DEMOGRAPHIC, ECONOMIC-DEMOGRAPHIC AND OTHER DEMOGRAPHICALLY RELATED MODELS: AN ANALYSIS

by

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The last decade has witnessed a number of research projects to develop models linking demographic with social and economic variables. Increasing use is being made of such models in formulating long-range plans for economic development. The objective of the present paper is to examine such models with a view to assessing their relative merits as instruments for development planning in Latin America.

The term "model" has an extremely wide usage, from a single simple equation between two or more variables, to a large number of complex mathematical relationships determined simultaneously. However, in the context of population and development the term has had a more restricted meaning: generally, a computer simulation using recursive techniques, a set of quantified relationships and an iterative process viewing outcomes after many successive periods. Even within the latter, more restrictive sense, models vary from one another in important characteristics. For instance, they may be deterministic or stochastic; that is, contain relationships specified either in an exact manner or with a random component described only probabilistically. Next, models are static or dynamic in nature depending on whether the basic assumption is the attainment of equilibrium or the influence of trends and lagged variables (Christ, 1966). Thirdly, a differentiation can be made between macro-models (considering national/world aggregates) or micro-models (treating individual/household behaviour). These distinctions will prove useful later when we take a closer look at particular models.

At this point, we may ask what relevance models have in long-range planning. Models are not utilized to make forecasts, except in the case of short-range economic models (Clark et al, 1975). The idea, rather, is to compare the results of different policy strategies after 30 or so years of simulation. An underlying assumption, of course, is that biases and uncertainties present in the model will affect all simulation "runs" equally, thus allowing valid comparisons. Besides this, models may serve other, more specialized purposes: enhancing faulty data and thereby providing better estimates or projections (Menken, 1978); or dealing with the consequences of specific policies such as alternative family planning strategies (U.N. Population Division, 1977).

For descriptive ease, the paper classifies models into four categories. First, we consider "demographic" models, which have few or no linkages with social or economic inputs. However, by including intermediate variables affecting, say, fertility, some models of this type may be of use in introducing population policy into a larger model and/or increasing the precision of such a model's demographic component. A second grouping, "economic-demographic" models, are the large planning models of national systems with endogenous demographic variables and an economic sub-model specified in detail. A third category, "world" models, comprises global simulation exercises. Although not directly relevant to planning, they are included in our survey for completeness and because their more universalistic framework may nonetheless be useful in developing national models. Fourth, the paper examines other theoretical models[1/] which have either remained as analytical exercises or restricted themselves to the investigation of specific relationships. They are considered for reasons analogous to those given immediately above.

The remainder of the paper analytically describes these four classes of models, and then discusses their advantages and disadvantages.

ANALYSIS OF CURRENT MODELS

1. Demographic Models

Since surveys of demographic models are available elsewhere (Keyfitz, 1971; Dyke and MacCluer, 1973; Menken, 1978), we need not dwell extensively on them here. Following Menken (1978), these models may be divided into two groups (demographic and biological) depending on their treatment of fertility.

In the "demographic" approach, births are considered as events occurring to sub-groups of a population with certain probabilities. One such model, POPSIM (USA, 1973), simulates the fertility, nuptiality and mortality of a population, but excludes migration effects. Detailed fertility rates are

1/ Some models developed in Latin America are included here also.

required for input into POPSIM, and, with extensive contraceptive use inputs, consequences of family planning upon population growth can be investigated.

Many demographic models have been developed which adopt a "biological" approach. Such models use knowledge of the reproductive process (e.g. probabilities associated with foetal deaths, length of post-partum sterility, etc.) and have generally been applied to studies of contraception and abortion. REPSIM-B, POPREP, TABRAP and others are reviewed elsewhere in detail (Menken, 1978).

