

Toward An Integrated Economic-Demographic Model

THAILAND DEVELOPMENT
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TOWARD AN INTEGRATED ECONOMIC-DEMOGRAPHIC MODEL

by

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1 Introduction

This report is one in the series produced under the Project "Promotion of Analysis and Consideration of Population Consequences of Development Planning and Policy in Thailand". The long range objective of the project is "to increase and widen the knowledge base for policies-makers concerned with population and Development planning; aid planners to prepare more effective Development plans by integrating population into development planning and policies; monitor the impacts of national economic and social Development plans on demographic factors". In order to achieve the objective, the analysis on the effects of development and development policies on fertility, migration, educational investment, labor force participation rate, household formation and household composition, morbidity and the demand for health treatment have been studied. The task remained is to incorporate these micro level understandings into an economic model in such a way that it will facilitate analyzing the relationship between population and development. This paper is designed to bridge this gap. The organization of the paper will be as follows: Following this introductory section, a selective review of economic-demographic model will be given. The third section will summarize the results based on the micro level studies undertaken for the UNFPA project. The summary will serve as background information for model building in the fourth section. Test of the model and discussion of policy implications from the model will be presented in a separated paper.

2. Literature Reviews

Although it is widely recognized that economic and demographic interact, only recently that planners actively integrate population planning into economic planning. Nevertheless, understanding for such integration is still quite limited. The first demographic-economic model for Thailand and the only one in existence so far was built in 1988 by Phanaritmai and Chalamwong. The model

treated fertility, mortality, school enrollment, migration and labor force participation rate endogenously. Variables which linked economic and demographic sub-models were per capita income and the proportion of labor force in agriculture. Behavioral equations were mainly estimated from provincial data based on the 1980 population census. Several improvements on this model are possible. First, individual is used as the unit of decision making, hence it is independent of the characteristics of household in which the individual is a member. But literatures have shown that decision like fertility, school enrollment, migration and labor force participation are not only dependent on the characteristics of an individual, but also on the characteristics of other household members, such as the educational attainment of husband in the case of fertility, the educational attainment of parents and the age and sex of other siblings in the case of school enrollment, major source of household income and the age distribution of children in the case of female labor force participation. Hence a more desirable model would be to treat household, in stead of individual, as the unit of decision making. Second, using per capita income and the proportion of labor in agriculture does not seem sufficient to capture important population and economic interaction. Other economic variables such as work status:- own account worker versus employee, household major source of income and economic fluctuations can all be important determinants of demographic behaviors.

Another set of studies which was designed to improve the quality of demographic information available for development planning was the HOMES research project by Mason and et. al.. in late 1987. The strong point of this project is the recognition of household as the unit of decision making in many demographic and economic behaviors. Through HOMES (the Household Model for Economic and Social Studies), population projection was transformed into household projection with detail informations on the age-sex distribution of household members by household type and the age-sex distribution of household head. The household projection was then

used to study several demographic sensitive behaviors. HOMES had been applied to Thailand and behaviors such as consumption pattern, savings, labor force participation and wage rate, school enrollment and housing demand had been studied. HOMES is in fact a very useful tool which simplifies the process of studying demographic and economic behaviors using household as decision unit. But one weak point about the model is the assumption that all incidence rates, such as headship rates and co-residence rates in the model remained constant. Hence the studies were partial analysis in which population and household structure were allowed to affect economic performance, but not the reverse.

The model to be constructed in this study attempts to improve on some of the weak points appeared in the studies mentioned above. Based on the extensive micro level studies which will be reviewed in the following section, the model built will treat economic-demographic performance endogenously with more key link variables, and will also highlight the importance of household structure which is not only affected by both demographic and economic performances, but also affect many demographic and economic behaviors.

3. Reviews of The Micro Level Studies.

There are altogether 17 micro level studies undertaken under the UNFPA project. These studies can be classified into 4 categories:

Category 1: Studies related to the process of population dynamic.

1.1) Determinants of the Number of Surviving Children: A Recent Experience In Thailand.

1.2) Migration: Trend and Determinants.

Category 2: Studies related to human resource investment.

2.1) Number of Surviving Children and Schooling Continuation Rates in Thailand in the 1980's: Some Further Results.

2.2) The Determinants of Morbidity.

2.3) The Determinants of Type of Medical Treatment in Rural Thailand: Interactions and Sample Selectivity.

2.4) Conditional Predictions of Thai Health Care Demands to the Year 2010.

Category 3: Studies related to the supply of and the demand for labor.

