THE LABOR SUPPLY OF THAILAND: AN EMPIRICAL ANALYSIS OF THE DETERMINANTS OF PARTICIPATION RATES

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN ECONOMICS

MAY 1976

By

Srawooth Paitoonpong

Dissertation Committee:

John H. Power, Chairman
Burnham O. Campbell
James Mak
James E. T. Moncur
Robert D. Retherford

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ABSTRACT

This study analyzes the variation in labor force participation rates of several age-sex groups of the Thai population in 1970 in terms of an econometric model incorporating economic as well as demographic variables. The study is a cross-sectional one based mainly on census data for 71 provinces of Thailand. The econometric model incorporates eclectic theories of labor supply with human capital theory as well as economic/demographic theory. It consists of three structural equations and an identity equation reflecting the joint dependency among activity rates, wage rates, and family income. In the participation rate equation, age-sex specific activity rates are functions of wage rates, family income, unemployment rates, industrialization, education, population-density, and family size. Parameters of the model are estimated by two-stage least squares technique.

The results of the statistical estimation are generally consistent with the underlying theoretical concepts. The participation rates of prime-age males were found less sensitive to socioeconomic variations compared to those of other groups of the population. The effect of the

wage variable is positive and significant for females of every age group, but it was negative and not significant for males of every age group except the 20-29 age group (where it was negative and significant). The coefficients of the family income variable are negative and significant for females of all ages and young men (aged 11-19). The income effect is positive and significant for males aged 40 and above. Unemployment rates were found to have negative effects upon most workers except for young women aged 11 to 14 whose coefficient is insignificant statistically.

In terms of elasticity participation rates are generally less sensitive to the unemployment rates than to family income and wage rates.

Education has a relatively large positive effect on participation rates of the young of both sexes while it has a large negative effect on participation rates of women 40 to 59 years of age. A milder positive effect of education occurs in females aged 20-39. The coefficient of industrialization which captures the effects of difference in economic structure, rural-urban residence, and occupational composition among areas is positive for secondary workers. Family size is positively associated with participation rates of the young aged 11-19 and women aged 40 to 60 and above. Finally, population density was found negatively related to participation rates of secondary workers and positively related to participation rates of primary workers.

In conclusion, this study can serve as a guide to the effects of various variables on different measures of labor supply. Provided the

parameters of the model remained constant, a planner could use the model to test the effects of various manpower policies of labor supply if he could deduce how a policy change would affect the variables in the model.

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CHAPTER I

INTRODUCTION

Problems

Studies on the labor supply of Thailand are relatively few in spite of the fact that, in the process of modernization, many developing nations have recognized the need for a systematic approach to the problems posed by the excess supply of labor, widespread unemployment and underemployment, and other consequent social, economic and political problems.[1] In fact, as in most of the developing countries, labor supply in Thailand has been increasing at such a high rate that the problem of providing more employment opportunities can no longer be ignored.

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[1] In addition, in the literature of economic growth, the size and growth of the labor supply plays an important role in the stability and growth of an economy, developing or advanced. In the Harrod-type growth model, for example, the so-called natural rate of growth, G_n, is the combination of the rate of growth of labor force plus the rate of growth of labor productivity:

in the formula,

$$G_n = \frac{\Delta L}{L} + \frac{\Delta Y}{Y}$$

where $\Delta L/L$ is the rate of growth of labor force and $\Delta Y/Y$ is the rate of labor productivity change. If $G_n = G_w$, the warranted rate of growth defined as a rate at which entrepreneurs in the aggregate are just satisfied with their output and investment decisions, then equilibrium growth is possible; i.e., both full employment of the labor force and optimum utilization of capital would be achieved. A case typical of less-developed economies is the so-called Marxian unemployment which comes from too little saving or too high capital intensity or too rapid population growth; that is, when $G_n > G_w$ and G_w becomes an upper constraint on the actual growth rate, the rate of economic growth must fall short of that needed for full-employment, given the growth of productivity. (Power, 1974)