A recently developed "bio-demographic" model (U.N. Population Division, 1977), however, merits further discussion for two reasons. First, it has greater applicability in countries lacking extensive demographic, biological or contraceptive use data. Second, by specifying the demographic effects of broad, rather than detailed, policies on family planning the model could serve as a basis for integrating population policy into an economic-demographic model. Briefly, the U.N. model is a stochastic micro-simulation using "well structured bio-demographic processes" (U.N. Population Division, 1977, p. 3). For operation 14 types of data must be input, but all are readily available or easily estimated. For example, one such input is the singulate mean age at marriage, a figure approximated with minimum effort from a census marital/age distribution. As a further example, an estimate of the "level of sterility" must be entered prior to the simulation, but the estimate need be selected from among only three levels: low, medium or high.

2. Economic-Demographic Models

The models reviewed in this section are in large measure elaborations of the well-known work by Coale and Hoover (1958). The TEMPO series, in fact, can be considered as a direct descendant. In essence, these models consist of two principal components (modules), one simulating the behaviour of an economy, the other that of the corresponding population. Among the larger models these modules interact over many periods, each supplying and receiving from the other data which determine successive values of variables specific to each module. By necessity, economic-demographic models are macro-simulations and the ones developed so far have been deterministic in character.

The models to be reviewed are as follows: BACHUE, PDM, SERES, the TEMPO series and the LRPM series. One other model, PLATO (SEADAG, 1975), is omitted due to lack of information.[2/] Less attention will be given to TEMPO and LRPM as they represent earlier versions of later models.[3/]

BACHUE. Although various national applications are planned by the International Labour Organization which developed this model, only BACHUE-Philippines

2/ PLATO appears to be similar to TEMPO in any case (Quinn, 1976).
3/ SERES is a larger, completely re-worked version of TEMPO; PDM a less obviously related, sophisticated offspring of the LRPM series.

(Rodgers et al., 1978) has as yet been developed.[4/] BACHUE is concerned with the relationships "between population, employment and income distribution" and is aimed at "widening the knowledge base for policy-makers and others concerned with development planning". (Ibid., p. 1). Like other models, BACHUE is a complex computer program in which many connections representing the above relationships are defined mathematically. Using this in-built structure, the behaviour of the population-employment-economic system is simulated over a long run (20-50 years). At the end of each such run a series of data is output: population composition and characteristics, growth indicators, income distribution, employment data, etc. By undertaking several runs which incorporate alternative growth rate assumptions or development policies, a comparison of different futures can be made.

Among the various policies investigated in BACHUE-Philippines have been: educational emphasis, family planning effort, migration policy, minimum wages, wage subsidies, programs of public works, and so on. Space does not allow a full exposition of each of these policy variations, but one, education, can serve as an example. In this run, special governmental emphasis on education is simulated by exogenously increasing school graduation rates. The resultant changes in the other components of the system are noted. A further

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4/ Experiments with early versions of BACHUE for Brazil, Kenya and Yugoslavia have been reported (Burle de Figueiredo and Rato, 1977; Maruca, 1978; Rodgers and Anker, 1978).

use of BACHUE in termed "strategy analysis" by the authors (Ibid., p. 354ff). This consists of runs in which a set of policies (as outlined above) are selected which mirror an overall development strategy such as "industrialization" or "egalitarianism".

BACHUE's structure has several noteworthy features. Determination of demand, firstly, is based on an input-output table, but, unconventionally, production is not endogenously determined, at most responding to external constraints. The authors describe this as "demand driven" and take the position that supply (and investment) generally adjust automatically to demand. A second major point of departure in BACHUE is the adoption of a dualistic view of development. This is particularly evident, for example, in the treatment of the labour market: modern/traditional labour sectors both in urban and rural areas are defined separately. Despite the detailed emphasis on employment, however, the authors admit that the labour market sub-model is not a sufficiently "sensitive" item in terms of the overall performance of the model (Ibid., p. 255). The elaborate attempt to derive household income distribution from individual incomes is a further noteworthy feature of the economic sub-system.