3.1) The Female Labor Force Participating Rate and Surviving Children.

3.2) Household Structure and Labor Force Participation Rate in Thailand.

3.3) Labor Supply Forecasting: 1987-1996.

3.4) The Demand for Labor in Agricultural Sector during The Seventh Plan (in Thai).

3.5) Analysis of Wage Trends: 1988-1996.

Category 4: Studies related to household structure and the relationship between members.

4.1) Determinants of Household Structure in Thailand.

4.2) Some Implications of Household Structure in Thailand.

4.3) Determinants of Assortative Mating in Thai Marriage Markets and Implications for the Stability of Intact Households.

4.4) The Extended Structure of Thai Households.

4.5) The Determinants of Child Separating From Mothers' Households.

4.6) The Ties Between Children and Their Mothers' Households.

In all these studies, household is used as the unit of decision making. Hence, not only the characteristics of the individual involved are hypothesized to affect the decision outcomes, characteristics attributed to household and other household members, such as household structure, household size, the age structure of members, the age, sex and educational attainment of the head of household and/or the spouse of the head of household are also hypothesized to affect decision outcomes. As will be seen from the following review that in fact, the characteristics attributed to household and other household members are very important in understanding an individual's behavior. Although knowledge about the inter-relationship between population and economic development gained from these micro level studies are enormous, it is not possible to accommodate all the details in an economic model. Therefore the review to be presented below will be brief and selective, with focus on identifying key policy variables to be used as the linkage between the demographic and the economic sub-models.

Key policy variables which significantly affect the dependent variables studied under category 1 are summarized in Table 1. Fertility determination was studied based on the pooled data from the SES 1980/81 and 1985/86. Two measures of fertility were used:- the surviving co-resident children per married woman aged 15 to 45 and the surviving children aged less than 5 per married woman aged 15 to 45. In the equation for the average surviving co-resident children, income has a positive but diminishing effect on fertility. Total cultivated land owned which was used as a proxy for permanent income also has a positive effect. Family planning expenditure, the education of both husband and wife has a negative effect on fertility. Agricultural households and households that operate own enterprises tend to have a higher fertility rate. In the equation for the average surviving children aged under 5, similar results were obtained as in the

average surviving co-resident children, except for the effect of some economic variables. In this equation, income is not statistically significant, but total cultivated land owned has a negative effect. The elasticities of the demand for children with respect to these variables are also calculated. The elasticities imply that the effect of family planning expenditure on fertility is largest. The next largest effect comes from the wife's and the husband's education.

The migration study was based on the Labor Force Survey, Round 3, 1988. Important findings are that increasing the wage and the probability of being employee of a particular location will increase the probability of migration to that region. Male is more responsive to wage rate while female is more responsive to the probability of being employee. More over, young adults are more responsive to changes in economic opportunity. The relationship of education and the propensity to migrate of an individual had a U shape. Distance had a deterrent effect on migration, but the effect diminished with higher education of an individual. In terms of the magnitude of the effect of these variables, wage rate, the probability of being employee and the education of an individual, all have significantly large effect on migration propensity.

The effects of significant key policy variables on education and health investment are summarized in Table 2. Two levels of school investment, namely post-compulsory and post-upper elementary school were investigated based on the pooled data of the SES 1980/81 and 1985/86 surveys. The results for both levels of education are quite similar. Income has a positive but diminishing effect on the school continuation rate, but the effects are not large. Source of income is a more important determinant of school continuation rate. The school continuation rate of children who are members of agricultural households or households which operate own enterprises tends to be lower. The educational attainment of both father and mother are positively related to continuation rate of the children. The continuation rate for boys was higher than

for girls. School quality as measured by student-teacher ratio and municipality, both increase school continuation rate.

Health investment was studied indirectly by examining the determinants of morbidity. The study was based on the 1985 Thai morbidity survey. Although the study examined the determinants of morbidity by major categories of diseases, but such detail information will not be incorporated into the macro model. Therefore the review on health investment will be restricted only to the study on the determinants of the probability of being afflicted by sickness. The study estimated 5 logit equations for 5 age groups:- 0-4, 5-14, 15-44, 45-60 and 60 and over. Wealth has a negative effect on morbidity among children aged 0-4 and adults aged above 45 years. Own education has a negative effect on the morbidity of adults aged 15-44 years, but has a positive effect among elders aged 60 years or over. The cost of access to health services which is measured by the time required to travel from home to the place where health facilities are located has a positive effect on the reported morbidity among adults aged above 15 years old. Living in municipal areas reduces morbidity for children aged less than 5, but has no significant effect among population in other age groups.