Indeed, economic planners in Thailand must not only recognize employment as a target in competition with others, but must regard job creation now as a more pressing target than ever before. This, in turn, requires a systematic study of factors determining the dimension and composition of the labor force of Thailand, as a prelude to making labor force projections. Unfortunately, Thailand still uses highly primitive projection models which incorporate some oversimplified assumptions about labor force participation rates,[2] combined with a large element of personal judgement. Systematic analysis of the complex relationships between labor force participation and social, economic and demographic factors; such as, industrialization, income and wage levels, investment in human capital, population pressure and so on, has been largely neglected by social scientists in Thailand. This negligence could ultimately lead to misconceptions and misallocation of the nation's human as well as non-human resources.[3] Therefore, there is a legitimate need for research on the determinants of labor force participation for Thailand.

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[2]A projection of the labor force, in general, can be made on a basis of a population projection and the application thereto of estimated or assumed age-sex specific labor force participation rates: See (Parnes, 1962, 29) and the United Nations, Manual V: Methods of Projecting the Economically Active Population, (New York, 1971), pp. 7-8.

[3]For example, planners who overestimated the future of labor supply might mistakenly recommend a policy to increase opportunities and may go further to suggest labor-intensive investment programs, expanding money supply, etc., while the ones who underestimated will recommend the contrary. See B. D. Mabry and P. K. Tanomjit, "Manpower Imbalances in Thailand, 1976 and 1981," Western Economic Journal, December 1972; and Warren C. Robinson and L. Pawakaranond, "Manpower Imbalances in Thailand: A Comment," Western Economic Journal, 1973, pp. 375-379.

This study of labor force participation is a study of labor supply.[4] The underlying hypothesis is that the labor force participation rate does respond to economic and demographic factors. Whereas, economic theory strongly suggests economic factors such as wage rates, incomes, and rate of unemployment as major determinants of an individual's decision to enter the labor market, demographers observe that variations in the participation rate are influenced to a considerable extent by demographic factors such as family size, age-structure, dependency rate and so on. Education and urbanization, factors which can be considered economic as well as demographic, are also claimed as major determinants. In less-developed countries, however, Kelly (1967, 84) maintained that because labor supply in less-developed countries is less responsive to economic variables such as wages, income and unemployment than to social and cultural factors, the market mechanism; i.e., the network of economic factors, is not an effective device for allocating a given supply of labor.

Prior to Kelly, Duesenberry (1958, 310) postulated that labor force participation rates are largely determined by social attitudes and be techniques of production. Economic factors, according to Duesenberry, play only an indirect role over the decision to enter the labor market.

If these hypotheses are true, then it could be expected that the labor supply schedule in the less-developed countries would be

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[4]The discussion concerning the concept of labor force participation rates is in Appendix B. See also Albert Rees, The Economics of Work and Pay, (Harper & Row, New York), pp. 3-5, for the contemporary meaning of labor supply.

relatively inelastic with respect to wage rates. There is, of course, even the possibility of a negative elasticity. In his study of African labor, Berg found that the market supply schedules were positively sloped even though the individual supply schedule for low-paid workers was negatively sloped (Perlman, 9).

With these and similar questions in mind, this study attempts to determine and compare the responsiveness of the labor supply in Thailand to changes in economic factors vis-a-vis canges in the demographic factors. Since the dependent variable, the participation rates, are disaggregated in terms of age and sex, the result will help planners and other interested individuals to better understand the nature of the labor supply in Thailand in terms of its variation and changing age-sex composition as well as its sensitivity to various social and economic factors. In addition, as a by-product, parameters obtained from each age-sex specific activity rate equation can be utilized for a meaningful and systematic labor force projection.

Objectives

In general, the study tries to explain variations in the labor force participation rates of different age-sex groups of the Thai population in 1970. Our specific objectives are as follows:

1. To determine the relationships between labor force participation rate and the economic and social or demographic factors.