In its demographic module, BACHUE is more orthodox. Population accounting is performed using the cohort survival method. This is made unnecessarily complicated, however, by choosing five-year age groups for many purposes, while the projection period is generally one year, a difficulty recognized by the authors (Ibid., p. 243). Fertility, mortality and migration equations endogenously generate rates used by this sub-system. To illustrate the method, the following equation gives BACHUE's basic fertility rate:

$$GRR = 4.67 - 0.0064R + 0.016I - 0.0466E + 0.0059L$$

Where:

GRR = Gross reproduction rate
R = Female labour force participation rate (15-44 age group)
I = Percentage of adults illiterate
E = Life expectancy at birth in years
L = Percentage of labour force in agriculture

This equation was estimated from cross-sectional data for 47 countries. The four explanatory variables are supplied by other parts of BACHUE; from GRR, age-specific fertility rates are constructed. Among other criticisms of this approach, it can be objected that cross-national data are not the most appropriate inputs in estimating national parameters, in this case, those of the Philippines.

It is impossible to adequately summarize a model as large and complex as BACHUE in a few paragraphs. Although an undoubtedly great effort has been expended in defining the model, in certain ways its application seems limited. Lack of internalization of investment, output and education, as well as other lacunae,[5/] reflect judgements about Philippine conditions which may not be valid elsewhere.

5/ The reader may consult Table 1 in the Appendix for more details.

PDM. The objectives of this model are similar to those of BACHUE. These include providing a "model capable of simulating population dynamics, economic development and economic-demographic interaction" and a "total system framework... for evaluating the multiple impacts of policies and programs designed to modify economic or demographic behavior" (White et al., 1957b, p. 2-3). In fact, much the same procedures for policy evaluation occur in PDM as in BACHUE (see above). Hence, there is no need for further explication here.

An examination of the structure of PDM demonstrates similarities, as well as differences, with respect to BACHUE. PDM uses a modified type of input-output analysis and adopts, as in BACHUE, the concept of dualistic development (White, 1975a, 1975b). However, if it is the labour market which received most attention in constructing BACHUE, it is the agricultural sector which is emphasized in detail in PDM. The fundamental economic principle incorporated in PDM is the maximization of welfare in the sense of "consumer plus producer surplus" (White, 1975b, p. 18), within each simulation period.

The PDM economic sub-module contains a more conventional treatment of prices, supply, demand and investment than BACHUE. Prices, for example, are almost completely ignored in BACHUE, but enter endogenously into the estimation of the main economic variables in PDM. Investment, too, plays a more important role in PDM through an investment allocation matrix. In this regard, it is worth mentioning that investment in land improvement in particular is modelled by PDM, providing ample possibilities for investigating alternative strategies of agricultural development. Additionally, PDM incorporates some resource constraints, such as stocks of capital and quantity of agricultural land, but, along with other models, ignores the question of possible relative scarcities in natural resources. PDM builds into its economic subsystem a "result analysis" module which makes it possible to evaluate simulated data with actual data. This is an important feature since a major criticism of large-scale models is the lack of serious validation attempts (Arthur and McNicoll, 1975).

In their demographic characteristics, PDM and BACHUE are similar,[6/] although PDM has a more thorough treatment in two areas. First, migration patterns, both international and internal, are modelled in detail by PDM. Given the necessary input data, this allows a more realistic projection of migration than is possible in models such as BACHUE, which both ignore international movement and regard internal migration simply as a rural-to-urban phenomenon. Second, population sub-groups as well as demographic rates are estimated separately for 105 age/education/location groups.

PDM seems to be a well designed model, incorporating more of the main econometric relationships than other current models. According to information

6/ E.g., use of the cohort survival method and endogenous variables.

available, however, the model has not undergone a detailed application similar to BACHUE in the Philippines. Hence, it is not known how well the model behaves, i.e., how sensitive or "robust" it is with respect to exogenous changes. A second possible difficulty with PDM may be precisely its extra disaggregation. The demands for input data are correspondingly greater, leading, perhaps, to greater non-availability in many LDCs. It should be pointed out, however, that in many cases disaggregation is optional rather than required and, also, that statistical information may be of a higher quality in much of Latin America than was the case for BACHUE-Philippines.