The effects of significant key variables affecting the labor force participation rate were summarized in Table 3. Working age population who were not enrolled in any formal educational institutions were divided into three groups:- married women in the child bearing ages with spouse present, all other women and all men. The labor force participation rate of these three groups of labor reserve was estimated by logit model using the pooled data from SES 1980/81 and 1985/86. The results confirm the conventional wisdom that female labor participation rate is much more sensitive to social and economic change than that of male's. Male labor force participation rate is positively related to income and his own educational attainment, and is negatively related to wealth and the size of household. There were more similarity than differences

in the determinants of labor force participation rates among married women in the child bearing age and other women. Female labor force participation rates are positively related to income. The participation rate of women in agricultural households and households which operate own enterprises is higher compared to the participation rate of women in households of other occupations. The women's own education and economic opportunity also have positive effects on the participation rate. More over, female labor force participation rates also exhibits an increasing trend over time. For both groups, the rates are negatively related to wealth and the existence of children aged less than 5 years. For married women in the child bearing ages, their labor force participation rate is also negatively related to the education of husband, but positively related to the number of children in school ages. And for other women only, their labor force participation rates are also negatively related to the size of households and the number of children in school ages.

Although there were six studies related to household structure and relationship among members, only three studies will be highlighted here since the rests would not be appropriate to be accommodated in an economic model. The first study to be reviewed is the study on household structure (study number 4.1), which results are summarized in Table 4. The study using multiple logit model to estimated the probability that an individual being head (if male) or spouse (if female) in an intact household, being the head of single headed household, forming a one person household or being non-head members in intact, male single headed or female single headed household. The data used was the 1987, round 3, Labor Force Survey. Since being in each status are more or less a life cycle phenomena, therefore it is most influenced by the age of an individual. But in addition to age, it is also dependent on the educational attainment, employment and migration status of an individual, and community type in which households are located. The probability of being single head or forming one person household increases with the educational attainment of an

individual. Likewise, individual who works as employee in agricultural sector or being employed in non-agricultural sector also has a higher probability of being single head or forming one person household compared to individual who is self-employed in agricultural sector. Higher education increases the likelihood of being non-head members, but working in non-agricultural sector decreases such likelihood. The results mentioned above were confirmed by study number 4.4 which was based on the 1989 Labor Force Survey. In addition, the later study also reveals that highly educated individual and employee are more likely to form primary individual households, and vertical extended households are more prevalent in rural areas and among agricultural households or households which operate own enterprises.

Study number 4.3 estimated a logit model on the male's choice of mate of different age and educational attainment, conditioning on his own age and educational attainment. Using data from the Labor Force Survey on 1987, round 3, the results are summarized in Table 5. The findings confirm that males and females of similar qualities tend to be matched in general. However, an exception is found among males with intermediate schooling who tend to match with females with primary schooling or less.

4. Model Specification

The knowledge gained from these micro level studies seems to suggest that study of several demographic and economic behaviors by using household as decision unit is necessary. Characteristics of households which are essential include the age, sex and educational attainment of household head and/or the spouse of the head, main source of household income and the nature of work undertaken, and the proportion of members aged under 5 years old. Given the information suggested, a fully integrated economic-demographic model should look like the diagram given in Figure 1. Household income, wage rate by education, the proportion of labor by work status (own account worker versus employee) and by industry (agriculture versus non-agriculture) and by regions as of year $t-1$

(variables in block I) will be generated from the economic sub-model. These economic outcomes, together with population by age, sex and educational attainment in year $t-1$, will determine the number of household and household structure classified by the age, sex and educational attainment of household head and by region in year t (variables in block II). Variables in block I and II, together will determine the level of fertility, mortality, migration, school enrollment and labor force participation rate by age sex and educational attainment and by region in year t (variables in block III). The variables in block III, together with population in year $t-1$ then determine population and the supply of labor by age sex and educational attainment in year t (variables in block IV and V). These variables will be sent to the economic sub-model to determine labor productivity, output and wage rate.

Several points in the model worth noting: First, investment in health has not been included in the model. According to the micro level study, beside age and sex, the incidence of being afflicted by sickness is most affected by the cost of health care which should be treated exogenously. Education affects the incidence of afflicted by sickness in some age groups only, and the effect is not uniform. Hence, the effect of economic variables on morbidity are not yet clear. Morbidity may affect the productivity of labor and also the investment in education. But no study available to allow systematic inclusion of these relationship in an economic model. Therefore, study of health determination will be treated as a separate block by itself and no feed back into the main model from this block.

