Research on Population and Employment under the World Employment Programme

IN 1972 the ILO launched a comprehensive research project on the relationship between population and employment growth, financed by a substantial grant from the United Nations Fund for Population Activities (UNFPA).¹ The main objective of this project is to extend the knowledge base of policy-making, especially in developing countries, so that adequate account is taken of the effects of population changes on employment, income distribution and growth, as well as the effects on population of growth strategies and employment and income distribution policies. This requires research on numerous little-investigated issues that arise out of the interactions between economic and demographic variables.

Research priorities

The research programme consists of two related activities-

(1) The formulation and quantitative elaboration of a series of economic-demographic simulation models dealing with the direct and indirect effects of population on employment, output and income distribution, and vice versa.

(2) Empirical studies dealing with important elements in the network of relations between population and employment growth and focusing on policy issues. Some of the main studies are concerned with: the determinants of labour force participation rates; the economics of fertility; rural-

¹ The preliminary version of this project was outlined in the ILO document Scope, approach and content of research-oriented activities of the World Employment Programme, D.24 1972 (Geneva, 1972). An updated account appears in ILO: World Employment Programme: a progress report on its research-oriented activities, D.27 1973 (Geneva, Dec. 1973).

urban migration; consumption patterns, private and governmental, as they are affected by economic-demographic variables; labour market pressures and wage rates; population pressure and technical progress; and population pressure, agrarian structure and employment.

Two special features of the project deserve emphasis. The first is the mutual feedback between the empirical research and the modelling activity. The initial exploratory model—the "Bachue prototype "—incorporates the relevant key behavioural relationships on the basis of existing knowledge and *a priori* reasoning, and initial empirical studies are also concentrated on these relationships. Subsequent adaptation of the Bachue prototype into country-specific models will, however, draw upon an analytical review of the economic-demographic experience of the respective countries, carried out with a view to discovering more about their particular problems and obtaining more precise specifications of the behavioural relationships in each national context. At the same time, use of these models to simulate the effects of different policies will identify the crucial policy variables that need deeper investigation.

The second special feature of the project is the manner in which it is organised. It is conceived as a joint endeavour of the ILO, a group of high-level experts, and national research organisations in different regions. While the first outline of the model was prepared by the ILO team and approved by the experts, it is in the process of revision in the light of comments from scholars in different countries, especially those who have entered into research contracts on the project with the ILO. At the same time, the latter have been requested to go more deeply into those aspects of their research which appear crucial for policy-making in the light of the research activities of the ILO team.

Economic-demographic modelling activity

A large number of economic-demographic models have been developed in recent years. They fall into two broad categories. Most of the growth models take the demographic variables as exogenous and analyse their economic consequences in a neo-classical framework, in which the supply of inputs and the nature of production functions are the main determinants of growth of income and employment. The models in the second category seek to analyse demographic responses to economic and social changes, which are treated as exogenous variables.

However, interaction among the different sets of variables is closer to the reality of the economic-demographic process than is uni-directional causation. Moreover, effective demand is as important to the growth of the economy as the increase in resource inputs. The functioning of the developing economies is further complicated by the coexistence of modern and traditional sectors, which show fundamental differences in many respects. These facts have received inadequate attention in the existing models. A major effort in the present research undertaking is therefore directed to developing a comprehensive economic-demographic model which weaves into an integrated framework a complex set of relationships between the key variables in population and employment growth.

A modified version of the Enke-Tempo model with greater disaggregation, dividing the economy into primary, secondary and tertiary sectors, and further splitting each of these into modern and traditional sectors, was earlier ¹ envisaged as a framework for analysis, since it explicitly incorporated an employment function, the elasticity of employment with respect to capital accumulation depending on the rate of unemployment. But initial simulation experiments performed with this model revealed its inadequacy. Being completely supply-oriented, the results depended entirely on the form of the production functions, which could not be meaningfully specified in relation to traditional sectors that serve to mop up all labour not absorbed elsewhere, regardless of its contribution to total product. It was decided, therefore, to shift the approach so as to concentrate first on the demand side. This led to the development of the first of the Bachue line of models.

The first exploratory model is Bachue-1², an initial attempt to set out the structure of a large economic-demographic model suitable for application to high-fertility developing countries. As such, Bachue-1 has three main distinctive features. First, a very large number of variables are explained by and within the model itself: fertility, mortality, rural-urban migration, schooling propensities, productivity, income distribution and consumption patterns—all respond endogenously to the behaviour of the system. Secondly, it involves a high level of disaggregation: population is broken down into groups characterised by age, sex, activity status, ruralurban residence and levels of educational attainment. Similarly, economic activities are broken down into ten different sectors, an input-output matrix being used to derive value added by sectors and employment. Thirdly, it makes an explicit attempt to represent economic dualism (i.e. the co-existence of modern and traditional sectors), a vital feature of developing countries which has a significant bearing on economicdemographic interactions.

Bachue-1 is composed of three sub-systems: (i) a demographic subsystem including rural-urban migration; (ii) an education sub-system; and (iii) an economic sub-system.