SERES. This third major economic-demographic model was designed speficically for Colombian conditions (CCRP, 1975). At the core of the economic submodel is an input-output table similar to BACHUE's. However, relatively less endogenous rendering of interrelationships has been attempted in SERES compared to either BACHUE or PDM. For instance, trade, wages, government expenditure and capital/output ratios are exogenous to the system. Labour supply is also treated in a less sophisticated manner: labour participation rates are fixed without constraints on occupational mobility.

The population module resembles those of BACHUE and PDM, particularly as regards population accounting. Again, however, less endogenization is evident in that migration and, to an extent, mortality are predetermined as inputs. Migration (net rural-urban), for example, is input as a set of rates which remain fixed for the entire simulation. On the other hand, health and family planning are explicitly modelled.

The health module is useful for simulating public health policies. The main feedback into other parts of the model is through the generation of deaths and man-days of incapacity. The costs of including a health sector, however, seem to outweigh the benefits of such feedbacks, unless the user of SERES also has a specific interest in health policy.

The family planning module attempts to build into SERES the demographic impact of contraceptive use. However, the treatment is largely conjectural since cost per acceptor rates are "guestimates" and the distribution of new users and contraceptive discontinuation rates are only rough estimates.

Overall, SERES achieves a much lower level of endogenization than either of the previous two models. Furthermore, an actual full-scale operation of the model has so far not been reported.[7]

TEMPO. The set of TEMPO models (aside from SERES) represents an older, less sophisticated generation of models (TEMPO, n.d.; Brown, 1974; Carbon, 1978). Production, for example, is given by a simple Cobb-Douglas function. Demographic rates are supplied exogenously and hence the model is not interactive. Migration is not considered, nor is the labour market defined. The main purpose for which TEMPO seems to have been used is to make projections of economic gains from reduced fertility (Brown, 1974; Fucaraccio, 1976).

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7/ See Heredia and Baldion (1976) for an application of the demographic submodel.

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LRPM. The LRPM series also consists of a set of relatively unsophisticated models (Quinn, 1975, 1976). LRPM models are made up of several modules which can function independently or in combination. This offers considerable flexibility in constructing models according to particular user requirements (Quinn, 1976). In addition, the economic module is readily adaptable to specific needs: the form is given -an optimal solution with competitive market behaviour- but the user must supply the econometric equations. Demographic modules of LRPM can also be used to enhance faulty data or for estimation. Another module of LRPM makes simple but useful projections in social sectors such as health, housing or food, without elaborate input data requirements.

To supplement this brief description, Table 1 (see Appendix) lists further details of the five above models. Part A of Table 1 provides an idea of the composition of the models, that is, which socio-economic features are incorporated and which are omitted. Part B presents the degree of endogenization in each model. The higher the endogeneity, the greater is the use of theory in the model building process. It should be remembered that only with correct theory is accurate prediction possible. The level of disaggregation is shown in Part C. Greater disaggregation increases modelling precision, since different sub-groups behave differently and global measures cannot capture compositional changes exactly. A rough breakdown of input requirements needed (or derirable) for initialization of each model is listed in Part D.[8/]

8/ This breakdown may not be wholly accurate as detailed literature on input requirements was not available in all cases.

As can be seen, PDM makes the heaviest demands for data, followed by BACHUE and SERES. Finally, in Part E, some major assumptions are enumerated. As can be seen BACHUE and SERES appear to make more assumptions than does PDM. Of course, many other assumptions, judged to be either of minor importance or not seriously unrealistic, have not been shown.

3. World Models

Another class of models treats world-systems as subjects for simulation. Since they have been reviewed elsewhere (Carter, 1975; Clark *et al.*, 1975), this discussion will be limited to a few general remarks.