2. To estimate parameters of the determinants of the age-sex specific activity rates ("activity rates" will be used interchangeably with "labor force participation rates").

3. To derive from (2) the elasticities of labor supply with respect to various socio-economic variables to be specified in Chapter 3.

4. To discuss some policy implications of the empirical results for manpower planning.

Data Sources and Method of Analysis

This work is primarily a cross-section study of labor force participation in terms of a given individual's likelihood of entering the labor market. Census data for 71 administrative units of Thailand (Changwads) in 1970 will be the basic observations to which the regression model is fitted in testing our hypotheses and in estimating parameters concerning the influence of a variety of socio-economic variables on labor force participation rates of males and females of various age-cohorts. Supplementary data for the analysis, in most cases, are from the Office of the National Economic Development Board, the National Statistical Office and the Department of Labor.

Our analysis is based mainly on a theory of labor supply, in which both short-run and long-run effects of socio-economic variables are taken into account. The traditional ideas of income and substitution effects, the discouraged workers and additional workers hypotheses and the relations to labor supply of variations in economic structure and demographic factors provide theoretical concepts for this study.[5] The explanatory variables used are: Family income, wage rates,

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[5]Detailed discussion is in Chapter 3.

unemployment rates, population-resource ratios, family size, education, and industrialization.

A general linear regression model is first specified: the dependent variables being age and sex specific activity rates of fourteen subgroups of population; namely, young males and females (ages 11-14 and 15-19), adult males and females (ages 20-29, 30-39, and 40-49), and aged males and femals (50-59 and 60 and over). Then, because of the problem of identification and the joint dependency of activity rates, wage rate, and family income, a simultaneous equations model is postulated. The parameters of the postulated model are then estimated and tested by two-stage least squares (TSLS) method to obtain the best linear unbiased estimates.

Organization of the Study

The study has been organized in the following manner:

In Chapter 2, we present a brief review of the economic structure and some aspects of the labor force of Thailand.

In Chapter 3, we review extant work on Thai labor force participation as well as a brief review of key ideas in the literature. The underlying theoretical concepts together with the empirical studies will then be discussed and utilized for the formation of a general model as well as a simultaneous equations model for hypothesis testing and parameter estimation. In addition to the theoretical variables, choices of measured or empirical variables will also be discussed in this chapter, while detailed calculations of measured variables will be presented in the Appendix.

Statistical methodology is discussed in Chapter 4 while results of the two-stage least squares estimates of structural parameters will come in Chapter 5. In this chapter, sensitivity in terms of elasticities of labor supply with respect to each explanatory factor will be computed and discussed.

Finally, in Chapter 6, conslusions from the study are set forth. Some inspiration on manpower policy derived from the study are also discussed.

CHAPTER II

THE ECONOMY AND SOME ASPECTS OF THE LABOR FORCE OF THAILAND

Thailand is predominantly agricultural with approximately 80 percent of the total labor force in the agricultural sector in 1970. Between the census years of 1960 and 1970, the proportion of labor in agriculture fell slightly from 82.9 percent to 78.3 percent while the percentage of the labor force in the service sector rose a little and that in commerce remained about constant. (For the change in other industrial sectors, see Appendix C, Table 9). Industrialization, which virtually began in 1960, does not seem to have been very successful in drawing labor force from the agricultural to the nonagricultural sector. The labor force in the agriculture, as a percentage of total labor force, declined at a rate of only about 0.46 percent per annum between 1960 and 1970.

The economic performance of Thailand since the introduction of her First Economic Development Plan in 1960 has been impressive. The economy has grown at rapid rates, averaging some 10.4 percent per annum in GDP (money terms or 7.3 percent in real terms at 1962 prices). Unfortunately, a high rate of population growth has been an obstacle to rapid economic development; i.e., growth of per capita income. From Appendix C, Table 10, one can see that much of the growth in GDP has been used to support additional population at the expense of more productive investment programs to accelerate the growth of the economy.

