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DESCRIPTION OF THE ECONOMIC-DEMOGRAPHIC MODEL

68TMP-120

Revised Edition

June 1971

Prepared for the Agency for International Development
U.S. Department of State
by TEMPO, General Electric's Center for Advanced Studies
Santa Barbara, California

PREFACE

This document is a revision of an earlier one that was intended to assist AID officials in developing a technical understanding of the economic-demographic model designed by TEMPO. It presents not only a comprehensive description of the input and output variables, the equations, and the computer program, but also some important changes in the model.

In the new version of the model, independent population projections now can be supplied directly, and up to five labor force participation rate schedules can be used. Furthermore, the new capital accumulation function permits foreign capital inflows to enter into the model which then can be used to analyze the economic impact of direct investment and foreign government assistance. Finally, salaries paid to social service workers can be made a function of the average productivity of the economy. This permits analysis of cost inflation resulting from differential rates of productivity growth.

The user of this revised model should be aware of small changes in the new program such that the operating instructions in this manual differ slightly from those in the original manual. These changes are described in detail at the end of Chapter VII.

This document has been prepared by TEMPO, General Electric's Center for Advanced Studies, located in Santa Barbara, California, under contract to the Agency for International Development, U.S. Department of State. Other TEMPO documents in the same AID series on population growth and economic development include: Population Growth and Economic Development: Background and Guide, Calculating the Benefits of Slower Population Growth: A Short Method and Workbook, Manual for Calculation of Government Expenditures for Selected Social Services, and Economic Benefits of Slowing Population Growth.

This work was under the general supervision of Dr. Stephen Enke. Other members of the project included Dr. James P. Bennett, Dr. David N. Holmes, Jr., Mr. Richard Brown, and Dr. Donald O'Hara. This particular document was the special responsibility of Dr. Bennett and Mr. Brown.

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CHAPTER I

INTRODUCTION

A model that analyzes implications for the economic development of a less-developed country of different demographic assumptions was designed by TEMPO as a part of this program. It makes a series of demographic and economic projections based on identical data except for the particular demographic assumptions being contrasted. Differences in resulting projections can be attributed solely to the differences in the demographic assumptions.

This volume describes the economic-demographic model and the mechanics of the computer program designed to make projections with the model. It also provides material necessary for an evaluation of the projections and for using the computer program (available upon request) to make one's own projections.

Chapter II provides a brief nonalgebraic description of the model. Chapter III gives a list of the data requirements and the outputs of the model. Chapter IV discusses certain aspects involved in interpreting the outputs of the program, Chapter V presents a complete algebraic description of the model.

Chapter VI discusses procedures for obtaining necessary data inputs and provides a description of the data inputs used in the application of the program to a typical but nonexistent less developed country named Developa. Chapter VII provides a guide to the use of the program, including a detailed description of the data formats of the program and of the computer printout. A printout for the case of Developa is added as an annex.

CHAPTER II

NONALGEBRAIC DESCRIPTION OF THE ECONOMIC-DEMOGRAPHIC MODEL

The TEMPO model consists of two parts. One describes the demographic features of a country. The other describes the economic features. Interaction between the two parts of the model proceeds in one direction only—from the demographic to the economic.

DEMOGRAPHIC SEQUENCE

The demographic part of the model provides a projection of population by age and sex at 5-year intervals over a specified number of years. For the first year of the projection, e.g., 1970, an initial population is derived from census data applicable to the country ir question. The initial size and the age (by 5-year cohorts) and sex composition of the population is required. The number, age, and sex of the people who die during each succeeding 5-year interval are computed with the use of age- and sex-specific survival rates and age-specific birth rates.

Given the initial population, its age and sex composition, and the deaths and births during the next 5 years, the size and composition of the population at the end of the interval are computed. Repeating this computation results in a projection of the size and composition of the population over any given number of 5-year intervals. The birth and survival rates used are adjusted from interval to interval according to a pattern that corresponds to a set of stipulated expectations or objectives.

When population projections are available from other sources, they can be used in the economic portion of the model in place of projections computed by the demographic portion of the model.

ECONOMIC SEQUENCE

Yearly projections of the population are obtained from these 5-year interval projections by interpolation. Combined with age- and sex-specific labor force participation rates, they give the size of the labor force each year of the projection.

An initial proportion of the labor force is assumed to be employed. The initial values of employed labor and the stock of capital (representing all of the economy's produced means of production, including plant and equipment) determine the gross national product (GNP)—the total domestic production of the economy—during the first year of the projection. A standard Cobb-Douglas production function determines the size of GNP associated with any given amounts of capital and employed labor. Technological progress is introduced by increasing the GNP resulting from any given amount of capital and labor by a fixed percentage each year.

The year's GNP is divided between total consumption and net investment, e.g., additions to the stock of capital or plant and equipment.* The size of consumption is determined by the level of GNP, plus the size and age composition of the population. The effect of the age composition on consumption is accounted for by using "equivalent consumers" as the population term in the consumption function. In the computation of equivalent consumers, each member of the work-age population is considered a full equivalent consumer. The old and the young may be given smaller weights. The portion of GNP not consumed represents net investment.

The sum of the stock of capital available at the beginning of the year and net investment during the year gives the stock of capital available at the beginning of the next year. The growth of the capital stock and the labor force determine the growth in employed labor. The available capital and employed labor determine the economy's GNP during the following year. The process is repeated each year for the duration of the projection.

Figure 1 is a simple flow-chart showing how the values of demographic and economic variables at the end of one year (t-1) determine the values of the desired variables for the next year (t).

*Total consumption includes capital consumption allowances. Unless the "minimum growth option," discussed below, is chosen, the net foreign trade balance is assumed to be equal to zero.

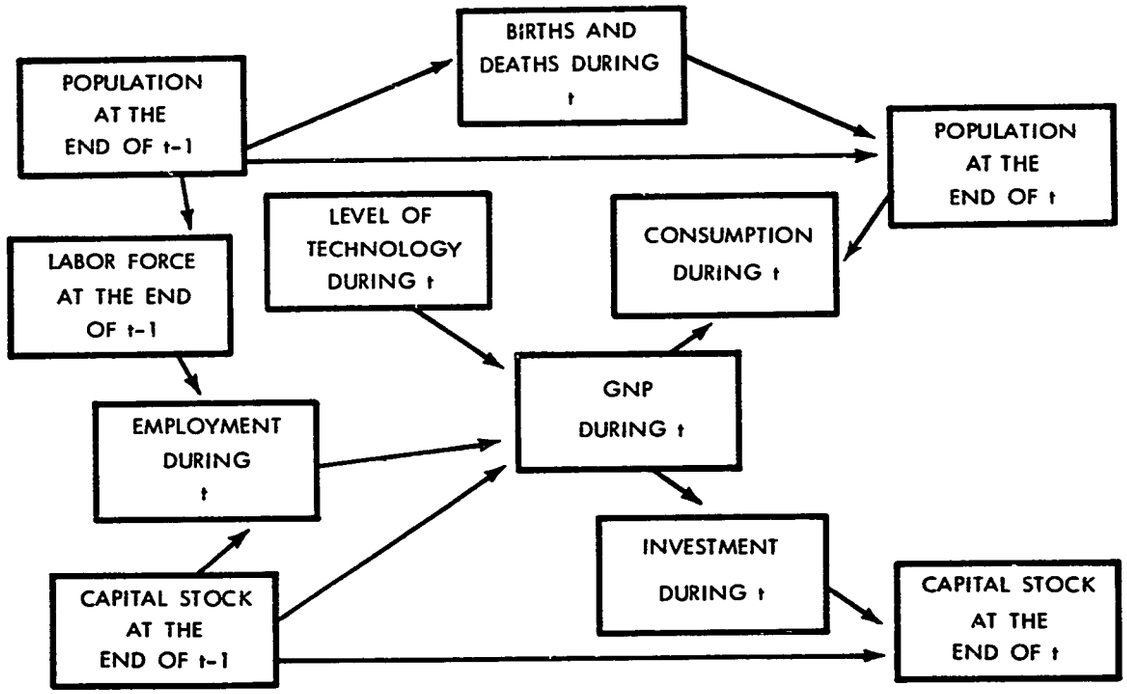

Figure 1. Flow chart of basic computer sequence.

ADDITIONAL FEATURES OF THE COMPUTER MODEL

The computer program provides the user with several optional features. Thus, assigning a goal rate of growth to per capita GNP is possible. The computer program computes the amount of capital accumulation from foreign sources (if any) required each year to maintain this aspired rate of growth. In addition, the user can specify the level and trend of capital inflows.

The program also provides a simple mechanism for dividing the population projection between urban and rural sectors, in addition to giving projections of net rural-to-urban migration.

Other options compute projections of (1) the costs of selected social programs, e.g., education, health, and housing, (2) the number of persons living below an arbitrarily defined poverty line, and (3) the reduction of births (by 5-year cohorts) induced by declining birth rates.

Additional options exist as to which projection results are printed out, e.g., index numbers and growth rates.

These features are described in more detail in subsequent chapters.

CHAPTER III

DATA REQUIREMENTS AND OUTPUTS OF THE MODEL

Following is a list of the data requirements and outputs of the model. The data requirements are discussed fully in Chapter VI. The outputs are discussed in Chapters IV and VII.

INPUTS

Demographic

1. Initial size of the population—with its age and sex composition

2. Up to three sets of age-specific birth rates by 5-year cohorts (The computer program provides for the transition at constant rates of change from the first set of birth rates to the second, and from the second to a third.)

3. Up to three sets of age- and sex-specific survival rates by 5-year cohorts (The computer program provides for the transition at constant rates of change from the first set of survival rates to the second, and from the second to a third.)

4. The ratio of male births to female births

5. The initial ratio of rural to total population

6. The annual rate of migration as a ratio of the rural population

Inputs 5 and 6 are optional. Inputs 1 through 4 can be replaced by an age-specific projection of the population by 1- or 5-year intervals.

Economic

1. A set of age- and sex-specific labor force participation rates by 5-year cohorts

2. The initial value of per capita GNP

3. The initial stock of capital

4. The initial rate of unemployment

5. The elasticities of GNP with respect to labor and capital

6. The annual rate of technological change

7. Weights to be applied to different age groups in the population to compute the number of equivalent consumers

8. The consumption function parameters (GNP and equivalent consumer coefficients)

OUTPUTS

Levels and Rates of Growth

A. Demographic

1. Population, by age and sex

2. Equivalent consumers

3. Urban population

4. Rural population

5. Age groups

   a. Young dependents (ages 0-14)

   b. Work age (ages 15-64)

   c. Old dependents (ages 65 and over)

   d. School age (variable ages)

6. Net rural-to-urban migration

7. Reduction in births resulting directly from decline in fertility

B. Economic

1. Labor force

2. Employed labor

3. Unemployed labor

4. GNP

5. Total consumption

6. Investment from domestic resources

7. Investment from foreign sources (minimum growth option or foreign capital inflow)

8. Capital stock

Ratios and Derivatives

A. Levels and Rates of Growth

1. GNP per capita

2. GNP per equivalent consumer

B. Values

1. Crude birth rate

2. Crude death rate

3. Life expectancy

4. Gross reproduction rate

5. Ratio of equivalent consumers to total population

6. Ratio of labor force to total population

7. Ratio of labor force to work-age population

8. Unemployment rate

9. Dependency ratios, with the work-age population as the denominator

   a. Young dependents (under 15)

   b. Old dependents (over 64)

10. Age-sex profiles of the population

11. Ratio of capital to employed labor

12. Ratio of investment from domestic sources to GNP

13. GNP per employed laborer

14. Marginal product of capital

15. Marginal product of labor

Obtainable with Additional Data Inputs

1. School enrollment

2. Numbers of teachers required

3. Numbers of classrooms required

4. Expenditures for education

5. Numbers of hospital beds

6. Numbers of physicians and other medical personnel required

7. Expenditures for health

8. Investments in public housing

9. Population below an arbitrarily defined "poverty line"

CHAPTER IV

COMMENTS ON THE INTERPRETATION OF THE MODEL

INTRODUCTION

The purpose of the model is to analyze the effects of different demographic assumptions. It does this by making demographic and economic projections in which all data are identical except for those particular demographic assumptions being contrasted. This chapter discusses certain considerations necessary to the evaluation of these assumptions and the interpretation of the computer results. It also discusses some of the alternative assumptions that might have been made but were rejected.

GENERAL PROCEDURE

It is essential that the user remember that the purpose is to contrast different demographic assumptions. When this contrast is being made, all other assumptions must be held constant. Only the parameters that specify the contrasting demographic conditions can be changed while making the comparative projects. The structure of the models, i.e., the form of the equations, and all other parameter values must remain unchanged from one projection to another.

Thus, comparing a case in which birth rates are held constant with a case in which birth rates decline is invalid if one uses a rate of technological progress of 1.5 percent in the first case and 1.0 percent in the second.

Although this requirement may seem obvious, it is sometimes violated by casual interpreters of the results of experiments similar to those performed with this model. One finds statements to the effect that only a small increase in the rate of technological progress or in the savings rate of a country would match the gains from a substantial reduction in birth rates. In a mechanical way, the statement is true. But when the case of higher birth rates and a higher rate of technological progress is contrasted with a case of lower birth rates and a lower rate of technological progress as

though these were mutually exclusive alternatives confronting decision makers, the statement is valid only if the fall in birth rates is demonstrated to be accompanied by a fall in the rate of technological progress. The latter is a difficult position to substantiate.

PROJECTIONS VERSUS FORECASTS

The user should be cautioned as to a basic limitation of the model. The projections computed with this model are not to be treated as forecasts. They illustrate what would happen if their underlying assumptions are satisfied over the projection period. Although an attempt should be made to use the best assumptions available, the probability that the assumptions used will actually be satisfied is never evaluated. A forecast predicts that certain events will occur or that a certain probability exists that they will occur.

The projections, in combination, demonstrate the relative effects of different demographic assumptions on the growth of various macro-economic variables. In no case, however, are the results of a single projection to be treated as predictions.

THE LEVEL OF AGGREGATION

The model is highly aggregated. The usual caveats apply: heterogeneity of the micro-relationships involved in the aggregates and changes in the composition of the aggregates increase the error associated with the use of the aggregate relationships. These warnings are especially necessary when the models are applied to underdeveloped countries, where the very process of economic development involves changing the nature of the micro-relationships and the composition of the aggregates.

The hazards of aggregation are less for the present purposes, however, than for many. Although aggregation may bias the projection results in an absolute sense, the distortion is not serious unless it affects the projections associated with alternative demographic assumptions differently. Thus, if changing the level of aggregation were to increase the rate of growth of per capita GNP by 10 percent, regardless of the demographic assumptions, choosing the more aggregated relationships would leave the contrast unchanged.

Also, the degree of aggregation is representative of the data generally available and of our knowledge of the systems. Given our

present state of knowledge and the fact that aggregate relationships often exhibit greater stability than the micro-relationships of which they are composed, little is likely to be gained by using a lower level of aggregation.

Finally, conceptualization of the overall scope of demographic-economic relationships commonly operates on an equally high level of aggregation. The model is used to place this conceptualization into a more rigorous framework to reveal the implications of the assumptions commonly used.

THE ABSENCE OF AN EXPLICIT FOREIGN SECTOR

The International Trade Balance

The computer model has very little to say about the relationship of demographic factors to a country's international trade balance. Except when the minimum growth goal option is chosen, the trade balance is assumed to be zero. In the absence of external aid, a zero trade balance seems a reasonable assumption for a long-term projection.

The minimum growth option (see Chapter V for a full discussion) computes the investment from foreign sources required to maintain a minimum annual rate of growth in gross national product (GNP) per capita. Experiments were conducted on a typical but abstract less developed country named Developa. If the minimum rate of growth is 3 percent per year, the required foreign assistance ranges from an initial value of 5 percent of the GNP to from 0 to 15 percent of the GNP in the year 2000, depending on the demographic assumptions. In no way do these computations represent forecasts of anticipated foreign assistance during the next 30 years.

Only general qualitative statements can be made about the effects of different demographic assumptions on a country's international trade balance. An increase in the rate of growth in a country's population is likely, all other things being equal, to increase the country's demand for imports and, with a constant pattern of exports, cause the country's trade balance to deteriorate. This, in turn, will have adverse effects on the country's foreign exchange position, its ability to acquire external aid, and its domestic prices. These changes, plus the different resource position of the country associated with the higher rate of population growth, will have additional effects on the country's imports and exports. We can

predict that the country's foreign trade position will, on balance, be worse off with the higher rate of population growth. The data required to make a quantitative measure of a country's general well-being of the type required for long-term projections are excessive.

The Structure of Exports and Imports

The computer model is intended for general use over a large variety of countries. As a consequence of this and the aggregate nature of the model, nothing is said about the mix of a country's production, consumption, or international trade. An investment good, e.g., a truck, may be produced domestically or it may be received in international trade (perhaps for domestically produced minerals); no distinction occurs in the model.

International Migration

The effects of international migration on a country's population and economy are completely ignored. For the majority of countries, the relative importance of immigration or emigration is minor. In any case, only the most speculative type of projection would be possible.

TREATMENT OF URBAN AND RURAL SECTORS, AND INTERNAL MIGRATION

Differential Demographic Characteristics of Urban and Rural Populations

The mechanism presently used by the computer model makes no distinction between the characteristics of urban and rural populations. These distinctions, including age and sex composition, birth rates and survival rates, and likelihood of rural-to-urban migration, are often substantial.