World models begin with Meadow's (1972) and Forrester's (1971) well-known contributions and now include *inter alia* a second Club of Rome model (Mesarovic and Pestel, 1974), the Bariloche model (Herrera *et al.*, 1976), a U.N. model (Leontief, 1977) and a north-south model being developed by UNITAR (1978).

Several elements in world models are not found in national-economy models.[9/] Depletion of natural resources is a case in point. The relationship explored here is between economic stability and scarcity of resources.

9/ We use this term equivalently to "economic-demographic" models.

Another example is the treatment of pollution and/or ecological imbalance: deleterious externalities consequent upon industrialization and agricultural development may lead to an eventual decline in production. A third feature of world models is an emphasis on the future sufficiency of food supplies. These three concerns, natural resources, pollution and food suplies, are new areas into which economic-demographic models could possibly be usefully expanded. For example, it seems fairly clear that economic development has some relationship to resource endowment, although there are, of course, dissenting opinions (e.g. Herrera et al., 1976).

Some aspects of the world social system have been ignored, at least in early models. Migration patterns, for example, are commonly excluded as are elements of international trade. However, as world models become more disaggregated such interchanges between global sub-divisions are beginning to be considered explicitly.

4. Other Theoretical Models

A number of other models are of interest either theoretically or because they relate specifically to Latin America. For brevity, only significant features will be noted.

CENDES (Venezuela) Model. Emphasizes the health sector. Demographic variables are exogenous.

ILPES-CELADE Model. Highlights income distribution in determination of demand. Purpose is to examine economic policies applicable to Latin America. Economic and demographic sub-models are not interactive (Urzúa, 1978, p. 193).

CEDE (Colombia) Model. An econometric model with no demographic sub-model. The model does, however, attempt to incorporate internal migration (Sapoznikow, 1975).

CELADE (Athanassiou) Model. A four equation model in which population is an exogenous variable (Athanassiou, 1976).

Social Psychology Model of Fertility. Bagozzi and Van Loo (1978) present a model of fertility with socio-psychological explanatory variables as well as economic ones. Providing data were available, this theoretical approach could be included in specifying fertility in an economic-demographic model.

Growth Model (Lloyd). A theoretical model featuring: labour productivity linked to caloric consumption; endogenous technological change; fertility reduction based on two types of governmental program intervention (Lloyd, 1969).

Easterlin Cycles Model. An attempt to explain fertility swings in terms of relative income (Lee, 1978). The link established between age-specific fertility and a number of economic variables could be incorporated into an interactive model.

DISCUSSION

This discussion is limited to one of the four classes of models reviewed, namely, economic-demographic models, as these are of more practical use to national development planners.

Several criticisms have been made of models such as BACHUE. Myrdal objects that "formal models are not appropriate for analysing the social and institutional changes that accompany any development, yet fertility trends are intimately linked to them" (McNicoll, 1975). In other words, models tend to focus attention on periferal adjustments to the system "in situations that may call for structural overhaul" (Arthur and McNicoll, 1975, p. 258). While this may be true,[10/] it is difficult to envisage governmental planning agencies being in a position to "plan" wide-ranging institutional reformation. In fact, it is an open question whether planners can function effectively if their views differ greatly from those held by the dominant power structure. Hence, models which operate largely within a given structural framework may be more realistic.

Another charge levelled against large models is that they mask simplicity behind much "window-dressing". "For a given issue, in fact, one or two relationships and assumptions dominate nearly all the outcome" (Arthur and McNicoll, 1975, p. 257). While any model, when rigorously analysed, may be made up of relatively simple premises and relations, it is the totality which is complex. Any method of planning necessarily proceeds from such

10/ Not all commentators deny the ability to model structural change (see Fox *et al*., 1973, p. 11). The Bariloche model, moreover, is premised on structural change.

simple elements, but models have the distinct advantage of operating with a large number of elements simultaneously. Arguing that this makes planning less "dangerous", the authors of BACHUE conclude: "the main advantage of a quantitative model is that it does not constantly alter shape, as a policy-maker's mental model is liable to do, and it is explicit, again unlike a mental model" (Rodgers et al., 1976., p. 399).