Second, mortality in Thailand has already reached a rather low level, and further reduction due to economic changes will be quite marginal. Any effort to reduce mortality further should come through specially designed program for the purpose, hence the level of mortality in the future might be considered as given exogenously. Fertility level in Thailand has declined rapidly in

the past, that further rapid reduction is unlikely. As seen from the review above, fertility has shown to be most sensitive to family planning expenditure. It is also responsive to the educational attainment of the parents, and their occupation, but less significantly. Hence it is expected that future change in mortality and fertility level will occur gradually and to a large extent will be determined by special program which can be treated exogenously. Therefore, the model proposed in this study will treat population by age and sex at the beginning of each period as given. Thus the model will be a partially integrated economic-demographic model, with the structure of the model as given in the diagram in figure 2. At the beginning of year t , population by age and sex is obtained exogenously by official population projection. Educational enrollment in year $t-1$ which are generated in the model will be used to update the educational attainment of the population (information in block II). These information, together with economic outcome in block I will be used to determine household projection (block III). Variables in block I and III are used to determine school enrollment and labor force participation rate at year t , which in turn determine the supply of labor by age, sex and educational attainment. Like the case of the fully integrated model, this partially integrated model can be separated by region. But due to difficulty in adjusting the CGE economic model by region, only whole kingdom simulation will be performed for this phase.

In order to grasp the mechanic part of the model, it is convenient to define various matrices which must be kept in the model and to view model simulation as involving various matrix operations. There are two types of matrices in the model, the first type is matrices of the stock of various entities such as the number of population, households, school enrollments, labor reserves and the supply of labor, disaggregated by the age sex and educational attainment of a person or of the head of households. The second type is matrices of rates, such as headship rates and labor force participation rates. Matrices on rates will be applied

to the matrices on stock at the beginning of each period which will results in the matrices of stocks in the following period. Matrices on rates will be updated annually using behavioral equations obtained from the micro level studies. For further detailed specification of the model, see "Results from Economic-Demographic Model: Population-Education-Labour Force" and "Results from Economic-Demographic Model: Labour Market and Macro Economic Performance".

Table 1 A Summary of The Effects of Key Variables
of Studies in Category I

Independent Variables	Fertility		Migration	
	All	Aged < 5	Male	Female
Income	+			
Income square	-			
Wealth				
Land Owned	+	-		
Agriculture	+	+		
Own account workers	+			
Employee			+	+
Husband' education	-			
Wife's education	-	-		
Husband & wife's education		+		
Own education			-	-
Own education square			+	+
Wife's age	+	+		
Female headed household	-			
Family planning expenditure	-	-		
Wage rate			+	+
Distant			-	-
Wage & Age			-	-
Distant & own education			+	+

Table 2 A Summary of The Effects of Key Variables
of Studies in Category 2

Independent Variables	Secondary		Incidences of sickness				
	Lower	Upper	0-4	5-14	15-44	45-60	60+
Income	+	+					
Wealth			-			-	-
Land Owned							
Agriculture	-	-					
Own account workers	-						
Husband' education	+	+					
Wife's education	+	+					
Husband & wife's educatio	-	-					
Ratio of eligible childre	-						
Ratio of boy	+	+					
Student/teacher, secondary	-	-					
Own age				-			+
Sex			+		-		
Own education					-		+
Cost of access to health					+	+	+
Municipality	+	+	-				

Table 3 A Summary of The Effects of Key Variables
of Studies in Category 3

Independent Variables	Married fema age 15-44	Other female	All Male
Income	+	+	+
Wealth	-	-	-
Land Owned	+		
Agriculture	+	+	
Own account workers	+	+	
Husband's of own educatio	-		+
Wife's or owned education		+	
Husband & wife's educatio	+		
Household size		-	-
Prop.of children aged 0-5	-	-	
Prop. of children aged 6-	+	-	
Prop. of children aged 12	+	-	
Economic shock	+	+	
Time trend	+	+	

Table 4 A Summary of The Effects of Key Variables
on Household Structure

	Single Head	One Person	Nonhead Intact	Nonhead Male	Single Female

Male					

Age	-	-	-	-	-
Age squares	+	+	+	+	+
Educational attainment	+	+	+	+	+
Age * Education	-	-	-	-	-
Employee in agriculture		+	-		
Employed in non-agriculture		+	-	-	-
Economically inactive	+	+	+	+	+
Migrants		+	-	+	-
Municipality		+		+	