Determinants of the Rate of Rural-to-Urban Migration

The rate of migration is determined exogenously in the computer model. The determinants of the rate of migration work through uncertain and unspecified mechanisms and are not included as variables in the model. The list of possible candidates includes

1. The cost of migration including the direct cost of relocating and the indirect costs of lost opportunities and investments in the former location

2. The earnings differential

3. Welfare payment differentials

4. Cultural differences

5. The intangible attractions of urban life including the wider range of personal contacts, consumption goods, and employment opportunities

6. Intangible attractions or detractions of the rural life including the "slower pace" (sometimes a plus, sometimes a negative)

Although an increasing amount of empirical work is being done on the determinants of migration, the results are still scant. In particular, determination of the lag structure of the relationship of migration to the above variables demands substantial amounts of data that generally are unavailable.

PRODUCTION FUNCTION

The General Form

The model uses a standard Cobb-Douglas production function, of the form

$$Y_t = z(1 + q)^t K^u N^v$$

where Y is GNP, q is the rate of technological progress, K is the amount of capital, and N is the amount of employed labor. The exponents, u and v , give the percentage increase in GNP that will result from a one percent increase in capital or labor, respectively. The presence of increasing, constant, or decreasing returns to scale depends on whether the sum of u and v is greater than, equal to, or less than unity.

The function treats technological progress in a simple but standard way. Each year, the introduction of better methods of production is assumed to increase by 100q percent the total value of GNP available from any combination of employed capital and labor.

The most common alternative to the Cobb-Douglas production function makes the GNP a function of capital alone and takes the form $Y = aK$ where a is the inverse of the capital-output ratio. This

production function can be considered a special case of the Cobb-Douglas, where $q = 0$, $u + v = 1$ and either (i) labor has a zero marginal productivity ($v = 0$), or (ii) the capital-labor ratio is a constant, $k = (z/a)^{1/v}$.

The assumptions of no technological progress, zero labor productivity, or a constant capital-labor ratio are equally untenable for long-term projections of a developing economy.

Capital

The stock of capital used by the model includes all man-made material means of production. Human capital, however conceptualized or measured, is excluded. The inclusion of human capital would have entailed consideration of the investment element of expenditures on such things as health, formal education, and on-job training. While these expenditures certainly contain an investment element, i.e., their benefits accrue over long periods of time, the problem of measuring that element and of converting it to a form compatible with material capital forced these expenditures to be treated entirely as consumption.

Labor and Employment

The total labor force is measured in strict body-count terms. All members of the labor force rank equally in the model, regardless of considerations of age, sex, or skills.

Labor force participation rates of the work-age population (ages 15 to 64) follow conventional terms, even though these terms are recognized as often not applicable to the conditions of developing countries.* Differences on reported labor force participation often reflect differences in the concepts and framework of employment. Schemes to recognize these differences by using some sort of "equivalent units" of labor or by disaggregating the labor force were rejected because of the absence of either adequate data or an adequate conceptual framework.

*See Gunnar Myrdal, The Asian Drama (New York 1968), for an ex-discussion of the inapplicability of conventional economic concepts to developing countries.

Employed labor is measured in terms of full-time equivalents. Two available laborers make the same contribution to employed labor when both are employed half-time as when one is employed full-time and the other is completely unemployed. The difference between the total labor force and employed labor represents "under-utilized available labor." "Unemployment" is frequently used in this report because of its brevity. The influence on labor productivity of such factors as the state of technology, natural resources per worker, education, and health are reflected in the production function parameters, and kept distinct from measures of labor under-utilization.

The Employment Function

The employment function is based on the assumption that unemployment results primarily from a growth of capital that is too slow to utilize (or "absorb") the available supply of labor. A more rapid growth of capital will result in a more rapid growth of employment.

It also assumes that for a given state of technology and real cost of capital—both determined exogenously in the model*—the incremental capital-labor ratio depends on the real cost of labor. The real cost of labor depends on the state of the labor market, for which the unemployment rate $(L - N)/L$, is the best single measure. (L is the available labor force, and N is the amount of employed labor.) As the unemployment rate falls, the labor market tightens and upward pressures are placed on the real cost of labor.†

Thus, as the unemployment rate falls, the incremental capital-labor ratio tends to increase and the growth in employed labor which results from a given growth in the capital stock becomes smaller. (The reverse takes place when the unemployment rate rises.) In the extreme case of full employment, i.e., a zero unemployment rate,

*Although the state of technology appears explicitly as part of the production function, the cost of capital operates only implicitly through the employment function.

†A tightening of the labor market places upward pressures on real wages. It also creates shortages of particular types of labor skills, causing substitution of inferior types of labor. Although the model does not treat wage rates explicitly and has only one variable for the labor force, L, implying some sort of homogeneity, both wage rates and the heterogeneous nature of labor operate implicitly in th employment function.

employment cannot increase regardless of how rapidly capital grows. In practice, it is usually difficult to drive the unemployment rate below some level for any feasible growth rate of capital.

The employment function used in the model captures these important qualities. Specifically, it takes the following form:

$$N_t = \left(1 + g \frac{K_t - K_{t-1}}{K_{t-1}}\right) N_{t-1}$$

and

$$g = h \left[\frac{(L_{t-1} - N_{t-1})/L_{t-1}}{L_o - N_o)/L_o} \right]$$

where N is employed labor, K is the stock of capital, and L is the labor force. The subscript o indicates that these are initial values. The coefficient h is a parameter.

The coefficient h has two roles. The first is to determine the initial relationship between the growth rates of the capital stock and employed labor. Initially, $g = h$. If h is larger than unity, employed labor initially grows more rapidly than the capital stock. If h is less than unity, employed labor initially grows less rapidly than the capital stock. If h has an initial value of unity, the unemployment rate will rise, fall, or remain constant, depending on whether the growth rate of capital is less than, greater than, or equal to the growth rate of the labor force.

The second role is to determine the effect of a given change in the unemployment rate on the coefficient g. The larger h is, the larger will be the change in the proportionality coefficient, g, which results from a given change in the rate of unemployment. Thus, it measures the sensitivity of the incremental capital-labor ratio to changes in the unemployment rate. In other words, the effects of an increase in h are (1) to increase the value of g for any given unemployment rate, and (2) to increase the sensitivity of g to changes in the unemployment rate.

For example, assume that the value of h is unity and let the initial conditions give a labor force of 1.0 million growing at 3 percent a year, with initial unemployment of 100,000. The percent

growth of employed labor will be equal to the percent growth of capital. If capital grows 3 percent the first year, employed labor will grow at the same speed as the labor force and the unemployment rate will remain at the initial value of 10 percent (103,000 unemployed out of a labor force of 1.03 million).

Assume that at some time in the future, say 1995, the labor force has increased to 2.0 million and is still growing 3 percent a year. Assume also that the growth rate of capital is 6 percent and that the unemployment rate has fallen to 7.5 percent, i.e., 150,000 are unemployed. There are 1.85 million employed. In 1996, the labor force will be 2.06 million. The value of g will have dropped to 0.75*, meaning that the growth of employed labor will be 4.5 percent, three-fourths of the percentage growth of capital. In 1996, 1.933 million will be employed labor. The number of unemployed will fall to 127,000 (2.06 million less 1.933 million) and the unemployment rate will fall to 6.2 percent.

The value of g falls as the ratio of the current to the initial unemployment rate gets smaller. Let h have a value of unity. If the unemployment rate falls to 3.5 percent from an initial value of 14.0 percent, the value of g will fall from 1.00 to 0.25. This means that employment will grow at only one-fourth the speed of the stock of capital. If the labor force is growing 3 percent per year, capital must grow at an annual rate in excess of 12 percent to lower the rate of unemployment any further. This is a healthy rate of growth for any country.

Should the unemployment rate drop to 2 percent, capital would have to grow in excess of 21 percent a year to obtain further reductions in the unemployment rate. It is evident that reductions in the rate of unemployment become successively more difficult—eventually virtually impossible—as the unemployment rate approaches zero.

Optional Treatment of Employment

At the option of the user, the assumption can be made that a condition of full employment exists continually, i.e., employed labor

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* $$g = \frac{(L_{t-1} - N_{t-1})/L_{t-1}}{(L_o - N_o)/L_o} = \frac{0.075}{0.100} = 0.75$$

and the labor force are identical. The contrasts of the fertility cases can then be made in terms of the implied projections of the ratios of capital to labor and of GNP to labor.

CONSUMPTION

Form of the Consumption Function

Total consumption is determined in the model by a function of the form

$$C = c_y Y + c_p P_e$$

where Y is the GNP and P_e is the number of equivalent consumers. Consumption includes all private and public expenditures that do not contribute directly to the net accumulation of capital, i.e., additions to the material means of production of the economy.

It is assumed to be a linear function of the size of the GNP (the more we have, the more we consume) and the number of equivalent consumers (some personal consumption, such as minimum food and shelter requirements, is inelastic income, and many public service requirements, such as education, are closely related to the size and age composition of the population).

Total consumption includes all investment used to replace previously existing capital. This form of consumption, which can be referred to as "capital consumption" or as "replacement investment*," is often assumed to be proportional to the stock of existing capital. Here, it is assumed to be proportional to the GNP. Justifications for this treatment are (1) much replacement investment is as closely related to the volume of production, i.e., GNP, as to the amount of capital being used, (2) its incorporation into total consumption through the coefficient c_p allows consideration of one less parameter and (3) it makes very little operational difference.

As mentioned earlier, consumption includes certain expenditures, e.g., health and education, that have an investment element. Improved nutrition associated with higher levels of consumption also has many short-term and long-term, but unquantifiable, benefits that are neglected in the computer model. We know that this biases

*It is common in most growth models, including the present one, to assume that capital consumption and replacement investment are continuously equal.

the long-term growth of GNP in a downward direction, but we have no measure of the amount of the bias.

The Role of Population and Equivalent Consumers

The size and composition of the population generally are recognized to influence the level of consumption expenditures. These effects are taken into account by the inclusion in the consumption function of a measure of "equivalent consumers." Equivalent consumers is an age-weighted sum of the population, with the weights varying according to the relative effects of different ages on total consumption.

The nature of these weights requires considerably more empirical research. It is common to assume that the weights for the young and the old should be smaller than for those of work age. This assumption is based primarily on a small sampling of household budget studies that consider the effects of family size on consumption expenditures and on extensions of estimates of relative food requirements. This is a weak empirical base, using data primarily from industrialized countries and making an extension from the household budget to the national budget (including public consumption) which may or may not be warranted.

If equivalent consumer weights based solely on household behavior are used, it is probable that the economic gains (in terms of higher total savings and investment) associated with declining fertility will be understated.

GNP, Consumption, and Investment

Once the level of consumption has been established for a given GNP, the level of net investment is determined as a residual. That is,

$$I_t = Y_t - C_t .$$

This assumes that consumption has the first cut from the production pie, and net investment takes whatever is left, small or large.

Although this treatment is plausible, especially for economies with low per capita incomes, it should be recognized that (1) in some cases the treatment of consumption as a residual is equally plausible,

e.g., the Soviet Union during much of the 20th century, and (2) in the general case, consumption and investment are determined jointly.

CHAPTER V

ALGEBRAIC DESCRIPTION OF THE MODEL

GLOSSARY OF VARIABLES AND PARAMETERS

The following notation is used in the presentation of the model: Capital letters are used to denote variables and lowercase letters to denote parameters. The subscript t designates the value of a variable at the end of year t if it is a stock variable, and during the period t if it is a flow variable. The subscripts M and F indicate that the variable or parameter is associated with males or females, respectively. The subscripts U and R indicate that the variable is associated with the urban or rural sector, respectively.

Variables

P_{Mi}	Male population of age cohort i (Age cohort i includes ages 5(i - 1) to 5i - 1 for i equal to 1 through 15. Age cohort 16 includes ages 75 and older.)
P_{Fi}	Female population of age cohort i
P_U	Total urban population
P_R	Total rural population
P	Total population
P_e	Equivalent consumers
MIG	Total net rural to urban migration
B_M	Male births
B_F	Female births
B	Total births
Y	Gross national product (GNP)

K	Stock of capital
L	Total labor force
N	Employed labor force, in full-time equivalents
C	Total private and public consumption, including capital consumption allowances
I	Net investment from domestic resources
FI	Capital accumulation from foreign sources

Parameters

s_{Mi}	Proportion of males of age cohort i surviving to age cohort i + 1 (e.g., from ages 5 to 9 to ages 10 to 14) 5 years later
s_{Fi}	Proportion of females of age cohort i surviving to age cohort i + 1
s_{MI}	Proportion of male births surviving to age cohort 1 (ages 0 to 4)
s_{FI}	Proportion of female births surviving to age cohort 1
b_i	Birth rate for females in age cohort i
w	Ratio of male births to total births
m	Proportion of rural population migrating (net) to the urban sector in a 5-year interval
z	Conversion constant in the production function
q	Annual rate of technological progress
h	Employment function coefficient
u	Elasticity of GNP with respect to capital
v	Elasticity of GNP with respect to labor

p_{Mi} Labor force participation rate for males in age cohort i

p_{Fi} Labor force participation rate for females in age cohort i

c_y Income (GNP) coefficient in the consumption function

c_p Equivalent consumer coefficient in the consumption function

e_i Equivalent consumer weight for age cohort i

DEMOGRAPHIC RELATIONSHIPS (COMPUTED FOR 5-YEAR INTERVALS)

Population Survival

$$P_{Mi,t} = s_{M,i-1,t} P_{M,i-1,t-5} \quad (i = 2, \ldots, 15)$$

$$P_{Fi,t} = s_{F,i-1,t} P_{F,i-1,t-5} \quad (i - 2, \ldots, 15) \qquad (1)$$

Behind this rather formidable looking subscripting lies a very simple interpretation. The number of males or females in age cohort i [between the ages of 5(i - 1) and 5i - 1] in year t is, for i equal to 2 through 15 (ages 5 through 74), some proportion of the number of males or females living in year t - 5. That proportion is $s_{M,i-1,t}$ for males and $s_{F,i-1,t}$ for females. These survival rates change at a constant rate from one schedule to another as explained in Chapter VI.

$$P_{M,16,t} = s_{M,15,t} P_{M,15,t-5} + s_{M,16,t} P_{M,16,t-5}$$

$$P_{F,16,t} = s_{F,15,t} P_{F,15,t-5} + s_{F,16,t} P_{F,16,t-5} \qquad (2)$$

The number of males or females in age cohort 16 (ages 75 and older) in year t is equal to the surviving members of the male or female age cohorts 15 (ages 70 to 74) and 16 (ages 75 and older) present 5 years earlier.

Births

$$B_t = 5\sum_{4}^{10} b_{i,t}\left(\frac{P_{Fi,t} + P_{Fi,t-5}}{2}\right)$$

$$B_{M,t} = wB_t$$

$$B_{F,t} = (1 - w)B_t \qquad (3)$$

In this instance, the subscript t on B_t refers to the 5-year interval ending year t. The number of births during this 5-year interval is equal to the sum of the products of age-specific birthrates, the b_i, and the average female population of age cohort i during the interval multiplied by 5 (since the b_i are annual birthrates and B_t is births over a 5-year interval). Male births are 100w percent of the total births. Women are assumed to be fertile only between the ages of 15 and 49 (age cohorts 4 to 10). Birth rates change at constant rates from one schedule to another as explained in Chapter VI.

Infant Survival

$$P_{M1,t} = s_{MI,t}B_{M,t}$$

$$P_{F1,t} = s_{FI,t}B_{F,t} \qquad (4)$$

The male or female population in age cohort 1 (ages 0 to 4) is equal to the male or female births during the 5-year interval multiplied by an infant survival rate.

ECONOMIC RELATIONS (COMPUTED ANNUALLY)

The demographic projections described above (or supplied independently) are first converted into projections of the size of the labor force (for the projection function) and the number of equivalent consumers (for the consumption function) over 5-year intervals, as described in Equations 5 and 6. These projections are then converted to annual projections by applying a constant percentage rate of growth to each 5-year interval.

Labor Force

$$L_t = \sum_{4}^{13} (p_{Mi} P_{Mi,t} + p_{Fi} P_{Fi,t}) \quad (5)$$

The total labor force L is the sum of the products of the age- and sex-specific labor force participation rates and the corresponding age and sex population cohorts. Only people between the ages of 15 and 64 (age cohorts 4 to 13) are considered potential entrants to the labor force.

Equivalent Consumers

$$P_{e,t} = \sum_{1}^{16} e_i (P_{Mi,t} + P_{Fi,t}) \quad (6)$$

The influence of each individual on the total consumption of the economy depends on his age. The number of equivalent consumers is the weighted sum of the population cohorts. The computer program allows each of the following age-groups to be assigned different weights: 0 to 4, 5 to 9, 10 to 14, 15 to 19, 20 to 64, and over 64.

Total Consumption

$$C_t = c_y Y_t + c_p P_{e,t} \quad (7)$$

Total private and public consumption consists of all production not used for net capital accumulation, i. e., for additions to the material means of production of the economy. It is assumed to be a linear function of the size of the GNP (Y) and the number of equivalent consumers (P_e). See Chapter IV for a full discussion.

Net Investment

$$I_t = Y_t - C_t \quad (8)$$

Net investment from domestic resources is the difference between GNP and total consumption (including capital consumption allowances). See the discussion of consumption in Chapter IV.