Probably a more genuine concern is that, being so complex, a model may be misused, mainly through ignorance of the assumptions and theoretical perspectives underlying the model's construction. This, however, is not a criticism of models themselves, but of their uses. What is needed, therefore, is a explicit description of at least the principal assumptions and premises on the part of the model-builder and a healthy awareness of the model's limitations on the part of the policy-maker.

There are other, more technical, problems in long-range models. One involves conjectural specification. An author of the first Club of Rome model estimated that only 0.1 per cent of the input data needed for a fully satisfactory world model are actually available (Clark et al., 1975). It therefore becomes necessary to operationalize many relationships more on the basis of informed guesswork than on known facts. In defense of this, one modeller's view is that:

> ... resort to reasonable conjectures (may) 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). (TEMPO, n.d., p. 53).

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It is also worth noting that even without models planners might prefer to make such conjectures rather than rely on possibly misleading past behaviour.

Secondly, there is the imprecision involved in long-horizon simulations. Pointing out that in the long run little is ever constant, Lloyd suggests that "economists are seldom, in practice, concerned with a time horizon of more than 10 years" (1969, p. 471). The problem is that the very parameters of the model's equations are likely to change in a long term of 25-50 years. Related to this are the random fluctuations present in all empirically estimated equations. Christ (1966, p. 221) describes the situation this way:

> ... the uncertainty in forecasting ... increases with increases in the length of the horizon... Similar conclusions hold for the stochastic version of any dynamic model.

There seems to be no way to overcome this defect. The prescription mentioned above, that models should be used for policy comparisons and not for forecasting, can only be reiterated here.

A third point bears upon the endogenization of demographic variables. Leontief refused to take this step in developing the U.N. world model because

> ... a perusal of recent writing on the effects of various economic variables on the rate of population growth leads

to the conclusion that the present understanding of these relationships is still much more uncertain [than purely economic ones] (Leontief, 1978, p. 3).

This is indeed a problem. Once again, however, we can ask what are the alternatives. Demographic projections, in the absence of theory, are notoriously inaccurate. It seems to make better sense, therefore, to use current theories, whatever their explicative powers may be, to project demographic variables than nothing at all.

APPENDIX

Table 1

SOME DETAILS OF SELECTED ECONOMIC-DEMOGRAPHIC MODELS

	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
A. Sub-Models					
1. Economic	P	P	P	C	P
2. Government	P	P	P	A	U
3. Labour market	P	I	A	A	C
4. Income distribution	P	A	C	A	P
5. Population accounting	P	P	P	P	P
6. Demographic rate simulator	I	P	C	C	P
7. Migration (internal)	P	P	P	A	P
8. Migration (international)	A	P	A	A	A
9. Education	P	I	P	A	C
10. Health	A	P	P	A	P
11. Family planning	A	A	P	A	A
12. Result analysis	A	P	A	A	A

A = Absent
C = Present, in crude form
I = Present, implicitly
P = Present
U = Not known

(continued)

Table 1 (continued)