¹ See ILO: Scope, approach . . ., op. cit.

² A detailed account of this model is given in René Wéry et al.: The demographiceconomic simulation model: Bachue 1B—technical report (Geneva, ILO, Sep. 1973; mimeographed). Shorter accounts appeared in R. J. Blandy et. al.: "Bachue-1", in Proceedings of the IUSSP Conference, Liège, August 1973; ILO: Economic-demographic modelling activities of the World Employment Programme (Geneva, July 1973; mimeographed), paper presented at the Liège Conference; and Richard Blandy and René Wéry: "Population and employment growth: Bachue-1", in International Labour Review, May 1973.

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The main variables simulated in the demographic sub-system are population by age, sex, location and activity status. The level of educational attainment is added in the education sub-system. The key variables simulated in the economic sub-system are final demand (including private consumption, government consumption and investment), value added, labour productivity, employment and income distribution. The principal feedback loops between these three sub-systems and some of the most important relationships within each sub-system are represented in the accompanying diagram.

The model consists of two types of equations: accounting identities (or definitional equations) and behavioural equations. In the demographic sub-system the behavioural equations are birth and death rates, propensities to migrate and labour force participation rates; they are linked to selected socio-economic determinants and policy variables. The education sub-system consists largely of a set of accounting identities. The enrolment and the drop-out rates, however, are functionally related to levels of household income. As has already been mentioned, the economic sub-system of Bachue in its current form is mainly demand-determined. In broad terms, it operates as follows.

The economy's vector of final demand, comprising private and government consumption, investment in private and government enterprise and in dwellings, and external trade, is determined through a set of behavioural equations using both economic and demographic factors as explanatory variables. For example, some of the variables in the consumption function are the level and distribution of income from the preceding period, size of household and the age, sex and activity status of its members. An input-output table is utilised to translate the vector of final demand into gross output and value added by sectors. A labour productivity function is specified for each of the modern sectors. Employment in each modern sector is then calculated by dividing the value added by labour productivity. The amount of labour not absorbed into any of the modern sectors is allocated to the traditional sectors according to their respective shares in traditional sector employment in the initial period. Bachue-1 thus treats the traditional sectors as " sponge " sectors. Finally, it is assumed that income per employee in each sector is distributed log-normally. The distribution per household is computed with the aid of an exogenously specified number of employees per household. The values of income, the distribution of income, and levels of domestic output in the current period are then fed as inputs into the subsequent period, along with updated characteristics of each five-year cohort (i.e. its composition by sex, location, education, and labour force activity) as determined in the demographic and educational sectors of the model.

It should be emphasised that, in its current form, Bachue-1 is useful mainly as an exploratory model. Even as such, it can serve the purpose of

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identifying the critical behavioural links about which more needs to be known. However, further development is clearly required, and modelling work has accordingly been proceeding in the following directions.

First, three empirical applications of the Bachue model are proposed. Bachue-2 will relate to the Philippines. Work is already in progress to adapt Bachue-1 in a manner consistent with actual economic and demographic conditions in the Philippines, and to estimate the many behavioural parameters of the model on the basis of Philippine data. Plans are also in hand to develop a version of Bachue for an African country, Kenya, and another version for a Latin American country (possibly Brazil).

A second area of modelling activity has involved the respecification of many of the relationships in the model in such a way as to increase the number of linkages between the economic sector and the demographic and educational sectors of the model.¹

Third, work is also proceeding on building supply constraints into Bachue. For this it is necessary to determine the potential supply of key inputs in a given period (investment funds, foreign exchange and technical skills) and to specify the nature of production functions, including technical progress. Two approaches to building the supply constraint into the model are being examined: (i) a general equilibrium model with relative and absolute prices determined endogenously ², and (ii) quantity adjustment mechanisms which re-allocate scarce resources among the " bottle-neck" sectors in proportion to the excess demand exhibited by them.³ The choice of the method will depend on the results obtained from experiments with country-specific data.

Finally, an attempt is also being made to develop a household sector model, since many of the important decisions involving economicdemographic interactions are taken at the household level. The allocation of time of members of the household between market and home activity—including child rearing—the disposition of income between different items of expenditure and savings, investment in children's education and migration basically lie in the realm of household choice.

Substantive studies on individual topics

(1) Labour force analysis. Several studies are under way on this topic. They are mainly focused on the relevance of the standard concepts of labour force, employment and unemployment to developing economies

¹ For a discussion of some of these changes, see James C. Knowles: Notes on the economic sub-system of Bachue (Geneva, ILO, Oct. 1973; mimeographed).

² Lu S. Ng: A proposal for the economic sub-system of the Bachue-line models—a generalisation of the Thorbecke-Sengupta intersectoral consistency model (Geneva, ILO, Aug. 1973; mimeographed).

⁸ Knowles, op. cit.

with a dualistic structure, the effects of demographic and socio-economic changes on labour force participation rates, and the structural shifts in labour force that accompany economic development. These studies are based on analyses of national data in different countries as well as crosscountry comparisons.