Capital Stock

$$K_t = K_{t-1} + I_t + FI_t \tag{9}$$

The capital stock at the end of year t is the sum of the capital stock at the beginning of the year, net investment from domestic resources, and capital accumulation from foreign resources. The foreign capital term can be used either for the minimum growth option or capital inflow analysis.

Employed Labor

$$N_t = \left(1 + g \frac{K_t - K_{t-1}}{K_{t-1}}\right) N_{t-1} \tag{10}$$

where

$$g = h \frac{1 - \left(N_{t-1}/L_{t-1}\right)}{1 - N_o/L_o}$$

The percent increase in employed labor is some proportion, g, of the percent increase in the stock of capital. The proportion is determined by the unemployment rate and decreases from an initial value of h to a value of zero as the unemployment rate decreases from its initial value to zero. The subscript, o, indicates that these are initial values. The coefficient, h, is a parameter.

See Chapter IV for a complete discussion.

An option is available which assumes continual full-employment.

Gross National Product

$$Y_t = z\,(1 + q)^t K^u_{t-1} N^v_{t-1} \tag{11}$$

This is a standard Cobb-Douglas production function, with Y as GNP, q as the rate of technological progress, K as the amount of employed capital, and N as the amount of employed labor. See Chapter IV for full discussion.

ADDITIONAL OPTIONS

Minimum Growth of GNP per Capita

At the option of the user, the computer constrains the annual growth in per capita GNP from falling below a specified minimum. For example, it can be stipulated that per capita GNP must increase by at least 3 percent each year. The amount of investment from foreign sources required annually (if any) to satisfy this constraint is computed by the program.

The growth of capital stock is calculated so that, combined with the associated growth in employed labor determined by Equation 10, it will result in the goal per capita GNP for the following year. This requires the solution of nonlinear equation, solved in this model by the method of false position. *

If the required growth of capital is less than or equal to the net investment generated by Equation 8, nothing in the preceding procedure is changed. If the required growth is greater than that generated by Equation 8, the difference is the required capital accumulation from foreign sources, FI_t.

It should be noted that FI_t is equal to the trade deficit (imports less exports) only under the optimistic assumption that an increase in the trade deficit is associated with an equal increase in capital accumulation. More generally, an increase in the trade deficit will increase both investment and consumption. This can be seen from the common accounting identity

$$\text{GNP} = \text{consumption} + \text{investment} + (\text{exports} - \text{imports})$$

or

$$\text{GNP} + (\text{imports} - \text{exports}) = \text{consumption} + \text{investment}.$$

The sum on the left side of the equality represents the resources available for consumption and investment. An increase in those resources, due to an increase in the trade deficit would, in the general case, increase both consumption and investment.

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* This is a variation of Newton's method. See any text on numerical methods, e.g., Eugene Isaacson and Herbert B. Keller, Analysis of Numerical Methods, (New York: John Wiley and Sons, Inc., 1966) p. 99.

Urban-Rural Demographic Option

At the option of the user, a simple device is used to generate projections of the urban and rural populations from the aggregate projections computed in the manner described earlier.

It is assumed that each year $100m_a$ percent of the rural population represents net rural to urban migration. The rate of migration over a 5-year interval is then

$$m = 1 - (1 - m_a)^5 .$$

Given the size of the rural population in year $t - 5$ ($P_{R,t-5}$) and the size of total population in years $t - 5$ and t (P_{t-5} and P_t), the size of the rural population in year t and the migration during the interval are computed by solving simultaneously the following two equations:

$$M_t = 0.5\, m\, (P_{R,t} + P_{R,t-5}) ,$$

$$P_{R,t} = P_{R,t-5} + \frac{P_t - P_{t-5}}{P_t + P_{t-5}} (P_{R,t} + P_{R,t-5}) - M_t .$$

The first equation states that migration during the interval is 100m percent of the average rural population during the interval. The second equation states that rural population at the end of the interval is equal to the rural population at the beginning of the interval plus the "natural increase"* during the interval minus the net rural to urban migration during the interval. It is assumed that the natural rate of increase is the same for both the rural and total population.

Urban population for any year is the difference between the total and the rural population for the year.

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* That is, the increase resulting from births minus deaths, with migration excluded.

Population Below the "Poverty Line"

This computation is based on the assumption of a constant distribution of income, expressed in terms of the percent of total GNP received by each population decile. Let the ith decile receive 100x percent of the GNP. Then the average income of the people in the ith decile is 1000x percent of the average per capita GNP for the total population. From this data, the percent of the population and total number of people receiving per capita income equal to or less than any given percent of the average per capita GNP can be computed through interpolation.

Given some dollar amount which represents a "poverty line," one needs only to compute this amount as a percent of the average per capita GNP and use the above procedure to compute the number of people "below the poverty line."

Expenditures for Selected Social Service Programs

An option is provided which computes projections of costs of selected social service programs. These projections are discussed in detail in another document.* In summary, however, the calculations are as follows:

> Costs are first computed in physical terms, then converted to money costs if the data allow. There are three basic types of costs—operating costs, replacement investment, and net investment. Operating costs are proportional to the average user population during a projection interval. The number of users of a social service is the product of a participation rate and a relevant population, e.g., an enrollment rate and the primary school-age population. The proportionality coefficient is the product of (1) the ratio of a facility or personnel to users, (2) a unit cost, and (3) the length of the projection interval.
>
> Replacement investment is also proportional to the average user population, with the proportionality constant

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* See Manual for Hand Calculation of Government Expenditures for Selected Social Services, (68TMP-121) which is contained in this kit.

equal to the product of (1) the ratio of a facility or personnel to users, (2) a rate of attrition adjusted for the length of the projection interval, and (3) a unit investment cost. Net investment is proportional to the change in the user population during the projection interval, with the proportionality coefficient being the product of (1) the ratio of a facility or personnel to users and (2) a unit investment cost. Costs may be computed in this manner for the total budget of a social program or for some segment of the budget, such as school construction.

An optional feature of the revised model allows the salaries of social service workers to be dependent on average productivity or GNP per employed worker. This permits the incorporation of cost inflation resulting from differential rates of productivity growth. If the productivity of teachers, for example, shows no improvement while productivity in the economy as a whole grows at three percent a year, teachers' salaries will have to rise at about that rate in order to maintain resources in the teaching profession.

The program allows considerable flexibility in the change through time of the various parameters, ranging from arithmetic change through time to the arbitrary choice of a different parameter value for each projection interval.

CHAPTER VI
DATA INPUTS

The computer program requires two types of data. The first type provides the basic demographic and economic parameters and initial conditions required to carry out the computations for the projections as discussed in Chapter V. The second type is used by the computer as "control variables," giving it instructions regarding what data have been provided, what output options are desired, how far into the future the projections should be carried, etc.

This chapter discusses the basic data required and some of the procedures that might be used to obtain that data. The data used in illustrative projections for the typical country Developa are provided as examples. The control variables and the specific form that all of the data must take as they are read in by the computer are discussed at the end of Chapter VII.

DEMOGRAPHIC DATA

Initial Population

The first data requirement is the initial population of the country, along with its age composition (by 5-year cohorts) and sex composition. Estimates of the size and composition of populations are available for most countries, although in many cases the data are incomplete and biased. Procedures for working with imperfect demographic data are discussed briefly at the end of this section, and in detail in several United Nations publications*, especially two manuals, Methods for Population Projections by Sex and Age, and Methods of Estimating Basic Demographic Measures from Incomplete Data.

*United Nations, Department of Economic and Social Affairs, Manual on Methods of Estimating Population, Manual III, Methods for Population Projections by Sex and Age, Population Studies, No. 25, New York, 1956 (hereafter referred to as Manual III) and Manual on Methods of Estimating Population, Manual IV, Methods of Estimating Basic Demographic Measures from Incomplete Data, Population Studies, No. 42, New York, 1967 (hereafter referred to as Manual IV).

The initial population used for Developa is given in Table 1 and is taken from another excellent reference, Regional Model Life Tables and Stable Populations.* The population is 10 million and has an age composition that corresponds to a stable population† associated with a model South life table with a mortality level of 15 (see the discussion of Survival Rates) and a 3 percent annual rate of growth. The initial population used has an age composition representative of many less developed countries and was selected after a study of the census data provided in the recent Demographic Yearbooks of the United Nations.

Table 1. The initial population of Developa (1000s).

Age	Males	Females	Age	Males	Females
0-4	883	869	40-44	217	218
5-9	720	709	45-49	179	182
10-14	611	603	50-54	145	150
15-19	520	513	55-59	116	122
20-24	439	434	60-64	88	97
25-29	370	367	65-69	63	72
30-34	311	309	70-74	42	49
35-39	261	260	75+	39	46
			Total	5000	5000

* Ansley J. Coale and Paul Demeny, Regional Model Life Tables and Stable Populations, Princeton, N. J., Princeton University Press, 1966.

† A stable population is one generated by the continuation of a constant set of age-specific birthrates and age and sex-specific survival rates and is characterized by a constant rate of growth and age profile.

Survival Rates

Survival rates are the proportion of a population in a particular 5-year age cohort that survives from the beginning to the end of a 5-year interval. The "infant survival rate" used here is slightly different and is the proportion of the live births during a 5-year interval that survives to the end of the interval.

Up to three schedules of survival rates can be used by the program. The user stipulates the time (after the first year of the projection) at which the second and (if desired) the third schedules are to apply. The program interpolates geometrically between the different schedules to provide a set of survival rates applicable for each 5-year interval of the projection. Each survival rate changes by the same percent every 5 years as it moves from one schedule to the next.

The initial schedule of survival rates should conform with the best estimates available describing current mortality conditions in the country. The second and (if used) third schedules allow the consequences of anticipated or hypothesized changes to be analyzed.

The survival rates used for Developa are given in Table 2. They correspond to model life tables* from Regional Model Life Tables and Stable Populations. The first represents mortality level 15 of the South life tables and the second represents mortality level 19 of the West life tables. The mortality levels designate the life expectancy at birth, with level 15 giving a life expectancy of 55 years for females and 52 years for males and level 19 giving a life expectancy of 65 years for females and 61 years for males. The region, South or West, designates the age pattern of the survival rates. Survival rates for the young and the old are low in the South tables, relative to the West schedules.

The first schedule is representative of those implied by the life tables published by the United Nations in the 1963 Demographic Yearbook. The increase in life expectancies, with the largest relative changes in survival rates occurring in the younger and older ages, is consistent with the general expectations of many less developed countries. The transition is assumed to require 50 years.

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* A life table provides measurements of a particular level and age pattern of mortality. The survival rates normally appear in a column labelled either P(X) or ${}_5L_{x+5}/{}_5L_x$.

Table 2. Survival rates for Developa.

Age	Males		Females	
	Schedule 1	Schedule 2	Schedule 1	Schedule 2
Infants	0.8474	0.9299	0.8599	0.9428
0-4	0.9479	0.9826	0.9496	0.9851
5-9	0.9870	0.9929	0.9874	0.9939
10-14	0.9880	0.9918	0.9883	0.9932
15-19	0.9819	0.9878	0.9842	0.9904
20-24	0.9782	0.9853	0.9810	0.9879
25-29	0.9767	0.9840	0.9792	0.9859
30-34	0.9736	0.9809	0.9773	0.9833
35-39	0.9680	0.9753	0.9743	0.9795
40-44	0.9588	0.9658	0.9701	0.9735
45-49	0.9447	0.9507	0.9615	0.9635
50-54	0.9227	0.9277	0.9465	0.9480
55-59	0.8887	0.8933	0.9188	0.9228
60-64	0.8368	0.8433	0.8708	0.8815
65-69	0.7559	0.7713	0.7924	0.8158
70-74	0.6351	0.6705	0.6743	0.7182
75+	0.3958	0.4286	0.4250	0.4644

Birth Rates

The program requires birth rates that are age-specific for 5-year cohorts. Up to three schedules can be used, the first representing the initial conditions, the second and third designating hypothesized changes in the birth rates. The computer interpolates between the birth rate schedules supplied in the same manner as described for survival rates.

The birth rates used for Developa are given in Table 3. The initial set implies a gross rate of reproduction of 3.02 and a crude birth rate of 44 per 1,000 for Developa's initial population. The second

set implies a gross rate of reproduction of 1.48 and a crude birth rate of 22. The first set of birthrates has the "broad-peak, high-fertility" age pattern, published in Population Bulletin of the United Nations, No. 7,* and is an average of the birth rates of 13 African, Asian, and Latin American countries. The second set has the "broad-peak, low-fertility" age pattern and is an average of 16 countries, primarily European. The ratio of male to female births is assumed to be 1.05.

Table 3. Birth Rates for Developa (per 1000 females).

Age	Schedule 1 (High)	Schedule 2 (Low)	Ratio of Low to High
15-19	111	35	0.32
20-24	295	180	0.61
25-29	304	181	0.60
30-34	248	114	0.46
35-39	183	59	0.32
40-44	81	20	0.25
45-49	20	18	0.90

The difference in age patterns is apparent when the ratios of the two schedules are computed, as shown in the last column of Table 3. The sharpest decline is in the younger and the older women's birth rates (neglecting the last cohort, ages 45-49, which is relatively low in the initial birthrate schedule). The differential effect may be justified by the hypothesis that a larger share of the relatively young and the relatively old will accept family planning, compared to the intermediate ages. The older are generally of higher parity and have been found to be receptive to family planning programs. The younger also will be influenced more heavily by tendencies to marry later and to participate in the labor force.

Three different fertility assumptions were contrasted for Developa. Case I, the High-Fertility Case, assumes that age-specific birth rates remain at the initially high level for the duration of the population

* Department of Economic and Social Affairs, Population Bulletin of the United Nations, No. 7, 1963, United Nations, New York, 1965.

projections. Case II, the Medium-Fertility Case, assumes that birth rates decline at a constant rate to the second schedule of birth rates in 100 years. The gross reproduction rate reaches 2.42 in 30 years (by the year 2000), the duration of the projections. Case III, the Low-Fertility Case, assumes that birth rates decline at a constant rate to the second schedule in 25 years, and then remain constant.

Optional Treatment of Urban and Rural Populations

At the option of the user, a simple device may be used to divide the population between the urban and rural sectors. (See Chapter V.) The data required are (1) an estimate of the initial ratio of the rural population to the total population and (2) an estimate of the current ratio of annual net rural-urban migration to the total rural population.

For Developa, the initial ratio of rural to total population was assumed to be 0.70, and the ratio of net migration to the rural population was assumed to be 0.01.

THE USE OF STABLE POPULATION TECHNIQUES

Introduction to the Problem

The availability and quality of demographic data varies widely from country to country. At one end of the scale may be only rough guesses of the total population and how rapidly it is growing. Or, there might be census data (for 1 or more years) on the age and sex distribution of the population, possibly supplemented by survey and registration data on conditions of mortality and fertility. If these data are in the raw state, further refinement is required to correct for various distortions that usually are present. At the other end of the scale may be a complete set of demographic data that has already been refined and is ready to use.

Many times, small amounts of data of questionable quality can be combined with materials available on stable populations to obtain a set of data suitable for the demographic projections of the TEMPO model. The purpose of this section is to acquaint the reader with the general nature of stable population techniques.* Following a brief

* The refinement of demographic data and development of population projections constitute a major field which lies far beyond the scope of the present discussion.

introductory discussion, an example is given of their use under a special set of conditions. For a more general discussion of stable population techniques, the reader is directed to Manual IV, or the Coale and Demeny volume.

Characteristics of a Stable Population

If it maintains constant conditions of mortality and fertility, a closed population will eventually attain a constant age distribution and a constant rate of growth. Such a population is known as a "stable population." In the strict sense, stable population analysis is applicable only when these conditions are satisfied. In the words of one widely used United Nation's population study,

> The question of when estimates can be based on stable analysis is easily answered in principle: whenever fertility has been subject to no more than low-amplitude and short duration variations during the previous five or six decades, and mortality has changed only slightly and gradually during the past generation. *

The techniques may also be used, with modifications, to deal with so-called "quasi-stable" populations. These are characterized by relatively constant fertility conditions and declining death rates. The reader is referred to the U. N. 's Manual IV for a brief discussion of the application of these techniques to quasi-stable populations.†

For every population with a constant age distribution and a constant growth rate, there is a unique set of age-specific survival rates or life table. Conversely, for every set of age-specific survival rates and constant growth rate exists a stable population with a unique age distribution. Stable population analysis utilizes these relationships and others directly derivable from them.

Regional Model Life Tables and Stable Populations

The source of the most extensive materials for stable population analysis is the Coale and Demeny volume referred to earlier in this section. It presents four families of model male and female life

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* Manual IV, p. 12, op. cit.
† Manual IV, pp. 25-29, op. cit.

tables and stable population age distributions, identified by the designations East, North, South, and West. These "regional" tables are characterized briefly as follows:

East. The East model tables summarize life tables from Austria, Germany, Czechoslovakia, North and Central Italy, Hungary, and Poland. They are characterized by high mortality in infancy and increasingly high rates over age 50.

North. These summarize tables from Norway, Iceland, and Sweden until 1920. They are characterized by low infant mortality rates and rates that are lower by an increasing margin for ages beyond 45 to 50.

South. These summarize tables from Spain, Portugal, and Southern Italy. They are characterized by high mortality under age 5, low mortality from about age 40 to age 60, and high mortality over age 65.

West. The West tables, which represent the typical age pattern of mortality evidenced by the 326 life tables used, reflect the life tables of Australia, Belgium, Canada, Denmark, England and Wales, Estonia, Finland, France, Ireland, Israel, Japan, Latvia, Luxemburg, Netherlands, New Zealand, Scotland, Sweden from 1931, Taiwan, the Union of South Africa white population, and the United States.

