, 1971.
3. Corporación de Fomento de la Producción, Perspectivas de Crecimiento de la Población Chilena, 1970-1985. Publicación N° 10-A-70, Santiago de Chile, 1970. (Trabajo realizado por CELADE).

a/ 10-14 years.

Table 7

POPULATION AND LABOUR FORCE BY AGE AND SEX FOR MEXICO IN THE CENSUS YEAR 1970

Age-groups	Population								
	D.G.E.			ILO			CELADE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
12-14	1 917 337	1 841 408	3 758 745	1 948 000	1 844 000	3 792 000	1 948 000	1 844 000	3 792 000
15-19	2 491 047	2 563 344	5 054 391	2 671 000	2 586 000	5 257 000	2 671 000	2 586 000	5 257 000
20-24	1 930 300	2 102 041	4 032 341	2 155 000	2 127 000	4 282 000	2 155 000	2 127 000	4 282 000
12-24	6 338 684	6 506 793	12 845 477	6 774 000	6 557 000	13 331 000	6 774 000	6 557 000	13 331 000
	Economically Active Population								
12-14	245 939	93 676	339 615	401 000	65 000	467 000a/	625 000	138 000	763 000a/
15-19	1 244 052	536 720	1 780 772	1 656 000	421 000	2 077 000	1 939 000	566 000	2 505 000
20-24	1 536 418	505 872	2 042 290	1 985 000	447 000	2 432 000	2 039 000	566 000	2 605 000
12-24	3 026 409	1 136 268	4 162 677	4 042 000	933 000	4 976 000	4 603 000	1 270 000	5 873 000

Source: 1. Dirección General de Estadística, IX Censo General de Población 1970. Resumen General. México, D.F., 1972.
2. International Labour Office, Labour Force Projections 1965-1985. Part III, Latin America. Geneva 1971.
3. Alvarado, Ricardo, México: Proyección de la Población Total 1960-2000 y de la Población Económicamente Activa 1960-1985. Series C Nº 114, Santiago 1969.

a/ 10-14 years.

Table 8

POPULATION AND LABOUR FORCE BY AGE-GROUPS AND SEX FOR CHILE IN THE YEAR 1975

Age - groups	Population								
	Numerical model[a/]			ILO			CELADE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
12-14	369 779	366 455	736 234	388 700	378 600	767 300	388 700	378 600	767 300
15-19	560 084	556 338	1 116 422	583 000	583 000	1 166 000	583 000	583 000	1 166 000
20-24	453 409	451 247	904 656	497 000	496 000	993 000	497 000	496 000	993 000
12-24	1 383 272	1 374 040	2 757 312	1 468 700	1 457 600	2 926 300	1 468 700	1 457 600	2 926 300
	Economically Active Population								
12-14	14 347	9 161	23 508	19 000	6 000	25 000[b/]	35 400	15 500	50 900[b/]
15-19	235 236	100 141	335 377	284 000	105 000	389 000	335 500	160 800	496 300
20-24	378 597	169 218	547 815	430 000	168 000	598 000	450 100	192 200	642 300
12-24	628 180	278 520	906 700	733 000	279 000	1 012 000	821 000	368 500	1 189 500

Source: 1. International Labour Office, Labour Force Projections 1965-1985. Part III, Latin America. Geneva, 1971.
2. Corporación de Fomento de la Producción, Perspectivas de Crecimiento de la Población Chilena 1970-1985. Publicación N° 10-A-70, Santiago de Chile, 1970 (Trabajo realizado por CELADE).

a/ Population forecasts made by CELADE; Boletín Demográfico N° 15, Santiago de Chile, January 1975.
b/ 10-14 years.

Table 9

POPULATION AND LABOUR FORCE BY AGE-GROUPS AND SEX FOR MEXICO IN THE YEAR 1975

Age-groups	Population								
	Numerical model[a]			ILO			CELADE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
12-14	2 278 469	2 193 092	4 471 561	2 284 000	2 202 000	4 486 000	2 284 000	2 202 000	4 486 000
15-19	3 275 715	3 159 250	6 434 965	3 301 000	3 117 000	6 418 000	3 301 000	3 117 000	6 418 000
20-24	2 688 622	2 604 195	5 292 817	2 642 000	2 570 000	5 212 000	2 642 000	2 570 000	5 212 000
12-24	8 242 806	7 956 537	16 199 343	8 227 000	7 889 000	16 116 000	8 227 000	7 889 000	16 116 000
	Economically Active Population								
12-14	133 443	154 881	288 324	390 000	65 000	455 000[b]	674 000	157 000	831 000[b]
15-19	1 621 059	725 543	2 346 602	1 896 000	481 000	2 377 000	2 295 000	698 000	2 993 000
20-24	2 203 863	678 873	2 882 736	2 390 000	554 000	2 944 000	2 481 000	722 000	3 203 000
12-24	3 958 365	1 559 297	5 517 662	4 676 000	1 100 000	5 776 000	5 450 000	1 577 000	7 027 000

Source: 1. International Labour Office, Labour Force Projections. Part III, Latin America. Geneva, 1971.
2. Alvarado, Ricardo, México: Proyección de la Población Total 1960-2000 y de la Población Económicamente Activa, 1960-1985. CELADE, Series C Nº 114, Santiago, 1969.

a/ Population forecasts made by CELADE; Boletín Demográfico Nº 13, Santiago de Chile, January 1975.
b/ 10-14 years.

Year 1970

Census Schedule

QUESTIONS	First person
I. GENERAL CHARACTERISTICS	
1. NAME AND SURNAME	
2. SEX	
3. AGE	
....	
....	
....	
9. RESIDENCE	
II. EDUCATIONAL CHARACTERISTICS	
10. EDUCATIONAL LEVEL (What type are you studying)	None ....
	Compulsory ....
	High School ....
	....
	Professional school ....
	....
	University ....
	....
	Unknown ....
11. ATTENDANCE (Are you attending regularly or not)	Attends 1
	Does not attend 2
12.	

III. ECONOMIC CHARACTERISTICS

13. TYPE OF ACTIVITY

(Were you working in the week from 13 to 18 April)

I worked	0
I didn't work but I had a job.	1
I looked for a job and I worked before	2
I looked for a job for the first time	3
Pensioner	4
Living on independent income..	5
Student	6
Home houseworker	7
Other	8
Unknown	9

Note: From "ECONOMIC CHARACTERISTICS" the questions numbered by 0-3 and 4-9 give economically active and inactive population respectively.

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