Nevertheless the average annual rate of growth during the past decade is 7.5 percent in terms of real GDP, which has made possible a respectable 3.4 percent growth in per capita real GDP.

As a result of this growth, the structure of the economy has also changed since 1960. More resources have been allocated toward the non-agricultural sector. But in 1973 as shown in Table 1, agriculture still remained the predominant sector of the Thai economy, while wholesale and retail trade ranked second and manufacturing and services sector were next in their importance.[6]

The pattern of age and sex composition of the labor force of Thailand is presented in Table 2. The total labor force in 1970, as reported by the census, was 16.85 millions, or 49.0 percent of the total population. Of this 8.9 millions were male and 7.9 millions were females, constituting 52.9 percent and 47.1 percent of their respective population. The proportion (49.0 percent) of the total population in the labor force is relatively high when compared to the corresponding figures for many other countries (see Appendix C, Table 12). The proportion of the youth in the labor force in 1970 was relatively high for both sexes.

Table 3 gives the participation rates by different age groups and by sex. The activity rates of young workers (11-19) are relatively high. The female participation rate in Thailand is especially high compared with other countries in Asia (see Appendix C, Table 11), presumably because of the substantial numbers of family workers in

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[6]National Income of Thailand, 1972-1973 edition, p. 23.

Table 1

Sectoral GDP of Thailand in 1973 at
1962 Prices (Millions of Baht)

Industry	GDP	Percentage Share
Agriculture	36,174	30.0
Manufacturing	20,607	17.1
Wholesale and Retail Trade	20,995	17.4
Transportation and Communication	8,241	6.8
Construction	7,019	5.8
Banking	7,074	5.9
Others	20,618	17.1
Gross Domestic Product (GDP)	120,728	100.0

Source: Table 1 and 7, National Income of Thailand, 1972-73 Edition, Office of the National Economic and Social Development Board of Thailand.

Table 2

Size and Percentage Distribution of Labor Force by Age and Sex, Thailand, 1970 (Number in Thousands)

Age Group	Labor Force					
	Both Sexes		Male		Female	
	Number	%[a]	Number	%[a]	Number	%[a]
All Age Group	16,850.2	100.0	8,910.8	52.9	7,939.4	47.1
11 - 14	1,688.3	10.0	790.8	4.7	897.5	5.3
15 - 19	2,874.3	17.1	1,418.8	8.4	1,455.5	8.6
20 - 24	2,253.7	13.4	1,178.3	7.0	1,075.4	6.4
25 - 29	1,944.6	11.5	1,047.7	6.2	896.9	5.3
30 -39	5,958.3	35.4	3,252.7	19.3	2,705.6	16.1
40 -49	1,414.9	8.4	788.3	4.7	626.6	3.7
50 - 59	710.8	4.2	431.3	2.6	279.5	1.7
60 and over	5.3	0.0	2.9	0.0	2.4	0.0

[a]Percentage of total labor force.

Source: 1970 Census of Population and Housing, National Statistical Office.

Agriculture and Services. A broader definition of "Economic Activity" employed by the Thai Census could also be a reason.[7]

Participation rates in the upper age groups (60 and over) for both sexes also remain high reflecting the absence of any clear-cut retirement age for persons engaged mostly in agriculture, services and other family-oriented economic activity, as well as the absence of social security for the aged.

Table 3 and Figure 1 show the trends in activity rates by age and sex for Thailand from 1960 to 1970, revealing some interesting changes. The overall crude activity rate seems to have fallen from 1960 to 1970. For males, there is a slight increase in activity rates for all ages below 20, no real change for those between 25 to 50, and a slight drop in the rate for the age group 50 to 59. The rate for the age group 60 and over drops moderately but more pronouncedly than the rate for the age group 50 to 59. Overall, the male activity rate fell slightly apparently due to earlier retirement. For females, the rates declined in every age group except for the 11-14 age group. The overall participation rate fell more sharply between 1960 and 1970. Although there is a possibility that a subtle difference in the definitions employed in the censuses might explain part of the decline in female activity rate, there is, however, no sure evidence of such bias.