The most available and commonly used tables are those for the West region. Many parts of the world, however, are represented better by the East or South tables with their higher mortality rates for the very young and the very old. If these tables are available to the user and appear more appropriate to the user's country, he should probably use either the East or South tables. Otherwise, he can use the West tables, recognizing that an additional (but probably small) amount of distortion is present.

The next section illustrates the application of stable population techniques to a hypothetical set of demographic data. Although it is specialized, the nature of the example will demonstrate how a full set of demographic data can be constructed from very modest amounts of raw materials.

Illustration of the Demographic Data Selected from Stable Population Materials

Assume that we are given the data in Table 4 for a country.

Table 4. Hypothetical demographic data.

Female Population by Age			
Age	Female Population (1000s)	Age	Female Population (1000s)
0-4	360	35-39	82
5-9	314	40-44	90
10-19	202	45-49	76
15-19	194	50-54	70
20-24	202	55-59	40
25-29	134	60-64	46
30-34	146	over 64	44

Population Totals (1000s)		
Male	Female	Total
1,985	2,000	3,985

Ratio of male to female births: 1.05

Annual growth rate of population: 3.0 percent

Only the female population is given by age. Although the female ages obviously are misreported, the distortion in our hypothetical country is much worse for males. We therefore will use the female age composition and stable population tables to obtain an age distribution for the males.

Also, the conditions in this country that determine the age pattern of fertility are similar to those in a neighboring country with the following age-specific birth rates:

Age	Birth rate (per 1000)	Age	Birth rate (per 1000)
15-19	85	35-39	140
20-24	227	40-44	62
25-29	234	45-49	15
30-34	190		

Finally, evidence exists that conditions of fertility and mortality have been constant long enough to approximate the requirements for stable population analysis. The conclusion is based on the relative constancy of the age distribution reported by the censuses of the last 20 years, in addition to the opinions of medical authorities.

The data needed for the demographic projections can be derived using these materials and the stable population materials available in the United Nations' Manual IV. The needed data are: (1) the initial population by age and sex, (2) an initial set of survival rates by age and sex, (3) an initial set of age-specific birth rates, (4) the ratio of male to female births, and (5) assumptions that specify how the survival rates and birth rates will change during the projection. The fourth item is given to us in the basic data, and the fifth is based primarily on assumptions. The example demonstrates how the first three types can be obtained.

First, the female age distribution and the annual rate of growth are used to find a West life table (West is the only "region" available in Manual IV) with the appropriate level of mortality. This is done by (1) computing a cumulative age distribution for the female population, (2) determining which mortality level would, with a rate of growth of 3.0 percent, result in the proportion of the female population up to each specified age, and (3) taking the median of the mortality levels thus computed.

The first step requires finding the ratio of each 5-year cohort to the total female population, then, for every 5th year adding the cohorts up to the specified age to find the portion of the female population under that age. The results of these calculations are given in Table 5. The second step will generally require linear interpolation. For example, with the 3.0 percent growth rate, the West female model life tables result in 53.65 percent and 52.62 percent of the population below the age of 20, with mortality levels of 17 and 19, respectively. Our population has 53.5 percent of the reported female population below the age of 20. This percent is 0.15(15/103) times the distance between 53.65 and 52.62. The mortality level obtained by linear interpolation is 0.15 times the distance between 17 and 19 (17 plus 0.15 times 2), or 17.3.

Only the first nine cohorts are used in these calculations. The results of the second step are presented in Table 6.

The median mortality level is 15.8. The female age distribution associated with this mortality level is contrasted with the reported age distribution of our hypothetical country in Figure 2.

Table 5. Demographic data calculation results.

Age Cohort X	Portion of Population in Age Cohort Z	Age Z	Percent of Population Under Age X
0-4	18.0	5	18.0
5-9	15.7	10	33.7
10-14	10.1	15	43.8
15-19	9.7	20	53.5
20-24	10.1	25	63.6
25-29	6.7	30	70.3
30-34	7.3	35	77.6
35-39	4.1	40	81.7
40-44	4.5	45	86.2
45-49	3.8	50	90.0
50-54	3.5	55	93.5
55-59	2.0	60	95.5
60-64	2.3	65	97.8
over 64	2.2		

Table 6. Mortality level calculation results.

Age	Mortality Level	Age	Mortality Level
5	13.5	30	16.1
10	11.5	35	14.1
15	16.1	40	16.2
20	17.3	45	15.8
25	14.9		

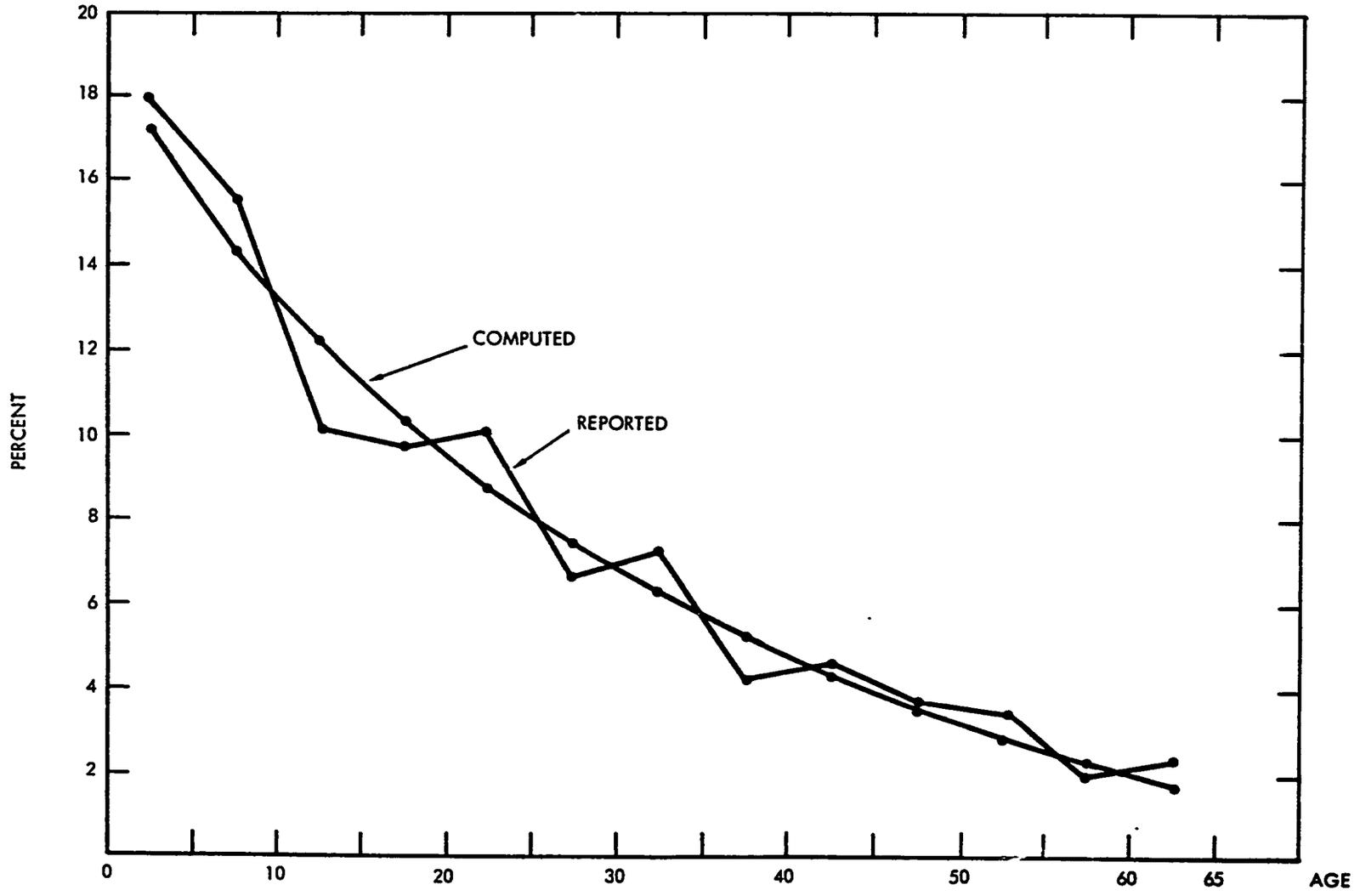

Figure 2. Contrast of reported female age distribution and age distribution computed for mortality level 15.8. (The value at the midpoint of each 5-year interval gives the percent of the total population in that interval.)

This mortality level, the age distribution of the associated stable population, and the rate of growth of 3.0 percent imply a death rate of the female population of 0.0115 and a birth rate of 0.0415. The expectation of life at birth is 57.0 years.

These parameters, the ratio of male to female births, and the ratio of males to females in the population* are then used to compute estimates of the male parameters.

We first compute the male birth rate, using the formula

$$\text{male birth rate} = \frac{(\text{female birth rate})(\text{sex ratio at birth})}{(\text{sex ratio of population})}$$

$$= \frac{(0.0415)(1.05)}{(1,985/2,000)}$$

$$= 0.0439.^{\dagger}$$

By subtracting the growth rate of 3.0 percent, or 0.0300, from the male birth rate of 0.0439, we obtain a male death rate of 0.0139. The growth rate of 3.0 percent and death rate of 0.0139 identify the West male mortality level of 15, with a life expectancy at birth of 51.8 years.

The crude birth rate (for the total population) is obtained as a weighted average of the male and female birth rates, as follows:

$$\text{Crude birth rate} = \frac{(\text{male pop.})(\text{male birth rate})+(\text{female pop.})(\text{female birth rate})}{(\text{total population})}$$

$$= \frac{(1,985)(0.0439)+(2,000)(0.0415)}{(3,985)}$$

$$= 0.0427$$

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* Caution: Under-reporting of males is an important cause of faulty age-distributions. The procedure used here implies that this is not a problem in our hypothetical country.

† This formula is derived from the identity

$$\frac{\text{male birth rate}}{\text{female birth rate}} = \left(\frac{\text{male births}}{\text{male pop.}}\right) / \left(\frac{\text{female births}}{\text{female pop.}}\right) .$$

We now have all of the material necessary to compute the needed demographic data in a straightforward fashion.

INITIAL POPULATION. The age distributions of the initial male and female populations are taken from the stable populations associated with the growth rate of 3.0 percent and the mortality levels of 15 for males and 15.8 for females. In this instance, the male age distribution can be taken from available tables. The female age distribution must be obtained by linear interpolation of the stable population tables for mortality levels 15 and 17. The interpolation is applied to the cumulative age distributions. Table 7 illustrates the process.

The derived cumulative distribution then is decomposed to obtain the desired age distribution.

Table 7. Cumulative female age distributions for mortality levels 15, 17, and 15.8.

Percent of Population under Age X Mortality Level			
Age X	15	17	15.8
5	17.5	17.0	17.3
10	32.0	31.2	31.7
15	44.3	43.3	43.9
20	54.8	53.6	54.3
25	63.6	62.4	63.1
30	71.0	69.8	70.5
35	77.1	76.1	76.7
40	82.3	81.3	81.9
45	86.6	85.7	86.2
50	90.1	89.3	89.8
55	93.0	92.3	92.7
60	95.3	94.8	95.1
65	97.0	96.7	96.9
70	98.3	98.1	98.2
75	99.2	99.0	99.1

Table 8 shows the derived female age distribution and the male age distribution associated with mortality level 15. The initial male and female populations are then computed by multiplying these age distributions by the total male and female populations.

Table 8. Male and female population distribution.

Ages	Male		Female	
	Percent	Population (1000s)	Percent	Population (1000s)
0-4	17.8	353	17.3	346
5-9	14.7	292	14.4	288
10-14	12.4	246	12.2	244
15-19	10.6	210	10.4	208
20-24	8.9	177	8.8	176
25-29	7.5	149	7.4	148
30-34	6.2	123	6.2	124
35-39	5.2	103	5.2	104
40-44	4.3	85	4.3	86
45-49	3.5	69	3.6	72
50-54	2.8	55	2.9	58
55-59	2.2	44	2.4	48
60-64	1.6	32	1.8	36
65-69	1.1	22	1.3	26
70-74	0.7	14	0.9	18
75+	0.6	12	0.9	18
Total	100.1	1986	100.0	2000

SURVIVAL RATES. The initial survival rates are taken from the model life tables associated with mortality levels 15 for males and 15.8 for females. Again, the survival rates for males are taken directly from available tables, but the female survival rates are obtained by interpolation. Linear interpolation is applied to the survival

rates* of the model life tables for mortality levels 15 and 17. The computed female survival rates and the male survival rates for level 15 are shown in Table 9.

Table 9. Survival rates.

Age[a]	Female			Male
	Level 15	Level 17	Level 15.8	Level 15
0	0.889	0.917	0.900	0.872
1	0.961	0.974	0.966	0.954
5	0.986	0.990	0.988	0.986
10	0.985	0.990	0.987	0.985
15	0.980	0.986	0.982	0.979
20	0.976	0.982	0.978	0.974
25	0.972	0.980	0.975	0.971
30	0.969	0.976	0.972	0.966
35	0.964	0.972	0.967	0.958
40	0.958	0.966	0.961	0.946
45	0.946	0.955	0.950	0.929
50	0.927	0.938	0.931	0.904
55	0.897	0.910	0.902	0.866
60	0.849	0.865	0.855	0.811
65	0.778	0.797	0.786	0.736
70	0.676	0.697	0.684	0.632
75	0.424	0.443	0.432	0.393

[a]Below is the age notation that will be found in the model life tables. The rows designated 0, 1, and 75 give the survival rates for "infants," ages 0-4, and over 74, respectively. The other rows give the survival rates for the 5-year cohort beginning with the age given.

* Labeled P(X) in the Demeny and Coale volume, and ${}_5L_{x+5}/{}_5L_x$ in the U. N. 's Manual IV.

BIRTH RATES. The initial age-specific birth rates are obtained from the female population from ages 15 to 49, the crude birth rate calculated previously, and the age-specific birth rates of the neighboring country given in the basic data. The first step in the calculation is to apply the neighboring country birth rates to our computed female population. This implies some crude birth rate which, in general, will not equal the desired crude birth rate. The ratio of the desired crude birth rate to the crude birth rate just calculated is then multiplied by the neighboring country birth rates to obtain the desired initial age-specific birth rates for our country. These calculations are illustrated in Table 10.

Table 10. Initial computed births.

Ages	Neighbor birth rate (per 1000)	Female population (1000)	Computed births (1000)
15-19	85	208	17.7
20-24	227	176	40.0
25-29	234	148	34.6
30-34	190	124	23.6
35-39	140	104	14.6
40-44	62	86	5.3
45-49	15	72	1.1
Total		918	136.8

Crude birth rate implied by neighboring birth rates: 34.3 per thousand.
Desired crude birth rate: 42.7 per thousand.
Ratio of desired to computed birth rate: 1.248.

The resulting age-specific birth rates are as follows:

Ages	Birth rate per 1000	Ages	Birth rate per 1000
15-19	106	35-39	175
20-24	283	40-44	77
25-29	292	45-49	19
30-34	237		

Specialized Nature of the Example

The preceding example, while illustrative of the nature of stable population techniques, is specialized in two important aspects. First, it assumed that the population was very nearly stable in a literal sense. Unstable populations are the rule, not the exception. Second, the specific set of demographic data available for the country depicted only one of many data situations the reader might confront.

UNSTABLE POPULATIONS. The assumption that the population is stable can always be made as an approximation. However, systematic divergences from the characteristics of a truly stable population commonly exist. If it is large enough, the divergence seriously can affect the results of the projections.

Almost universally, mortality has been improving, i. e., survival rates increasing, during recent decades. A population with improving mortality and relatively constant fertility, known as a quasi-stable population, is what one would expect to find in most of the less developed countries. *

More troublesome, but infrequent, are populations for which mortality has been improving and birth rates falling. Finally, one must constantly be on the alert for extraordinary events, such as wars, that may affect seriously the age composition and growth of a population. Some corrections can be made for these factors, but they generally require significantly greater sophistication in demographic techniques.

AVAILABILITY OF DATA. We need do no more with this topic than call to the reader's attention the great variety of data conditions one might confront. He might have only crude estimates of a population size and rate of growth. He might have used both male and female populations, otherwise repeating the procedures of the example. He might have additional materials on the conditions of mortality and fertility. Or, he might have a complete set of data, ready for use without modification, that has been prepared by someone else.†

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* Manual IV, pp. 25-29, op. cit.

† Nathan Keyfitz and Wilhelm Flieger, in World Population, (Chicago, University of Chicago Press, 1968) have compiled substantial amounts of demographic data for many countries.

As the example demonstrates, however, one can go quite far combining stable population materials with quite meager amounts of country-specific data.

ECONOMIC DATA

Labor Force Participation Rates

The reported proportion of each sex and age cohort in the labor force varies substantially from country to country. This is especially true of female labor force participation rates. Sometimes these differences represent true differences in the behavior of the populations, but often they are due to different methods and definitions used in the collection of the basic data.

The participation rates used for Developa and presented in Table 11 were chosen as representative of those found in the 1967 Yearbook of Labor Statistics.* Variation in male participation rates is relatively small. In every continent, however, examples can be found of female participation rates that are either substantially higher or substantially lower than those used for Developa.

Table 11. Labor force participation rates.