A study of female activity rates in the Philippines ¹ brings out two interesting results: (i) a negative association with husband's income below a threshold level, but no significant relation above it; and (ii) a negative correlation with education below a threshold level and a positive one above it.

An introductory study 2 of the labour force data by industry for developing countries based on regression analysis shows that reduction in population growth produces the desired results, viz. a relative shift of labour force into the non-farm sector and reduction in unemployment, *but only in the long run*.

(2) Economics of fertility. The studies in this field are mainly concentrated on the socio-economic determinants of fertility levels based on survey data in several countries. An inter-country analysis of birth rates that is under way is based on a simultaneous equation model, using birth rates, female employment in the modern sector and children's education as endogenous variables, and income, family planning programmes and social security systems as exogenous variables.³

The Philippine study referred to above includes an analysis of fertility. It yields the expected negative association of fertility with female participation in economic activity as well as with female education above a certain minimum level.

An interesting study on the welfare analysis of fertility reduction 4 exposes the unsatisfactory state of debate on the subject in the existing literature, and suggests that a convincing case could be made out only with the aid of a welfare function taking account of societal preferences, particularly in respect of social equity, less spatial crowding and the externalities of technology, environment, defence and crime control.

(3) Population, consumption patterns and savings. Studies on this topic will estimate the parameters of consumption of different commodities with respect to household income and the demographic characteristics of households. The parameters with respect to sex and age will be used to

¹ José Encarnación, Jr.: Fertility and labour force participation: Philippines 1968, Population and Employment Working Paper No. 2 (Geneva, ILO, Mar. 1974; mimeographed).

² Richard Blandy: "Population and employment growth: an introductory empirical exploration", in *International Labour Review*, Oct. 1972.

³ Richard Anker: An analysis of international variations in birth rates: preliminary results, Population and Employment Working Paper No. 3 (Geneva, ILO, Apr. 1974; mimeographed).

⁴ R. Blandy: "The welfare analysis of fertility reduction", in *Economic Journal* (London), Mar. 1974.

establish " adult equivalent coefficients " so that persons in different age and sex groups can be converted into equivalent adult units. An important point to be covered in these studies is the economies of scale which arise in consumption. As a by-product, the cost of an additional child in different income groups can be worked out and used as an input in models which treat children as a competing alternative to consumer durables.

Studies on savings as a function of the size and distribution of income and of various demographic variables complement those on consumption patterns. At the same time, the effects of population growth on government expenditure are being analysed. Public services like education, health, family planning and other welfare services are linked to population, with the result that their expansion with rapid population growth may constitute a drain on government reserves which could otherwise be utilised for directly productive outlays.

(4) Effects of labour force growth and labour market pressures on wage rates and productivity. The main point of interest in studies on this subject is the extent to which the labour market signals through wage variations the rapid growth of population and labour force and the resulting excess supply of labour in relation to modern sector jobs. Further, in view of the variety of skills and the heterogeneity of the labour markets, the study of wage structure and the interdependence of wage determination in different markets forms an interesting subject in itself.

(5) Capital accumulation and employment. The main purpose of studies on this topic is to examine the process of resource allocation between the modern and traditional sectors in a labour-surplus situation resulting from the disproportionate growth of population and labour force, the elasticity of employment in the modern sector with respect to capital accumulation, and the resulting structural shifts in the labour force. One of the studies being carried out uses a simultaneous equation model integrating the wage determination function, the saving-investment function, production functions and some exogenous variables, and will investigate the relation between labour allocation and capital accumulation by attempting simulations with estimated parameters.

(6) Effects of population pressure on land tenure, agricultural productivity and employment. Research on this topic is intended to serve two purposes: (i) to bring out the impact of rapid population growth on land tenure, and (ii) to indicate how the interaction of demographic variables and changes in land tenure affects the growth of output and marketed surplus in agriculture and its labour-absorption capacity as well as the over-all employment situation. The tentative findings of an introductory study on the subject question the relevance of the Japanese models of land reforms to other densely populated agrarian economies, on the grounds that if big farms show optimal efficiency—as in some Asian countries—application of the Japanese models would amount to a mere income transfer mechanism, with positive cost to the State.¹

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The ILO is aware of the magnitude and complexity of the studies undertaken in the framework of the population and employment project. The exploratory model that has been set up is an ambitious undertaking, but it is indispensable to cover many vital aspects of the relationships between population and employment growth. It is hoped that the outcome of this research, including the quantification of key behavioural relations and simulations of the system as a whole, will make it possible to suggest an optimal mix of demographic, economic and social policies particularly those affecting fertility and migration behaviour and the employment structure—in any given context and in relation to any given set of output, employment and income distribution objectives. It is also hoped that the wide dissemination of these results through publications, conferences and seminars will contribute to a fuller understanding of the problems, and where necessary will stimulate further research.

¹ J. N. Sinha: "Agrarian reforms and employment in densely populated agrarian economies: a dissenting view", in *International Labour Review*, Nov. 1973.