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[7]Gavin Jones of the National Economic Development Board of Thailand, judged that the high female participation rates in Thailand are largely real, but that they are inflated to some extent by the loose definition (Stephen Yeh and You Poh Seng, 37); Maurer, et al., has pointed out that, "Thai women have lagged only slightly behind men in their educational achievement. Therefore, the opportunities for women to find productive employment in the modern sector of the economy are not obviously constrained in Thailand by a colonial heritage that favored the education of men, as in the case in much of Africa, Asia and Latin America," (Maurer, et al., p. iv).

Table 3

Labor Force Participation Rates by Age and Sex
Thailand 1960 and 1970

Age Group	1960			1970		
	Both Sexes	Male	Female	Both Sexes	Male	Female
All Ages	52.7	54.3	51.1	49.0	52.0	46.0
11 - 14	45.5	40.5	50.5	47.3	43.7	50.9
15 - 19	90.7	76.9	84.7	77.3	77.4	77.2
20 - 24	87.4	88.2	86.6	84.0	89.2	79.0
25 - 29	90.4	96.0	85.0	86.8	95.4	78.4
30 - 34	91.4	97.5	85.2	87.5	96.5	78.7
35 - 39	92.3	97.8	86.6	88.3	96.6	80.0
40 - 49	92.6	97.6	87.6	88.2	92.6	80.0
50 - 59	87.7	94.5	80.9	80.8	91.6	70.3
60 and over	51.2	64.4	40.0	42.3	56.4	30.5

Source: National Statistical Office, 1960 Population Census, 1970 Census of Population and Housing.