Age	Males	Females
15-19	0.70	0.30
20-24	0.90	0.40
25-29	0.99	0.50
30-34	0.99	0.60
35-39	0.99	0.60
40-44	0.99	0.60
45-49	0.95	0.60
50-54	0.95	0.60
55-59	0.90	0.50
60-64	0.70	0.40

* International Labour Office, Geneva.

Equivalent Consumer Weights

Very few reliable statistics exist on the effects of age composition on the total (private and public) consumption of an economy. A general assumption is that, for a given population and GNP, a population which has relatively more young and old people will have smaller consumption expenditures.

A cross-sectional study of total consumption, however, recently found evidence that, for a given population, the ratio of consumption to GNP changes directly with changes in dependency ratios.* This is in direct opposition to the findings one would anticipate from weights of the nature commonly used in the computation of equivalent consumers.

The Coale-Hoover study of the Indian economy used the weights of 0.5 for children under 10, 0.9 for females 10 and older, and 1.0 for males 10 and older. These were apparently based on weights used for dietary standards set up by the Nutrition Advisory Committee of the Indian Council of Medical Research.† More recently, E. Kleiman used a range of weights derived from studies of family budgets and nutritional requirements. His weights ranged from 0.11 to 0.37 for children under 1, to from 0.84 to 0.86 for people ages 15 to 19, and to 1.0 for people over 19.**

The computer program allows different weights to be assigned to each of the following age groups: 0-4, 5-9, 10-14, 15-19, 20-64, and over 64.

The projections for Developa use weights of 0.75 for those under 15, 1.0 for those ages 15 to 64, and 0.5 for those older than 64. The weight for the younger population is larger than that used or implied by earlier studies, whereas the weight for the older population is smaller. (The proportion of older people is small enough—initially, 3 percent—to minimize the importance of the weights applied to them.) The choice of weights reflects the implications of the cross-section study of total consumption and the feeling that insufficient attention has been devoted to the role of public consumption in earlier studies.

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* N. H. Leff, "Birth Rates and Savings Rates," American Economic Review, forthcoming.

† A. J. Coale and E. M. Hoover, Population Growth and Economic Development in Low-Income Countries, Princeton, N. J., Princeton University Press, 1958, p. 88.

**E. Kleiman, "Age Composition, Size of Households, and the Interpretation of Per Capita Income," Economic Development and Cultural Change, October 1966, p. 37.

The ratio of government to private consumption commonly ranges from 0.15 to 0.25.*

Whatever weights are chosen should be considered very tentative, given the present state of knowledge. Preliminary experimentation, however, indicates that the results are insensitive to rather wide variations in the weights chosen.

Consumption Function Parameters

The consumption function of a country might be statistically estimated to obtain the required parameters. Inadequate data and statistical difficulties common to the estimation of consumption functions often preclude this procedure.

Another procedure is to assume a value for one of the two coefficients (for GNP or for equivalent consumers) and to use this value combined with an average of the recent ratio of total consumption (including capital consumption allowances) to GNP to solve for the second coefficient. The reasonableness of the estimates of the parameters should then be checked by the behavior of consumption relative to GNP through time.

The following procedure was developed for Developa:

First, the initial ratio of consumption to GNP was determined to approximate 0.93. The value of this ratio will approach the value of the GNP coefficient as per capita GNP increases. Historical experience indicates that the ratio of total consumption to GNP will fall rarely below 0.80. This value, 0.80, then was chosen for the GNP coefficient. Combined with a value of $30† for the coefficient for

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* Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of National Accounts Statistics, 1966, New York, 1967, pp. 681-691.

† $C/Y = c_y + c_p (P_e/P)(P/Y)$.

Given that $c_y = 0.80$, $P_e/P = 0.8748$, $P/Y = 0.005$, and $C/Y = 0.93$, we can solve the preceding equation to find a suitable value for C_p.

$$0.93 = 0.80 + (0.8748)(0.005)C_p$$

or

$$C_p = 0.13/0.0044$$
$$= 29.55$$

This was rounded to $30 to avoid the appearance of specious accuracy.

equivalent consumers, an initial ratio of equivalent consumers to population and the choice of equivalent consumer weights, and an initial per capita GNP of $200, the resulting ratio of total consumption to GNP is 0.931.

Experimentation with other values of the coefficients that yield an initial ratio of total consumption to GNP of approximately 0.93 indicates that the results are relatively insensitive to the particular coefficients chosen.

Production Function Parameters and Initial Conditions

In some cases, adequate data may be available to estimate the parameters of the production function: the conversion constant (z), the rate of technological progress (q), and the elasticities of GNP with respect to capital (u) and labor (v).

In many cases, however, resort to reasonable conjectures will lead to estimates that are at least as satisfactory as statistical estimates. (Statistical estimates sometimes have the unhappy quality of summarizing a past that poorly represents the course of future events.)

The procedure used for Developa is as follows:

The initial value of $200 for per capita GNP was chosen as representative of many developing countries. This, plus the initial population of 10 million, lead to an initial GNP of $2 billion. The initial population combined with labor force participation rates and an estimate of initial unemployment rate (15.0 percent was chosen as representative) lead to an initial employed labor force of approximately 3.6 million.

A rate of technological progress of 1.5 percent per year was chosen to represent a moderately progressive economy. (The choice of a higher rate is possible, although one must proceed carefully. A rate of 2 percent or higher may present an unduly optimistic picture of the future, regardless of the demographic assumptions.)

The elasticities of GNP with respect to labor and capital are often measured in terms of the share of total income received as compensation for employment and all other. Regardless of the theoretical justifications, such estimates commonly are consistent with those

implied by statistically estimated production functions. One must also make a decision regarding the returns to scale he feels are applicable.

For the case of Developa, modestly diminishing returns to scale were assumed. The sum of the elasticities of GNP with respect to capital and labor was therefore placed at 0.95. This implies that, for a given state of technology, doubling the amounts of both capital and labor results in an increase in the GNP by a factor of 1.97.

The specific elasticities used were 0.35 for capital and 0.60 for labor. These are based on the share of total income received as compensation of employees for a wide range of countries, as reported in the 1966 Yearbook of National Accounts Statistics, accompanied by the assumption that a substantial portion of the income reported as profits to unincorporated business represents wages to self-employed labor. *

Finally, an estimate of the initial stock of capital is required. This was obtained by assuming that the initial capital-output ratio was 2.5. This is compatible with incremental capital-output ratios of from 3 to 4, under the assumption that the incremental ratios of most developing countries are substantially greater than the average ratios. It is also consistent with estimates for India and Mexico published by the International Association for Research in Income and Wealth.† Given the initial value of the capital-output ratio and the initial value of the GNP, the initial stock of capital ($5 billion for Developa) is quickly computed.

Substitution into the production function of the initial values of GNP, capital, and employed labor and the values of the elasticities of GNP with respect to capital and labor, the necessary value of the conversion constant (z) can be computed. (The last calculation is done by the computer.) For Developa, z is equal to 819.9.

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* A selection of LDCs was taken from the United Nation's 1966 Yearbook of National Accounts Statistics for which data on "compensation of employees," "income from unincorporated enterprises," and "national income" were reported. The share of national income going to labor was computed for each country, under the assumption that one-third of the income reported as "income from unincorporated business" represented wages to self-employed labor. The shares ranged from a low of 0.49 to a high of 0.74 and had mean and median values both equal to 0.615. The share was rounded to 0.60 to avoid the appearance of specious accuracy.

† The Measurement of National Wealth, R. Goldsmith and C. Saunders, eds., London, 1959, p. 32.

DATA FOR OPTIONAL PROJECTIONS

Population Below the "Poverty Line"

The data required for this option are (1) a per capita income that designates the "poverty line" and (2) an income distribution for the country, divided by deciles of the population. Only the bottom portion of the income distribution, initially covering at least incomes up to the poverty line, is required.

Reliable data on income distributions in less developed countries are relatively scarce and will generally be most easily obtained from local sources. The income distribution used for Developa is taken from material in Gunnar Myrdal's Asian Drama, which contains data on several Asian countries, and a 1963 article of Simon Kuznets, * which contains data on several other countries.

The "poverty line" chosen for Developa was $100, 50 percent of the per capita GNP. The income distribution used gave 5 percent of the GNP to the eighth decile of the population, 4 percent to the ninth decile, and 2 percent to the bottom decile of the population.

Expenditures for Selected Social Services

The specific data required for the social service projections is listed in the next chapter under the section on data formats. The nature of these data is described in detail in Manual for Calculation of Government Expenditures for Selected Social Services.

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* Quantitative Aspects of the Economic Growth of Nations: VIII. Distribution of Income by Size," Economic Development and Cultural Change, January 1963, pp. 1-80.

CHAPTER VII
GUIDE TO THE COMPUTER PROGRAM*

The discussion in the first part of this chapter provides the information required for a user to interpret the printout of the computer program. The second part discusses the control variables used by the program and the specific form the data inputs must take.

GUIDE TO THE PRINTOUT

The following guide is keyed to the first pages of the Developa printout.** Subsequent pages repeat the formats outlined here.

Page 1:

The first output is a descriptive statement of the set of projections to follow. This would normally include the name of the country being projected, the date of the computer runs, and any other information (within broad space constraints) the user desires.

At the top of each subsequent page is a two-line statement which identifies each specific projection.

Page 2:

A list of the values of certain control variables used by the program is given. These variables are discussed in the second part of this chapter, under DATA FORMATS.

Page 3:

This page presents the initial population used, classified by age and sex and the same classifications as proportions of the total population. If a projection of the population is supplied independently, it

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* The changes in the operating instructions that occurred with revision of this model are detailed at the end of this chapter. The changes are also noted with a †.

**The guide assumes that all of the original tables have been printed.

will begin on page 3, and the demographic data described for pages 4 and 5 will be omitted.

Page 4:

This page contains the mortality information used by the program. The survival rate schedules (up to three) used are listed by age and sex, in addition to the life expectancy at birth implied by each schedule. The year to which each schedule applies is also given.

Page 5:

This page contains the fertility information used by the program. Above the table is the ratio of male births to female births. The table lists the age-specific birth rates (up to three sets), in addition to the gross rate of reproduction and the crude birth rate (for the initial population) implied by each schedule of birth rates. The year to which each schedule applies is also given.

Page 6:

This page presents the economic parameters and initial conditions required by the program, with identifying labels.

Page 7:

The aggregate results of the demographic projection are printed out for every five years. These include the total population at the end of the 5-year interval, the births and deaths during the interval, the crude birth rate for the interval (with the average of the beginning and ending populations as the denominator), the crude death rate for the interval, the life expectancies at birth for males and females implied by the survival rates used for the interval, and the gross reproduction rate implied by the birth rates used for the interval.

Pages 8 and 9*:

These pages present the population projection classified by age and sex, and the ratios of these age and sex groups to the total population.

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*Optional.

Pages 10 and 11*:

These pages present the age-specific birth rates and the age- and sex-specific survival rates used for each 5-year interval of the projection.

Page 12*:

The material on this page gives the population projection for the urban and rural sectors, in addition to the parameters used to obtain these projections.

Pages 13 and 14*:

These two pages present material on the reduction of births which results directly from the decline in birth rates, broken down by 5-year cohorts. Page 13 gives tables on the reduction of births, first in absolute numbers and then as a proportion of the births which would have occurred if there had been no reduction in birth rates.

Page 14 presents results on the relative decline of birth rates, on the number of women, by age, who are effectively practicing family planning (under the assumption that this is the sole cause of the decline in birth rates), and the number and proportion between the ages of 15 and 59 who are effectively practicing family planning.

Page 15:

Several tables are presented on this page which give projections of various age groups and of the labor force. The ratios of these groups to the total population and to the population between the ages of 15 and 64 are also given. The age groups include ages 0 to 14, 15 to 64, over 64, primary school age, and secondary school age.

Page 16*:

This page presents the principal results of the economic projections. Projections are printed for GNP, total population, per capita GNP, capital stock, labor force, investment from domestic sources, the unemployment rate, the ratio of investment to GNP, and the capital stock per employed worker. Although the economic projections are made year-by-year, the economic results can be printed (on these and the following pages) for any interval, e.g., every 5 years.

*Optional.

Page 17*:

The results given on the preceding page are repeated here in two different forms. One table presents the projections in index number form. A second table presents the results as annual rates of growth. The unemployment rate, ratio of investment to GNP, and capital stock per employed worker are not included in these two tables.

Page 18*:

The table on this page gives the projection of the marginal products of labor and capital, the GNP per employed worker, and the size of the employed labor force.

Page 19*:

The first table presents projections of the number of equivalent consumers, the GNP per equivalent consumer, and the ratio of equivalent consumers to total population. The second table gives the number of people below the assigned poverty line.

Page 20*:

The final economic table gives data resulting from the minimum growth option, if it has been selected. (If the minimum growth option has been selected, all of the economic projections presented above will reflect this.) Given in the table are the projections of the actual GNP, the goal GNP, and investment from both domestic and foreign sources. The two sources of investment are also expressed as ratios of the GNP.

Pages 21 - 35*:

These pages present the projections of government expenditures for selected social services: primary education, secondary education, health services, and public housing. All of the services cover the same projection period, and present data for the same intervals. Both the length of the projection and the interval may be specified, and can differ from those used elsewhere in the economic and demographic projections.

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*Optional.

The presentation of data for all four services follows the same general pattern. On the first page is a listing of the rates, ratios, and unit costs used. The second page shows the user population for each service and the total number of personnel or facilities required at the end of each interval (e.g. 1975). The subsequent tables treat each type of personnel or facility separately, listing the numbers of additional personnel or facilities required over the projection interval (e.g., 1971-1975) and associated investment and operating costs for the same period.

Both primary and secondary education show data for enrollment, teachers, and classrooms. The projections for health services include the number of people using government health services, and number and cost data for physicians, nurses, medical assistants, midwives, and hospital beds. Where data on certain of these categories are not available, there is the option of omitting them from the run.

The public housing report shows the total number of persons requiring housing at each interval, broken down into those requiring replacements of current stock, those now in substandard housing, and additions to the users population caused by population growth. Costs of construction are shown.

Subsequent pages:

Should any of the data used in subsequent projections be changed, the new data is printed before the start of the results of the projection. The presentation of results then uses the same format described above.

DATA FORMAT FOR THE TEMPO ECONOMIC-DEMOGRAPHIC MODEL

Preceding each set of simulation runs is a set of up to 60 cards which gives a general description of the runs to follow. The first card of each data pack gives the number of cards used to provide the general description punched in columns 1 and 2. The description then follows in the first 72 columns of each card. For example, we might have:

Card 1: 05

Card 2: DECEMBER 31, 1969

Card 3: blank

Card 4: ECONOMIC-DEMOGRAPHIC PROJECTIONS FOR DEVELOPA

Card 5: THREE PROJECTIONS ARE MADE. I. HIGH FERTILITY
Card 6: II. MEDIUM FERTILITY. III. LOW FERTILITY

This general description is the first information printed.

The data pack for the first simulation run comes next, using the formats as illustrated below. In all cases, the data should be punched on the right side of a field. For example, if the number 123 is punched in a field located in columns 11 through 15, the number is punched in columns 13, 14, and 15. Any other location (e.g., if columns 12, 13, and 14 are used) will result in errors.

Cards

1, 2 Data. Identification for the particular simulation run.

Format. Use only the first 72 columns of each card. There is virtually no restriction on the characters which can be used. (4A18)

3-6 Data. Eighty control variables, twenty to a card. These are described in detail below. (20I3)

7, 8 Data. Initial male population (in thousands), by 5-year cohorts—beginning with the youngest (0-4) and ending with the open-ended oldest cohort (over 74).*

Format. The data are punched in 7 column fields, 70 columns to a card. (10F7.0)

9, 10 Data. Initial female population, in the same form used for males.*

Format. The format is the same as for the initial male population.

*If an independent population projection is used, it is located at this place in the deck. The projection may be supplied at 1-year or 5-year intervals, in the following order: males, initial year; females, initial year, males, next year; females, next year, etc. In this case, the data for survival rates and fertility are omitted.

11, 12* Data. Male survival rates, beginning with the "infant" survival rate (i.e., proportion of male babies born during a 5-year period who survive to the end of the period), then the youngest age cohort (0-4), and ending with the survival rate for the cohort 74 and over. Up to three sets of survival rates can be supplied.

Format. The data are punched in 5 column fields, 70 columns to a card. The survival rate is punched to four significant digits. The decimal point need not be punched. For example, if the first survival rate were 0.8599, then 8599 (without the decimal) would be punched in columns 2 through 5. (14F5.4)

13, 14** Data. Female survival rates, in the same form used for males.

Format. The format is the same as for the male survival rates.

15 Data. Ratio of male births to female births. (Omit if birth rates not supplied)

Format. The ratio is punched in columns 1 through 4, to 4 significant digits. The decimal point is not punched. For example, if the ratio were 1.05, then 1050 would be punched in columns 1 through 4. (F4.3)

16*** Data. Age cohort specific birth rates, beginning with the age cohort 15-19 and ending with the age cohort 45-59. Up to three sets can be provided.

Format. The format for birth rates is the same as for the survival rates. (14F5-4)

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* Each set of survival rates requires two cards. The second set is placed following card 14, so that the order is: set 1-Male, Female; set 2-Male, Female; set 3-Male, Female.