SOME DETAILS OF SELECTED ECONOMIC-DEMOGRAPHIC MODELS

	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
B. Endogenous Variables					
Demographic, Labour Supply					
1. Fertility rates	E	E	E	X	X
2. Mortality rates	E	E	X	X	X
3. Migration rates (internal)	E	E	X	X	X
4. Migration rates (international)	X	E	X	X	X
5. Marriage rates	E	X	X	X	X
6. Contraceptive use rates	X	X	M	X	X
7. Education: enrolment and graduation rates	X	E	M	X	X
8. Intersectoral labour mobility	E	E	X	X	X
9. Labour supply	E	X	X	X	X
10. Labour utilization	E	E	X	E	U
Economic					
11. Demand	E	E	E	X	U*
12. Output (supply)	X	E	U	E	U
13. Consumption	E	E	E	E	U
14. Prices	X	E	X	X	U
15. Savings	M	E	E	X	U
16. Investment	X	E	E	E	U
17. Government expenditure	E	X	X	M	U
18. Foreign trade	X	E	X	X	U
19. Land improvement	X	E	X	X	U
20. Terms of trade between agriculture and industry	E	E	X	X	U
21. Rate of technical change	X	X	X	X	U
22. Intersectoral transfers	X	E	X	X	U
23. Household income distribution	E	X	M	X	M

E = Endogenous, estimated statistically
M = Endogenous, conjectural
X = Exogenous
U = Not known

*/ LRPM series has optional economic sub-models.

(continued)

Table 1 (continued)

SOME DETAILS OF SELECTED ECONOMIC-DEMOGRAPHIC MODELS

	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
C. Level of Disaggregation					
1. Age groups*/	13	66	16	16	16
2. Education categories	3	5	16	0	U
3. Locations	2	3	2	0	2
4. Migration flows	2	9	1	0	1
5. Input-output sectors	13	7**/	10	0	0
6. Occupational categories	6	4	4	0	0
7. Types of agricultural land	1	5	1	0	0
8. Groups exposed to health risks	0	0	14	0	0
	U = Not known				
D. Input Data Requirements					
1. Population census	A	A	A	L	L
2. Demographic rates: fertility, mortality, marriage, migration	A	A	A	L	L
3. Education: enrolment, graduation rates	D	A	A	X	L
4. Teacher, classroon cost	X	A	X	X	L
5. Social programs (housing, health, etc.): costs, use rates, depreciation, etc.	X	0	A	X	0
6. Family planning survey	X	X	D	X	X

*/ All models treat male and female populations separately.
**/ For some purpose there is a further division into 84 sub-sectors.

(continued)

Table 1 (continued)

SOME DETAILS OF SELECTED ECONOMIC-DEMOGRAPHIC MODELS

	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
7. Survey of employment, income	D	A	L	L	A
8. Labour force survey	D	D	D	X	X
9. National accounts time series for output, investment, demand, trade	A	A	D	L	D
10. Input-output table	A	A	A	X	X
11. Industry and services census	D	A	A	X	L
12. Government revenue and expenditure	D	X	D	X	D
13. Profits/non-wage income data	D	D	X	X	X
14. Time series of prices	D	R	X	X	X
15. Time series of wages	R	R	D	X	X
16. Weights for "equivalent consumers"	X	X	X	A	X

A = Required
D = Desirable
L = Required in less detail
O = Optional
X = Not used

E. Some Major Assumptions	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
1. Compatibility between output and investment	A	N	N	A	O
2. Fixed pattern of internal demand	A	A	A	N	O
3. Fixed price elasticity of supply	A	N	A	A	O
4. Savings and investment unrelated	A	N	N	A	O
5. Unlimited natural resources	A	A	A	A	A
6. Single period economic equilibrium	N	M	N	A	O

(continued)

Table 1 (conclusion)

SOME DETAILS OF SELECTED ECONOMIC-DEMOGRAPHIC MODELS

	BACHUE	PDM	SERES	TEMPO Series	LRPM Series
7. Demand driven economy	A	N	N	N	O
8. Log-normal income distribution	A	N	A	X	M
9. Cobb-Douglas production function	N	N	N	A	O
10. Constant rate of technological change	A	U	A	A	O
11. Linear relationships	M	A	A	A	O
12. Perfect mobility between all occupational categories	A	N	A	A	N
13. Education homogenous with respect to graduation, quality, etc.	A	M	A	X	A
14. Assured future fertility decline	A	N	N	N	N
15. Family planning interventions unimportant	A	A	N	N	A

A = Assumed
M = More specific assumption
N = Not assumed
O = Optional
U = Not known
X = Not applicable

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