Female					

Age		-	-	-	-
Age squares	+	+	+	+	+
Educational attainment	+	+	+	+	+
Age * Education	-	-	-	-	-
Employee in agriculture	+	+	-		
Employed in non-agriculture	+	+	-	-	-
Economically inactive		+	+	+	+
Migrants	+	+	-	+	-
Municipality	+			+	

Table 5 A Summary of the Effect of Key Variables
on Determinants of Assortative Mating

Alternatives available to male					

	Age 40+ Primary	Age 40- Second	Age 40+ Second	Age 40- Higher	Age 40+ Higher

Conditional Variables					

Age differences	+	+	+	+	+
Age differences squares	-	-	-	-	-
Educational differences	+	+	+	+	+
Educational diff. squares	-	-	-	-	-
Unconditional Variables					

Male age		-			
Male age squares		+	-		-
Male educational attainment		+	+		
Male education squares		-	-		
Municipality		+	+	+	+

FIGURE 1 DIAGRAM OF A FULLY INTEGRATED MODEL

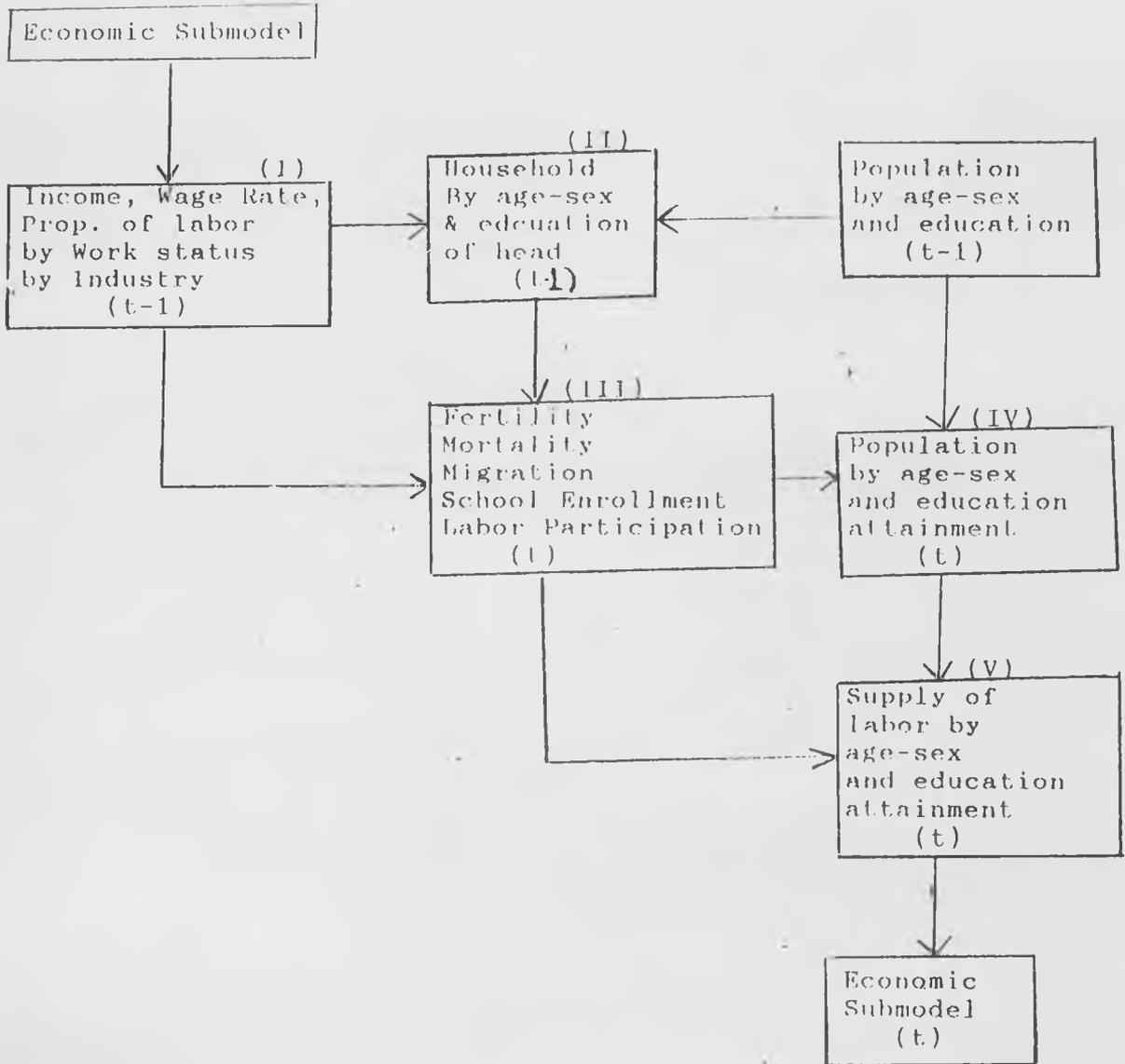
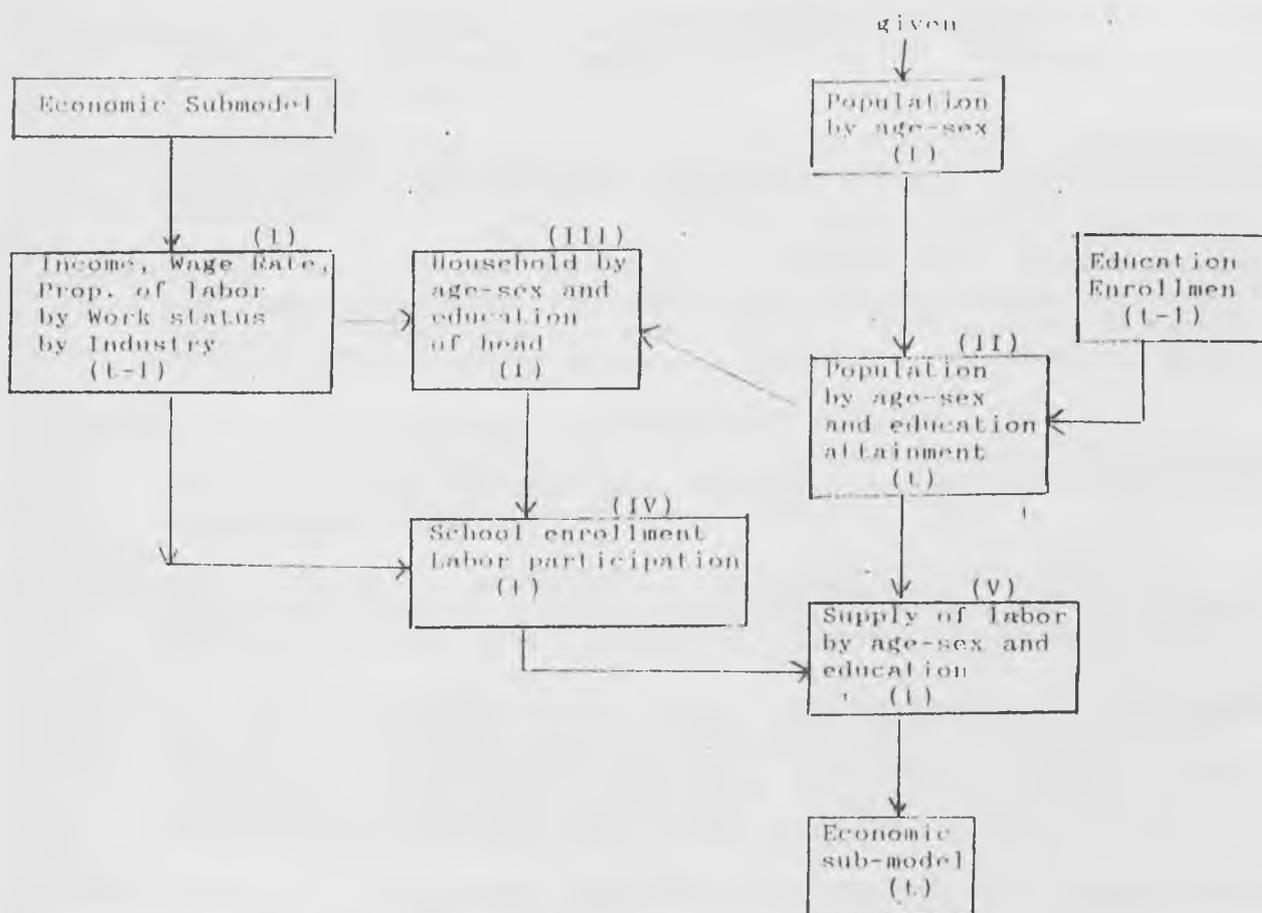


FIGURE 2 DIAGRAM OF A PARTIALLY INTEGRATED MODEL.



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