** Each set of survival rates requires two cards.

***Each set of birth rates requires a separate card.

17 Data. Age-sex specific labor force participation rates. Male labor force participation rates are given first, beginning with age cohort 15-19 and ending with age cohort 60-64, followed by the female labor force participation rates, followed by elapsed years from beginning of projection before schedule applies. Up to five sets of labor force participation rates may be supplied. (Omit if economic projection not requested.)

† Format. The participation rates are punched in 3 column fields, using the first 60 columns. The rate is punched to three significant digits. The decimal point need not be punched. For example, if the first rate were 0.50, then 50 would be punched in columns 1 and 2. The elapsed years until the schedule applies is punched in columns 62 and 63. For the first schedule this will be zero. (20F3.3,I3)

18 Data. Miscellaneous economic data. (Omit if economic projection is not elected.)

Format. The data are punched on a single card according to the following format. No decimal points should be punched.

Columns	Data
1-10	Initial GNP per capita.
11-20	Initial stock of capital, in millions.
21-23	Initial unemployment rate, to two significant digits. If the initial unemployment rate is zero, the model assumes that the values of employed labor and the labor force will coincide throughout the projection.
24-28	Annual rate of technological progress, to three significant digits.
29-33	Elasticity of GNP with respect to capital, to three significant digits.

† Change from original edition.

34-38	Elasticity of GNP with respect to labor, to three significant digits.
39-43	Income (GNP) coefficient in the consumption function, to three significant digits.
44-48	Equivalent consumer coefficient in the consumption function, in whole numbers.
49-53	Employment coefficient, to two significant digits to the right of the decimal. The decimal point is not punched.
54-71	Equivalent consumer weights for the following age groups: 0-4, 5-9, 10-14, 15-19, 20-64, and over 64. These are punched in 3-column fields, to two significant digits to the right of the decimal. The decimal point is not punched.
† 73-76	Initial savings in millions.
† 77-80	Annual decrement in savings in million. (2F10 0, F3.2, 4F5.3, F5, 0, F5.2, 6F3.2, F4.0, F5.0).

19* Data. Data for projection of population below the poverty line.

Format. The income (in whole numbers) defined as the poverty line is punched in columns 1 through 5. The proportion of GNP received by each decile of the population is punched in 3-column fields, to two significant digits, in columns 6 through 35. The income distribution is punched in reverse order. That is, the proportion of the income received by the last decile is punched in columns 6 through 8, by the ninth decile in columns 9 through 11, etc. Only the deciles up through the one receiving at least one-tenth of the ratio of the poverty line to the initial per capita income need to be supplied. For example, if the poverty line is $100 and the initial per

† Change from original edition.

* Omitted if this option is not elected.

capita income is $200, only those deciles up through the one receiving at least 5 percent of the GNP need to be supplied. (F5.0, 10F3.2)

The following data cards are required for the social services calculations if that option is selected. Additional options are provided for selecting which of the four social services routines are desired. Primary Education, Secondary Education, Health, and Public Housing.

Data formats for all four social services follow the pattern described below. Some exceptions in the case of public housing are indicated.

Card

20 Data. Participation rate. The first data item is the initial year of the projection, and the second is the current rate. If the rate does not change over the projection period, no further data are shown on the card. If the rate changes, however, the next two data items are the year* in which the change first takes effect and the value of the new rate. A maximum of five different rates is allowed, including the initial rate.

† Format. Five sets of two fields, the first five columns wide, and the second 10 columns wide. The first field indicates the year, and the second field indicates the value of the rate. The rate is expressed as the number of participants per hundred of the relevant population. In all cases data is right-justified and no decimal points need be punched if data are in whole percentage points. For example, if the initial participation rate of a projection period beginning in 1970 is 50 percent, and it is to be raised to 60 percent by 1975 and to 70 percent by 1985, the data format will read as follows: 1970 in columns 2-5, 50 in columns 14 and 15, 1975 in columns 17-20, 60 in columns 29 and 30, 1985 in columns 32-35, and 70 in columns 44 and 45. (5(I5, F10.2))

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*Must be a multiple of five years from the initial year of the projection.

†Change from original edition.

21** Data. Identification number* and name of service type to which the subsequent data applies (e.g., 1-teachers, 5-hospital bed).

Format. Identification number in column 1. Name beginning in column 2 and extending as far as column 30, if needed. Any characters may be used, alphabetic, numeric, punctuation and other symbols, as well as spaces.

22** Data. Service rate, in the same form as used for participation rates, except that the values are expressed as numbers of service personnel or facilities per 10,000 user population on punch decimal points and state data as per 1 person.

† Format. Same format as used for participation rates. (5(I5, F10.4))

23 Data. Attrition rate, in the same form as used for participation rates. If a schedule for replacement construction is provided, a zero should be punched in column 5, and the remainder of the card should be left blank.

† Format. Same format as used for participation rates. (5(I5, F10.2))

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* For all education programs, identification numbers are: 1-Teachers; 2-Classrooms. For health, identification numbers are: 1-Physicians; 2-Nurses; 3-Medical Assistants; 4-Midwives; 5-Hospital Beds.

** Omit this card for Public Housing.

† Change from original edition.

24* Data. Replacement construction schedule, showing the number of units to be replaced in each interval. Data must be provided for every year if an annual interval is selected or for every fifth year if a 5-year interval is selected. Values are shown as numbers of persons living in public housing to be replaced.

Format. The data are punched in 10-column fields, seven fields per card. If a yearly projection interval is to be used, the first field contains data for year 1, the second field for year 2, etc. If a 5-year interval is used, the first field contains data for year 5, the second field for year 10, etc., where the initial year is "year zero." (7F10.3)

25 Data. Unit investment cost, in the same form as used for participation rates, except that values are expressed in dollars. For personnel, stated as a multiple of GNP/work. For facilities stated in dollars.

Format. Same general format as used for participation rates. (5(I5, F10.0))

26** Data. Unit operating cost, in the same form as used for investment costs for personnel, stated as a multiple of GNP/worker. For facilities, stated in dollars.

† Format. Same general format as used for participation rates. (5(I5, F10.0). Return to 21 for next type service. Return to 20 for next group of participants.

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* To be included only when a zero is shown in column 5 of card 23; an additional card will be necessary where more than seven intervals and values are provided.

**Omit this card for Public Housing.

† Change from original edition.

27 Data. Construction schedule to meet current deficit in public housing, showing the number of persons to be provided with new housing in each interval. Data must be provided for every year of the projection if an annual interval is selected or for every fifth year if a 5-year interval is selected.

Format. Same format as used for the replacement construction schedule. (7F10.3)

28* Data. Current stock of public housing, in terms of numbers of people currently in public housing.

Format. Data right-justified in columns 1-10.

A complete set of cards is required for each of the four social service options selected. Cards 21-26 must be duplicated for each type of service (e.g., teachers and classrooms) to be considered under the specific social service.

The data pack for each subsequent simulation run must begin with two identification cards and four control variable cards (cards 1 through 6, above). Data cards then follow only for the data which has been changed from the preceding simulation run, using the same order and form as that given above. For the purposes of changing data, the following pieces of data are considered "units." If any element of a unit is changed, all of the data for the unit must be included in the data pack of that simulation run.

Unit	Data
1	Initial population
2	Survival rates
3	Ratio of male to female births and birth rates
4	Labor force participation rates
5	Miscellaneous economic data

*Use only with Public Housing.

Unit	Data
6	Poverty projection data
7	Social service data. (In the following order: primary secondary, tertiary education; health; housing. Data supplied is control variables 53, 54, 63, 55, 56, respectively, are equal to 1.

Control Variables

The control variables supply a variety of information needed for the projections, primarily of a bookkeeping nature (e.g., the initial year of the projections) or specifying which options have been elected. They are punched in the first 60 columns of cards 3 through 6 in 3-column fields. They must be right-adjusted. (20I3)

The information provided by each variable is as follows:

Card 3

Variable	
1	Initial year of the projection less 1970.
† 2	Takes the value 1 if 5-year interval population projection supplied or if population projection calculated by program. Takes the value of 2 if 1-year interval population projection supplied.
3*	Number of years projected, less than or equal to 95.
4	Number of survival rate schedules supplied, less than or equal to 3.
† 5	Number of birth rate schedules supplied or used if previously supplied, less than or equal to 3.

† Change from original edition.

* Must be divisible by five.

Variable	
† 6	Takes a value of 1 if new initial population supplied, 2 if same initial population used, 3 if projection supplied, 4 if previously supplied calculated projection to be used again.
7	Takes a value of 1 if new survival rates supplied, 2 if not supplied.
8	Takes a value of 1 if new birth rates supplied, 2 if not supplied.
9	Takes a value of 1 if all new economic data supplied, 2 if new miscellaneous economic data, 3 if no new economic data.
† 10	Number of labor force participation rate schedules supplied.
11*	Elapsed years from beginning of projection before 2nd survival rate schedule applies.
12*	Elapsed years from beginning of projection before 3rd survival rate schedule applies.
13*	Elapsed years before 2nd birth rate schedule applies.
14*	Elapsed years before 3rd birth rate schedule applies.
15	Takes a value of 1 if survival rates change through time, 2 if not.
16	Takes a value of 1 if birth rates change through time, 2 if not.
17	Takes a value of 1 if minimum growth option selected, 2 if not.

*Must be divisible by five.

†Change from original edition.

Variable	
18	1000 times the minimum annual rate of growth of per capita GNP.
19	100 times the initial ratio of rural to total population.
20	Annual rate of net rural to urban migration per thousand of rural population.

Card 4

Variable	
† 21	Not used.
22	Takes a value of 1 if migration option chosen, 2 if not.
23	Takes a value of 1 if calculation of births prevented material wanted, 2 if not.
† 24	Not used.
25	Takes a value of 1 if economic projection wanted, 2 if not.
26	Takes a value of 1 if social service option chosen, 2 if not.
27	Takes a value of 1 if projection of population below the poverty line wanted, 2 if not.
28	Not used.
29	Not used.
30	Not used.
31	Takes a value of 1 if population by 5-year cohorts desired, 2 if not.

† Change from original edition.

Variable	
32	Takes a value of 1 if population profile desired, 2 if not.
33	Takes a value of 1 if birth rates table desired, 2 if not.
34	Takes a value of 1 if survival rates table desired, 2 if not.
† 35	Takes a value of 1 for "standard" tertiary school-age at 20-24. Otherwise, takes the first year of tertiary education.
† 36	Final year of tertiary education, if standard school-age not used.
37	Takes a value of 1 for a "standard" primary school-age of 5 to 14. Oterwise, takes the first year of primary school age.
38	Final year of primary school age, if standard school-age not used. *
39	Takes value of 1 for a "standard" secondary school-age of 15-19. Otherwise, takes the first year of secondary school age.
40	Final year of secondary school-age, if standard school-age not used. *

† Change from original edition.

* If the standard school ages are not used, estimates of the population by single years of age are computed with the use of Sprague multipliers. These estimates are then used to obtain projections of the population of the appropriate age groups. See Manual III, pp. 68-69.

Card 5

Variable	
41	Takes a value of 1 if index number table desired, 2 if not.
42	Takes a value of 1 if marginal-average product table desired, 2 if not.
43	Takes a value of 1 if equivalent consumer table desired, 2 if not.
44	Print-out interval for economic output. (1 or 5 only)
45	Takes a value of 1 if the table of growth rates is desired, 2 if not.
† 46	Takes a value of 4 if interest table requested for minimum growth option.
† 47	Interest rate on foreign capital required to maintain GNP/Population growth, in minimum growth option.
48-50	Not used.
51	Number of years in the social services projection.
52	Number of years in the social services projection interval (may only be 1 or 5).
53	Takes a value of 1 if primary education option is taken, 2 if not.
54	Takes a value of 1 if secondary education option is taken, 2 if not.
55	Takes a value of 1 if health option is taken, 2 if not.

† Change from original edition.

Variable

56	Takes a value of 1 if public housing option is taken, 2 if not.
57	Takes a value of 1 if new social services data is supplied, 2 if not. (Must be 1 if more than one level of education used.)
58	Number of service types in primary education.
59	Number of service types in secondary education.
60	Number of service types in health services.

Card 6

Variable

61	Takes a value of 1 if a separate schedule is supplied for construction to meet current housing deficit; 2 if not (public housing only).
62	Takes a value of 1 if data on current stock of public housing is supplied; 2 if not (public housing only).
† 63	Takes a value of 1 if tertiary education option is taken; 2 if not.
† 64	Number of service types in tertiary education.
65-80	Not used.

† Change from original edition.

Input Modifications of the Original 68TMP-120

Page Number	Change
63	**Age Specific Labor Force Participation Rates** Rates are punched left justified in all three columns instead of the second and third columns in each field.
64	**Miscellaneous Economic Data** Columns 73-80 include foreign savings parameters of initial savings level and yearly decrement.
65, 66	**Social Services** The format is changed from (5(I5, F5.2)) to (5(I5, F10.2)).
68-71	**Control Variables** Variables which have had changes in definition include: 2, 5, 6, 10, 21, 24, 35, 36, 46, 47, 63, 64 Please review instructions for current definitions. All other variables have the same definitions.

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ANNEX

DEVELOPA PRINTOUT

This annex presents a selected printout of the Developa projections, keyed to the discussion in Chapter VII. Nearly all of the printout is given of the first projection, for which fertility did not change. Omissions from the printout for the first projection (e.g., age-specific birth rates for each projection interval) are noted. With a few exceptions, these omitted tables are given for at least one of the subsequent projections.

Tables of the general demographic and economic results, in addition to tables previously omitted, are given for the second (slow decline of fertility) and the third (rapid decline of fertility) projections. Summary tables are given for the fourth and sixth projections. The fourth combined the high fertility assumptions with the minimum growth option, constraining annual growth of per capita income from falling below 3 percent. The sixth combined the low fertility assumptions with the minimum growth option.

In several instances, tables which appeared on more than one page of the original printout have been combined on a single page of the annex. The page numbers preceding each table (or set of tables) are those of the original printout. Some of the projection identification labels have also been omitted in order to conserve space.

Page 1

DECEMBER 31, 1969

ECONOMIC-DEMOGRAPHIC PROJECTIONS FOR DEVELOPA.

THREE REGULAR PROJECTIONS ARE MADE.
1. HIGH FERTILITY
2. MEDIUM FERTILITY
3. LOW FERTILITY

ANOTHER THREE PROJECTIONS ARE MADE FOR THE SAME FERTILITY ASSUMPTIONS, BUT WITH PER CAPITA GNP CONSTRAINED TO GROW AT LEAST 3 PERCENT PER YEAR.

Page 2

RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

CONTROL VARIABLES

1	0	21	2	41	1	61	-0
2	1	22	1	42	1	62	-0
3	30	23	2	43	1	63	-0
4	2	24	1	44	5	64	-0
5	1	25	1	45	0	65	-0
6	1	26	1	46	0	66	-0
7	1	27	1	47	0	67	-0
8	1	28	-0	48	0	68	-0
9	1	29	-0	49	0	69	-0
10	-0	30	-0	50	0	70	-0
11	50	31	1	51	30	71	-0
12	-0	32	1	52	5	72	-0
13	-0	33	1	53	1	73	-0
14	-0	34	2	54	2	74	-0
15	1	35	-0	55	2	75	-0
16	2	36	-0	56	2	76	-0
17	2	37	1	57	1	77	-0
18	-0	38	-0	58	2	78	-0
19	70	39	1	59	-0	79	-0
20	10	40	-0	60	-0	80	-0

Page 3

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

INITIAL POPULATION (THOUSANDS)

AGE	NUMBER MALES	NUMBER FEMALES	PERCENT OF TOTAL POPULATION MALES	PERCENT OF TOTAL POPULATION FEMALES
0 TO 4	883.00	869.00	0.0883	0.0869
5 TO 9	720.00	709.00	0.0720	0.0709
10 TO 14	611.00	603.00	0.0611	0.0603
15 TO 19	520.00	513.00	0.0520	0.0513
20 TO 24	439.00	434.00	0.0439	0.0434
25 TO 29	370.00	367.00	0.0370	0.0367
30 TO 34	311.00	309.00	0.0311	0.0309
35 TO 39	261.00	260.00	0.0261	0.0260
40 TO 44	217.00	218.00	0.0217	0.0218
45 TO 49	179.00	182.00	0.0179	0.0182
50 TO 54	145.00	150.00	0.0145	0.0150
55 TO 59	116.00	122.00	0.0116	0.0122
60 TO 64	88.00	97.00	0.0088	0.0097
65 TO 69	63.00	72.00	0.0063	0.0072
70 TO 74	42.00	49.00	0.0042	0.0049
OVER 74	35.00	46.00	0.0035	0.0046

TOTAL POPULATION = 10000.000

Page 4

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

SURVIVAL RATES

	SCHEDULE 1		SCHEDULE 2		SCHEDULE 3	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
AGE---INFANT*	0.8474	0.8599	0.9299	0.9428		
0 TO 4	0.9479	0.9496	0.9826	0.9851		
5 TO 9	0.9870	0.9874	0.9929	0.9939		
10 TO 14	0.9880	0.9863	0.9918	0.9932		
15 TO 19	0.9819	0.9842	0.9878	0.9904		
20 TO 24	0.9782	0.9810	0.9853	0.9879		
25 TO 29	0.9767	0.9792	0.9840	0.9859		
30 TO 34	0.9736	0.9773	0.9809	0.9833		
35 TO 39	0.9680	0.9743	0.9753	0.9795		
40 TO 44	0.9588	0.9701	0.9658	0.9735		
45 TO 49	0.9447	0.9615	0.9507	0.9635		
50 TO 54	0.9227	0.9465	0.9277	0.9480		
55 TO 59	0.8887	0.9188	0.8933	0.9228		
60 TO 64	0.8368	0.8708	0.8433	0.8815		
65 TO 69	0.7559	0.7924	0.7713	0.8158		
70 TO 74	0.6351	0.6743	0.6705	0.7182		
OVER 74	0.3958	0.4250	0.4286	0.4644		
LIFE EXPECTANCY (AT BIRTH)	51.87	55.00	61.23	65.00		

YEAR TO WHICH SURVIVAL RATES APPLY

SCHEDULE 1----1970
SCHEDULE 2----2020

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

RATIO OF MALE TO FEMALE BIRTHS = 1.050

BIRTH RATES

--AGE---	SCHEDULE 1	2
15 TO 19	0.1106	
20 TO 24	0.2949	
25 TO 29	0.3035	
30 TO 34	0.2476	
35 TO 39	0.1828	
40 TO 44	0.0809	
45 TO 49	0.0201	
CRUDE BIRTH RATE	0.0441	
GROSS REPRODUCTION RATE	3.0254	

YEAR TO WHICH BIRTH RATES APPLY

SCHEDULE 1----1970

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

LABOR FORCE PARTICIPATION RATES

AGE	MALE	FEMALE
15 TO 19	0.70	0.30
20 TO 24	0.95	0.40
25 TO 29	0.99	0.40
30 TO 34	0.99	0.50
35 TO 39	0.99	0.60
40 TO 44	0.99	0.60
45 TO 49	0.95	0.60
50 TO 54	0.95	0.60
55 TO 59	0.90	0.50
60 TO 64	0.70	0.40

GNP PER CAPITA = 200. STOCK OF CAPITAL = 5000.000 PROPORTION OF LABOR FORCE UNEMPLOYED = 0.15

INCOME(GNP) AND EQUIVALENT CONSUMER COEFFICIENTS IN CONSUMPTION FUNCTION = 0.80 30.00

RATE OF TECHNICAL PROGRESS = 0.015 ELASTICITIES OF GNP WITH RESPECT TO CAPITAL AND LABOR = 0.35 0.60

EMPLOYMENT COEFFICIENT = 1.00

PRODUCTION FUNCTION CONVERSION CONSTANT (Z) = 819.861

EQUIVALENT CONSUMER WEIGHTS

AGE	WEIGHT
0 TO 4	0.75
5 TO 9	0.75
10 TO 14	0.75
15 TO 19	1.00
20 TO 64	1.00
OVER 64	0.50

DATA FOR PROJECTION OF POPULATION BELOW POVERTY LINE OF 100. DOLLARS

POPULATION DECILE	PORTION OF GNP	POPULATION DECILE	PORTION OF GNP
1	*	6	*
2	*	7	0.06
3	*	8	0.05
4	*	9	0.04
5	*	10	0.02

NOTE-- * INDICATES THAT THE PORTION FOR THIS DECILE WAS NOT SUPPLIED

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

YEAR	TOTAL POPULATION	BIRTHS	DEATHS	CRUDE BIRTH RATE	CRUDE DEATH RATE	LIFE EXPECTANCY AT BIRTH MALE	LIFE EXPECTANCY AT BIRTH FEMALE	GROSS REPRODUCTION RATE	YEAR
		********** DATA APPLICABLE TO FIVE-YEAR INTERVAL ********** ENDING AT SPECIFIED YEAR **********							
1970	10000.0								1970
1975	11637.1	2386.4	749.2	0.044	0.014	52.30	55.45	3.025	1975
1980	13576.2	2774.6	835.5	0.044	0.013	53.17	56.38	3.025	1980
1985	15872.9	3228.2	931.6	0.044	0.013	54.05	57.33	3.025	1985
1990	18594.3	3759.6	1036.1	0.044	0.012	54.95	58.29	3.025	1990
1995	21824.0	4384.8	1155.2	0.043	0.011	55.87	59.27	3.025	1995
2000	25669.0	5129.3	1284.2	0.043	0.011	56.80	60.27	3.025	2000

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RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

POPULATION BY 5-YEAR COHORTS

MALE

	** AGE GROUP **							
YEAR	**0 TO 4	**5 TO 9	*10 TO 14	*15 TO 19	*20 TO 24	*25 TO 29	*30 TO 34	*35 TO 39
1970	883.0	720.0	611.0	520.0	439.0	370.0	311.0	261.0
1975	1040.6	838.5	710.9	603.8	510.7	429.6	361.5	302.9
1980	1221.2	991.7	828.3	702.7	593.4	500.1	420.0	352.4
1985	1434.1	1168.0	986.3	819.2	691.0	581.5	489.4	409.7
1990	1685.7	1376.6	1155.2	969.8	806.0	677.7	569.4	477.7
1995	1984.4	1623.9	1362.3	1143.3	954.8	791.0	664.1	556.3
2000	2343.0	1918.6	1608.1	1348.8	1126.3	937.7	775.8	649.2

	** AGE GROUP **							
YEAR	*40 TO 44	*45 TO 49	*50 TO 54	*55 TO 59	*60 TO 64	*65 TO 69	*70 TO 74	* OVER 74
1970	217.0	179.0	145.0	116.0	88.0	63.0	42.0	35.0
1975	252.7	208.1	169.2	133.8	103.1	73.7	47.7	40.7
1980	293.5	242.6	196.8	156.2	119.0	86.4	55.9	46.8
1985	341.7	282.0	229.5	181.8	139.0	99.8	65.6	54.9
1990	397.7	328.5	267.0	212.2	161.9	116.6	76.0	64.8
1995	464.0	382.5	311.2	246.9	189.0	135.9	89.0	76.0
2000	540.7	446.7	362.6	288.0	220.1	158.8	103.9	89.6

FEMALE

	** AGE GROUP **							
YEAR	**0 TO 4	**5 TO 9	*10 TO 14	*15 TO 19	*20 TO 24	*25 TO 29	*30 TO 34	*35 TO 39
1970	869.0	709.0	603.0	513.0	434.0	367.0	309.0	260.0
1975	1005.6	826.7	700.3	596.1	505.1	425.9	359.5	302.1
1980	1180.0	960.2	817.1	692.6	587.2	496.0	417.5	351.7
1985	1385.6	1130.9	949.7	808.5	682.7	577.1	486.5	408.6
1990	1628.6	1332.8	1119.2	940.2	797.5	671.4	566.4	476.5
1995	1917.0	1572.3	1319.9	1108.6	927.9	784.8	659.5	555.1
2000	2263.3	1857.5	1558.1	1308.0	1094.8	913.8	771.4	646.7

	** AGE GROUP **							
YEAR	*40 TO 44	*45 TO 49	*50 TO 54	*55 TO 59	*60 TO 64	*65 TO 69	*70 TO 74	* OVER 74
1970	218.0	182.0	150.0	122.0	97.0	72.0	49.0	46.0
1975	253.4	211.5	175.0	142.0	112.1	84.5	57.1	52.8
1980	294.5	245.9	203.4	165.7	130.5	97.8	67.3	61.6
1985	343.1	286.0	236.6	192.6	152.4	114.0	78.1	72.9
1990	398.9	333.2	275.2	224.1	177.3	133.3	91.3	85.8
1995	465.3	387.5	320.7	260.6	206.3	155.2	107.0	101.3
2000	542.4	452.3	373.0	303.8	240.1	180.8	125.0	119.9

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Age profile: omitted (data are ratio forms of data shown above).

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Birth rates: omitted (data do not change in the high fertility case; data for the low fertility case

RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

SURVIVAL RATES (APPLICABLE TO 5-YEAR INTERVAL ENDING AT YEAR SPECIFIED)

MALE

YEAR	INFANT	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 34	35 TO 39
	AGE GROUP								
1975	0.8513	0.9496	0.9873	0.9882	0.9822	0.9786	0.9771	0.9740	0.9684
1980	0.8593	0.9530	0.9879	0.9886	0.9828	0.9793	0.9778	0.9747	0.9691
1985	0.8673	0.9565	0.9885	0.9889	0.9834	0.9800	0.9785	0.9754	0.9698
1990	0.8754	0.9599	0.9891	0.9893	0.9840	0.9807	0.9792	0.9761	0.9705
1995	0.8836	0.9634	0.9897	0.9897	0.9846	0.9814	0.9800	0.9769	0.9713
2000	0.8918	0.9668	0.9902	0.9901	0.9851	0.9821	0.9807	0.9776	0.9720

YEAR	40 TO 44	45 TO 49	50 TO 54	55 TO 59	60 TO 64	65 TO 69	70 TO 74	OVER 74
	AGE GROUP							
1975	0.9591	0.9450	0.9227	0.8889	0.8371	0.7567	0.6368	0.3974
1980	0.9598	0.9456	0.9234	0.8894	0.8378	0.7582	0.6403	0.4006
1985	0.9605	0.9462	0.9239	0.8898	0.8384	0.7597	0.6438	0.4038
1990	0.9612	0.9468	0.9244	0.8903	0.8391	0.7613	0.6473	0.4070
1995	0.9619	0.9474	0.9249	0.8908	0.8397	0.7628	0.6508	0.4102
2000	0.9626	0.9480	0.9254	0.8912	0.8404	0.7643	0.6543	0.4135

FEMALE

YEAR	INFANT	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 34	35 TO 39
	AGE GROUP								
1975	0.8639	0.9513	0.9877	0.9885	0.9845	0.9813	0.9795	0.9776	0.9746
1980	0.8719	0.9548	0.9884	0.9890	0.9851	0.9820	0.9802	0.9782	0.9751
1985	0.8799	0.9584	0.9890	0.9895	0.9857	0.9827	0.9809	0.9788	0.9756
1990	0.8881	0.9619	0.9897	0.9900	0.9864	0.9834	0.9815	0.9794	0.9761
1995	0.8963	0.9654	0.9903	0.9905	0.9870	0.9841	0.9822	0.9800	0.9766
2000	0.9045	0.9690	0.9910	0.9910	0.9876	0.9848	0.9829	0.9806	0.9772

YEAR	40 TO 44	45 TO 49	50 TO 54	55 TO 59	60 TO 64	65 TO 69	70 TO 74	OVER 74
	AGE GROUP							
1975	0.9703	0.9616	0.9466	0.9190	0.8713	0.7936	0.6764	0.4269
1980	0.9706	0.9618	0.9467	0.9194	0.8724	0.7959	0.6807	0.4307
1985	0.9709	0.9620	0.9469	0.9198	0.8735	0.7982	0.6850	0.4345
1990	0.9713	0.9622	0.9470	0.9202	0.8745	0.8005	0.6894	0.4384
1995	0.9716	0.9624	0.9472	0.9206	0.8756	0.8028	0.6937	0.4423
2000	0.9720	0.9626	0.9473	0.9210	0.8767	0.8052	0.6981	0.4462

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RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

INITIAL RURAL SHARE OF POPULATION = 0.700
ANNUAL RATE OF MIGRATION AS PORTION OF RURAL POPULATION = 0.010
FIVE-YEAR RATE OF MIGRATION = 0.049

YEAR	* TOTAL	POPULATION URBAN	* RURAL	RURAL SHARE	RURAL-URBAN MIGRATION
1970	10000.0	3000.0	7000.0	0.7000	0.
1975	11637.1	3882.3	7754.8	0.6664	361.6
1980	13576.2	4963.7	8612.5	0.6344	401.1
1985	15872.9	6287.1	9585.8	0.6039	445.9
1990	18594.3	7904.5	10689.9	0.5749	496.9
1995	21824.0	9880.2	11943.8	0.5473	554.6
2000	25669.0	12295.9	13373.0	0.5210	620.4

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Reduction in births and decline in birth rates: omitted (no change; data are shown for low fertility case).

RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

YEAR	TOTAL POPULATION	AGE 0 TO 14	AGE 15 TO 64	AGE OVER 64	RATIO TO TOTAL POPULATION AGE 0 TO 14	AGE 15 TO 64	AGE OVER 64
1970	10000.0	4395.0	5298.0	307.0	0.439	0.530	0.031
1975	11637.1	5122.6	6158.1	356.4	0.440	0.529	0.031
1980	13576.2	5998.5	7161.9	415.8	0.442	0.528	0.031
1985	15872.9	7048.5	8339.1	485.2	0.444	0.525	0.031
1990	18594.3	8298.1	9728.5	567.7	0.446	0.523	0.031
1995	21824.0	9779.9	11379.7	664.4	0.448	0.521	0.030
2000	25669.0	11548.5	13342.4	778.1	0.450	0.520	0.030

YEAR	LABOR FORCE TOTAL	RATIO TO POPULATION	RATIO TO WORK-AGE POPULATION (15-64) LABOR FORCE	AGE 0 TO 14	AGE OVER 64
1970	3616.9	0.3617	0.6827	0.8296	0.0579
1975	4204.2	0.3613	0.6827	0.8318	0.0579
1980	4889.6	0.3602	0.6827	0.8376	0.0580
1985	5692.5	0.3586	0.6826	0.8452	0.0582
1990	6641.9	0.3572	0.6827	0.8530	0.0584
1995	7769.1	0.3560	0.6827	0.8594	0.0584
2000	9108.9	0.3549	0.6827	0.8656	0.0583

YEAR	SCHOOL AGE POPULATION PRIMARY	SECONDARY	RATIO TO TOTAL POPULATION PRIMARY	SECONDARY
	****(THOUSANDS)****			
1970	2643.	1033.	0.264	0.103
1975	3076.	1200.	0.264	0.103
1980	3597.	1395.	0.265	0.103
1985	4229.	1628.	0.266	0.103
1990	4964.	1910.	0.268	0.103
1995	5878.	2252.	0.269	0.103
2000	6942.	2657.	0.270	0.104

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RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

YEAR	GNP (MILLIONS)	POPULATION (THOUSANDS)	PER CAPITA GNP	CAPITAL STOCK (MILLIONS)	LABOR FORCE (THOUSANDS)	INVESTMENT FROM DOMESTIC SOURCES (MILLIONS)	UNEMPLOY-MENT RATE	INVESTMENT-GNP RATIO	CAPITAL PER EMPLOYED LABORER (THOUSANDS)	YEAR
1970	2000.00	10000.00	200.00	5000.00	3616.86	137.57	0.150	0.069	1.626	1970
1975	2477.89	11637.14	212.93	5782.83	4204.17	190.23	0.152	0.077	1.622	1975
1980	3142.07	13576.24	231.44	6884.43	4889.61	272.35	0.136	0.087	1.629	1980
1985	4045.04	15872.85	254.84	8469.73	5692.52	392.96	0.115	0.097	1.681	1985
1990	5253.73	18594.35	282.54	10752.53	6641.89	563.67	0.098	0.107	1.796	1990
1995	6868.00	21823.96	314.70	14015.75	7769.14	802.20	0.088	0.117	1.979	1995
2000	9029.66	25668.98	351.77	18646.42	9108.87	1134.15	0.083	0.126	2.231	2000

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RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

INDEX NUMBERS, BASE YEAR IS 1970

YEAR	GNP	POPULATION	PER CAPITA GNP	CAPITAL STOCK	LABOR FORCE	INVESTMENT FROM DOMESTIC SOURCES	YEAR
1970	100.00	100.00	100.00	100.00	100.00	100.00	1970
1975	123.89	116.37	106.46	115.66	116.24	138.28	1975
1980	157.10	135.76	115.72	137.69	135.19	197.98	1980
1985	202.25	158.73	127.42	169.39	157.39	285.65	1985
1990	262.69	185.94	141.27	215.05	183.64	409.74	1990
1995	343.40	218.24	157.35	280.31	214.80	583.13	1995
2000	451.48	256.69	175.89	372.93	251.84	824.43	2000

Growth rates: Omitted

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RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

YEAR	MARGINAL PRODUCT OF CAPITAL (PERCENT)	MARGINAL PRODUCT OF LABOR	GNP PER EMPLOYED LABORER	EMPLOYED LABOR FORCE (THOUSANDS)
1970	14.00	390.33	650.55	3074.33
1975	15.00	416.99	694.94	3565.37
1980	15.97	446.10	743.50	4226.07
1985	16.72	481.59	802.65	5039.60
1990	17.10	526.41	877.35	5988.21
1995	17.15	581.80	969.67	7082.82
2000	16.95	648.27	1080.44	8357.37

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RUN I* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

YEAR	EQUIVALENT CONSUMERS (THOUSANDS)	GNP PER EQUIVALENT CONSUMER	RATIO OF EQUIVALENT CONSUMERS TO POPULATION
1970	8747.7	228.63	0.8746
1975	10178.3	243.45	0.8746
1980	11868.7	264.74	0.8742
1985	13868.1	291.68	0.8737
1990	16236.0	323.59	0.8732
1995	19046.8	360.59	0.8727
2000	22392.8	403.24	0.8724

YEAR	POPULATION BELOW $,100. POVERTY LINE (THOUSANDS)
1970	2500.
1975	2556.
1980	2472.
1985	2321.
1990	2361.
1995	2376.
2000	2365.

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Minimum growth option: omitted (not applicable to this run; shown following Run IIIG tables).

RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

PRIMARY EDUCATION

ENROLLMENT RATIO

YEAR	
1970	0.50
1975	0.55
1980	0.60
1985	0.65
1990	0.65
1995	0.65
2000	0.65

TEACHERS

YEAR	SERVICE RATIO	ATTRITION RATE	UNIT INVESTMENT COST	UNIT OPERATING COST
1970	0.025	0.10	1500.	800.
1975	0.025	0.10	1500.	800.
1980	0.025	0.10	1500.	800.
1985	0.025	0.10	1500.	800.
1990	0.025	0.10	1500.	800.
1995	0.025	0.10	1500.	800.
2000	0.025	0.10	1500.	800.

CLASSROOMS

YEAR	SERVICE RATIO	ATTRITION RATE	UNIT INVESTMENT COST	UNIT OPERATING COST
1970	0.025	0.04	3000.	150.
1975	0.025	0.04	3000.	150.
1980	0.025	0.04	3000.	150.
1985	0.025	0.04	3000.	150.
1990	0.025	0.04	3000.	150.
1995	0.025	0.04	3000.	150.
2000	0.025	0.04	3000.	150.

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RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

TOTAL TEACHERS AND CLASSROOMS REQUIRED
(THOUSANDS)

YEAR	SCHOOL-AGE POPULATION	ENROLLMENT	TEACHERS REQUIRED	CLASSROOMS REQUIRED
1970	2643.	1322.	33.0	33.0
1975	3076.	1692.	42.3	42.3
1980	3597.	2158.	54.0	54.0
1985	4229.	2749.	68.7	68.7
1990	4984.	3239.	81.0	81.0
1995	5878.	3821.	95.5	95.5
2000	6942.	4512.	112.8	112.8

NOTE--ZEROS INDICATE NO DATA PROVIDED FOR THE SERVICE TYPE.

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RUN 1* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025*

NEW TEACHERS

(DATA APPLICABLE TO INTERVAL ENDING IN YEAR SPECIFIED)

	NUMBERS REQUIRED (THOUSANDS)			INVESTMENT COSTS (MILLIONS OF DOLLARS)			OPERATING COSTS (MILLIONS OF DOLLARS)
YEAR	ADDITIONS	REPLACEMENTS	TOTAL	ADDITIONS	REPLACEMENTS	TOTAL	TOTAL
1975	9.3	15.4	24.7	13.9	23.1	37.0	150.7
1980	11.7	19.7	31.4	17.5	29.6	47.1	192.5
1985	14.8	25.1	39.9	22.1	37.7	59.8	245.4
1990	12.3	30.7	42.9	18.4	46.0	64.4	299.4
1995	14.5	36.1	50.7	21.8	54.2	76.0	353.0
2000	17.3	42.7	59.9	25.9	64.0	89.9	416.7

Pages 24-35 Other social services data: omitted

RUN II* MEDIUM FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 100 YEARS*

********** DATA APPLICABLE TO FIVE-YEAR INTERVAL **********
********** ENDING AT SPECIFIED YEAR **********

YEAR	TOTAL POPULATION	BIRTHS	DEATHS	CRUDE BIRTH RATE	CRUDE DEATH RATE	LIFE EXPECTANCY AT BIRTH MALE	LIFE EXPECTANCY AT BIRTH FEMALE	GROSS REPRODUCTION RATE	YEAR
1970	10000.0								1970
1975	11599.9	2343.0	743.0	0.043	0.014	52.30	55.45	2.968	1975
1980	13412.5	2626.4	813.8	0.042	0.013	53.17	56.38	2.858	1980
1985	15469.1	2946.7	890.1	0.041	0.012	54.05	57.33	2.753	1985
1990	17802.2	3306.2	973.1	0.040	0.012	54.95	58.29	2.652	1990
1995	20437.9	3696.8	1061.0	0.039	0.011	55.87	59.27	2.555	1995
2000	23394.7	4109.3	1152.5	0.037	0.011	56.80	60.27	2.463	2000

Page 47 (Corresponds to Page 16 of Run 1.)

RUN II* MEDIUM FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 100 YEARS*

YEAR	GNP (MILLIONS)	POPULATION (THOUSANDS)	PER CAPITA GNP	CAPITAL STOCK (MILLIONS)	LABOR FORCE (THOUSANDS)	INVESTMENT FROM DOMESTIC SOURCES (MILLIONS)	UNEMPLOY-MENT RATE	INVESTMENT-GNP RATIO	CAPITAL PER EMPLOYED LABORER (THOUSANDS)	YEAR
1970	2000.00	10000.00	200.00	5000.00	3616.86	137.57	0.150	0.069	1.626	1970
1975	2478.52	11599.92	213.67	5784.53	4204.17	191.19	0.152	0.077	1.622	1975
1980	3146.44	13412.46	234.59	6897.40	4889.61	276.91	0.135	0.088	1.630	1980
1985	4059.17	15469.06	262.41	8519.02	5692.52	404.88	0.113	0.100	1.686	1985
1990	5282.13	17802.15	296.71	10884.09	6624.41	587.43	0.094	0.111	1.814	1990
1995	6901.69	20437.94	337.69	14297.11	7685.37	841.28	0.082	0.122	2.026	1995
2000	9033.79	23394.66	386.15	19156.89	8888.23	1189.03	0.074	0.132	2.327	2000

Page 67 (Corresponds to Page 7 of Run 1.)

RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

YEAR	TOTAL POPULATION	BIRTHS	DEATHS	CRUDE BIRTH RATE	CRUDE DEATH RATE	LIFE EXPECTANCY AT BIRTH MALE	LIFE EXPECTANCY AT BIRTH FEMALE	GROSS REPRODUCTION RATE	YEAR
		********** DATA APPLICABLE TO FIVE-YEAR INTERVAL ********** ENDING AT SPECIFIED YEAR **********							
1970	10000.0								1970
1975	11492.9	2218.2	725.3	0.041	0.013	52.30	55.45	2.805	1975
1980	12970.9	2234.1	756.1	0.037	0.012	53.17	56.38	2.418	1980
1985	14442.5	2259.1	787.5	0.033	0.011	54.05	57.33	2.092	1985
1990	15904.0	2285.8	824.2	0.030	0.011	54.95	58.29	1.817	1990
1995	17322.4	2280.8	862.5	0.027	0.010	55.87	59.27	1.583	1995
2000	18762.8	2353.9	913.5	0.026	0.010	56.80	60.27	1.479	2000

Page 69 (Corresponds to Page 9 of Run 1.)

RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

AGE PROFILE

MALE

YEAR	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 34	35 TO 39
	AGE GROUP							
1970	0.0883	0.0720	0.0611	0.0520	0.0439	0.0370	0.0311	0.0261
1975	0.0842	0.0730	0.0619	0.0525	0.0444	0.0374	0.0315	0.0264
1980	0.0758	0.0711	0.0639	0.0542	0.0457	0.0386	0.0324	0.0272
1985	0.0695	0.0651	0.0631	0.0567	0.0478	0.0403	0.0339	0.0284
1990	0.0644	0.0606	0.0585	0.0567	0.0507	0.0426	0.0358	0.0300
1995	0.0596	0.0570	0.0550	0.0531	0.0512	0.0457	0.0383	0.0321
2000	0.0573	0.0532	0.0521	0.0503	0.0483	0.0465	0.0413	0.0346

YEAR	40 TO 44	45 TO 49	50 TO 54	55 TO 59	60 TO 64	65 TO 69	70 TO 74	OVER 74
	AGE GROUP							
1970	0.0217	0.0179	0.0145	0.0116	0.0088	0.0063	0.0042	0.0035
1975	0.0220	0.0181	0.0147	0.0116	0.0090	0.0064	0.0041	0.0035
1980	0.0226	0.0187	0.0152	0.0120	0.0092	0.0067	0.0043	0.0036
1985	0.0237	0.0195	0.0159	0.0126	0.0096	0.0069	0.0045	0.0038
1990	0.0250	0.0207	0.0168	0.0133	0.0102	0.0073	0.0048	0.0041
1995	0.0268	0.0221	0.0180	0.0143	0.0109	0.0078	0.0051	0.0044
2000	0.0288	0.0238	0.0193	0.0153	0.0117	0.0085	0.0055	0.0048

FEMALE

YEAR	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 34	35 TO 39
	AGE GROUP							
1970	0.0869	0.0709	0.0603	0.0513	0.0434	0.0367	0.0309	0.0260
1975	0.0813	0.0719	0.0609	0.0519	0.0439	0.0371	0.0313	0.0263
1980	0.0733	0.0688	0.0630	0.0534	0.0453	0.0382	0.0322	0.0271
1985	0.0671	0.0630	0.0611	0.0560	0.0473	0.0400	0.0337	0.0283
1990	0.0623	0.0586	0.0567	0.0549	0.0501	0.0422	0.0356	0.0300
1995	0.0576	0.0552	0.0533	0.0515	0.0498	0.0453	0.0381	0.0320
2000	0.0554	0.0515	0.0505	0.0488	0.0470	0.0453	0.0411	0.0345

YEAR	40 TO 44	45 TO 49	50 TO 54	55 TO 59	60 TO 64	65 TO 69	70 TO 74	OVER 74
	AGE GROUP							
1970	0.0218	0.0182	0.0150	0.0122	0.0097	0.0072	0.0049	0.0046
1975	0.0220	0.0184	0.0152	0.0124	0.0098	0.0074	0.0050	0.0046
1980	0.0227	0.0190	0.0157	0.0128	0.0101	0.0075	0.0052	0.0048
1985	0.0238	0.0198	0.0164	0.0133	0.0106	0.0079	0.0054	0.0050
1990	0.0251	0.0210	0.0173	0.0141	0.0111	0.0084	0.0057	0.0054
1995	0.0269	0.0224	0.0185	0.0150	0.0119	0.0090	0.0062	0.0058
2000	0.0289	0.0241	0.0199	0.0162	0.0128	0.0096	0.0067	0.0064

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RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

BIRTH RATES, APPLICABLE TO 5-YEAR INTERVAL ENDING AT YEAR SPECIFIED

	**			AGE GROUP			**
YEAR	*15 TO 19	*20 TO 24	*25 TO 29	*30 TO 34	*35 TO 39	*40 TO 44	*45 TO 49
1975	0.0985	0.2806	0.2883	0.2291	0.1633	0.0703	0.0199
1980	0.0782	0.2541	0.2600	0.1962	0.1302	0.0532	0.0194
1985	0.0620	0.2301	0.2346	0.1680	0.1039	0.0402	0.0189
1990	0.0492	0.2084	0.2116	0.1439	0.0828	0.0304	0.0185
1995	0.0391	0.1887	0.1909	0.1232	0.0661	0.0230	0.0180
2000	0.0348	0.1796	0.1813	0.1140	0.0590	0.0200	0.0178

Page 73 (Corresponds to Page 13 of Run 1.)

RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

DECREASE IN BIRTHS DUE TO LOWER BIRTH RATES
(IN THOUSANDS, FOR 5-YEAR INTERVAL ENDING IN THE YEAR SPECIFIED)

	*			AGES			*	
YEAR	15-19	20-24	25-29	30-34	35-39	40-44	45-49	TOTAL
1975	33.49	33.49	30.21	30.88	27.47	12.43	0.24	168.21
1980	104.45	111.32	106.18	99.84	85.95	37.95	0.82	540.51
1985	182.24	205.61	184.91	179.87	150.05	64.84	1.58	969.10
1990	258.13	320.07	286.83	273.06	221.20	93.64	2.54	1455.47
1995	315.91	440.61	409.99	381.27	301.05	125.09	3.75	1977.69
2000	342.61	502.73	499.26	477.91	371.95	153.43	4.83	2352.72

RELATIVE DECREASE IN BIRTH RATES
(FOR 5-YEAR INTERVAL ENDING YEAR SPECIFIED)

	*			AGES			*	
YEAR	15-19	20-24	25-29	30-34	35-39	40-44	45-49	TOTAL
1975	0.109	0.048	0.050	0.075	0.107	0.130	0.012	0.070
1980	0.293	0.138	0.143	0.208	0.288	0.342	0.036	0.195
1985	0.439	0.220	0.227	0.321	0.432	0.503	0.059	0.300
1990	0.555	0.293	0.303	0.419	0.547	0.624	0.082	0.389
1995	0.647	0.360	0.371	0.502	0.639	0.716	0.104	0.464
2000	0.685	0.391	0.403	0.540	0.677	0.753	0.114	0.500

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RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

RELATIVE DECREASE IN BIRTH RATES
(FOR YEAR SPECIFIED)

YEAR	AGES 15-19	20-24	25-29	30-34	35-39	40-44	45-49	TOTAL
1975	0.179	0.082	0.085	0.124	0.175	0.211	0.021	0.117
1980	0.359	0.174	0.180	0.258	0.352	0.415	0.046	0.242
1985	0.494	0.254	0.262	0.367	0.486	0.560	0.069	0.342
1990	0.599	0.325	0.335	0.459	0.591	0.668	0.092	0.425
1995	0.666	0.375	0.387	0.521	0.658	0.734	0.109	0.482
2000	0.685	0.391	0.403	0.540	0.677	0.753	0.114	0.500

IMPLIED NUMBER OF WOMEN EFFECTIVELY PRACTICING FAMILY PLANNING
(IN THOUSANDS, FOR YEAR SPECIFIED)

YEAR	AGES 15-19	20-24	25-29	30-34	35-39	40-44	45-49	TOTAL
1975	106.64	41.30	36.12	44.75	52.98	53.55	4.40	339.74
1980	248.47	102.31	69.45	107.84	123.96	122.22	11.30	805.56
1985	399.09	173.27	151.33	178.53	198.59	192.17	19.83	1312.80
1990	523.53	259.15	225.05	259.88	281.57	266.56	30.63	1846.37
1995	594.29	323.60	303.36	343.38	365.05	341.56	42.20	2313.43
2000	627.34	344.67	342.06	416.23	437.96	408.32	51.75	2628.28

YEAR	NUMBER	PERCENT OF TOTAL WOMEN AGES 15 TO 49
1975	339.743	0.128
1980	805.556	0.261
1985	1312.801	0.365
1990	1846.368	0.448
1995	2313.430	0.502
2000	2628.276	0.520

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RUN III* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS*

YEAR	GNP (MILLIONS)	POPULATION (THOUSANDS)	PER CAPITA GNP	CAPITAL STOCK (MILLIONS)	LABOR FORCE (THOUSANDS)	INVESTMENT FROM DOMESTIC SOURCES (MILLIONS)	UNEMPLOY-MENT RATE	INVESTMENT-GNP RATIO	CAPITAL PER EMPLOYED LABORER (THOUSANDS)	YEAR
1970	2000.00	10000.00	200.00	5000.00	3616.86	137.57	0.150	0.069	1.626	1970
1975	2480.35	11492.90	215.82	5789.43	4204.17	193.97	0.151	0.078	1.622	1975
1980	3158.39	12970.89	243.50	6933.44	4889.61	289.24	0.132	0.092	1.633	1980
1985	4095.61	14442.51	283.58	8650.25	5692.52	435.26	0.107	0.106	1.702	1985
1990	5348.29	15904.04	336.28	11218.82	6574.16	644.12	0.085	0.120	1.864	1990
1995	6959.60	17322.37	401.77	14975.32	7458.34	926.09	0.066	0.133	2.150	1995
2000	8975.35	18762.77	478.36	20298.90	8322.67	1288.88	0.054	0.144	2.578	2000

Page 102 (Corresponds to the discussion of Page 20 in Chapter 7.)

RUN IG* HIGH FERTILITY* NO DECLINE IN BIRTH RATES*
GROSS REPRODUCTION RATE IS 3.025* MINIMUM GROWTH OF .03

GOAL GROWTH RATE FOR PER CAPITA GNP = 0.030

			NET INVESTMENT			
			FROM DOMESTIC SOURCES		FROM FOREIGN SOURCES	
YEAR	GNP (MILLIONS)	GOAL GNP (MILLIONS)	AMOUNT (MILLIONS)	RATIO TO GNP	AMOUNT (MILLIONS)	RATIO TO GNP
1970	2000.0	2000.0	137.6	0.0688	104.9	0.0525
1975	2698.1	2698.1	234.3	0.0868	195.1	0.0723
1980	3649.1	3649.1	373.6	0.1024	343.2	0.0941
1985	4945.9	4945.9	573.1	0.1159	537.7	0.1087
1990	6716.7	6716.7	856.3	0.1275	817.0	0.1216
1995	9138.9	9138.9	1256.4	0.1375	1252.4	0.1370
2000	12461.1	12461.1	1820.4	0.1461	1913.3	0.1535

Page 118 (Corresponds to the discussion of Page 20 in Chapter 7.)

RUN IIIG* LOW FERTILITY* DECLINE OF GRR FROM 3.025 TO 1.479
OVER 25 YEARS* MINIMUM GROWTH OF .03

GOAL GROWTH RATE FOR PER CAPITA GNP = 0.030

			NET INVESTMENT			
			FROM DOMESTIC SOURCES		FROM FOREIGN SOURCES	
YEAR	GNP (MILLIONS)	GOAL GNP (MILLIONS)	AMOUNT (MILLIONS)	RATIO TO GNP	AMOUNT (MILLIONS)	RATIO TO GNP
1970	2000.0	2000.0	137.6	0.0688	91.2	0.0456
1975	2664.7	2664.7	230.8	0.0866	111.3	0.0418
1980	3486.4	3486.4	354.8	0.1018	96.1	0.0276
1985	4500.2	4500.2	516.2	0.1147	25.1	0.0056
1990	5759.9	5748.7	725.6	0.1261	0.	0.
1995	7401.0	7375.5	1014.4	0.1371	0.	0.
2000	9462.8	9434.8	1386.4	0.1465	0.	0.