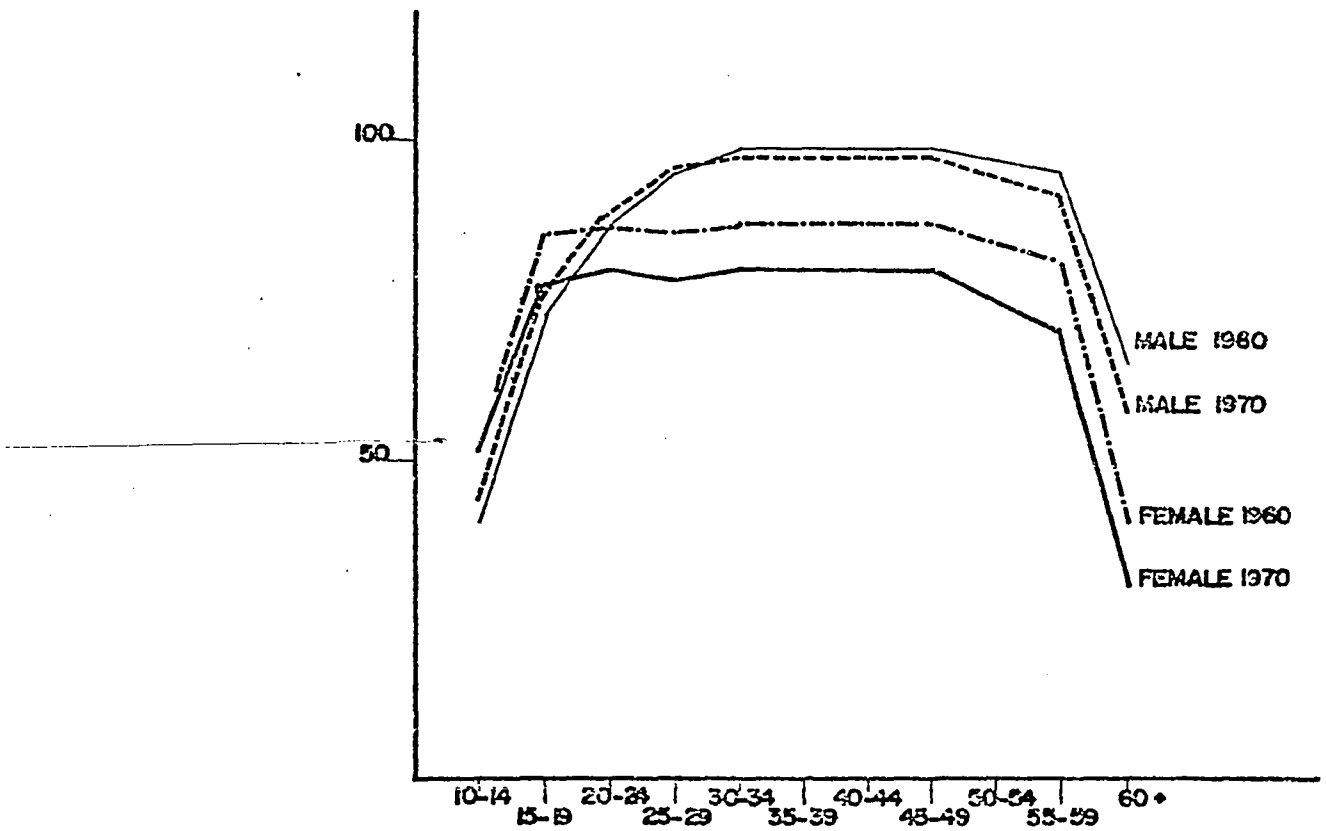

FIGURE 1: MALE - FEMALE
AGE SPECIFIC ACTIVITY RATE PATTERN 1960-1970

CHAPTER III

REVIEW OF LITERATURE, THE THEORETICAL UNDERLYING CONCEPTS AND THE BASIC MODEL

In this Chapter the review of the extant work on Thai labor force participation is presented in the first part, followed by a review of earlier literature on the theory of labor supply. The second part contains a presentation and discussion of various theoretical relationships which are used to formulate a testable model for this study. It focuses on how different variables theoretically affect an individual's probability of participating in the labor force. Finally, a basic model is developed for empirical testing of various hypotheses and estimating of theoretical parameters.

The Extant Work on the Labor Force Participation of Thailand

Analyses of labor force participation of Thailand have been done by Rachapaetayakom (1972), and Kenneth Maurer, et al. (1973).[8] Rachapaetayakom's work which is based on the one percent data from Thailand Population Census 1960, shows a comparative study of the sex and age patterns of labor force participation in the urban and rural population. She found that the urban population has a lower crude participation rate than does the rural population. This differential

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[8]A study by G. B. Rodgers (1974), p. 20-21, has some brief mention of the labor force participation rates of Thai married women as a function of education, employment opportunities at home and numbers and ages of living children. Rodgers, however, did not make any empirical test of his hypothesis.

is said to be mainly a result of the different age structure between the urban and rural population: the rural areas have a higher percentage of children under age 15 with considerably higher participation rates than the same age group in urban areas. It is not surprising, when one uses crude participation rates, to find a strong effect from age structure.[9] However, she also observed that the age-standardized participation rate as well as the age-specific rates show the same phenomena. Rachapaetayakom's comment was that "young persons in urban areas have a low activity rate because most of them are still in school. Old persons in urban areas have lower activity rates than rural areas because more follow the practice of retiring at age 60 (Rachapaetayakom, 27)." There is no economic reasoning found in her argument. Factors determining the labor force participations rates are far more complicated than being in or out of school or the retirement age as we shall see later in this Chapter.

A more rigorous study was attempted by Kenneth Maurer, et al., within a project seeking to formulate, test and integrate the components of a theory of fertility. In this study, a simultaneous-equations model is specified which includes equations on women's participation in the non-agricultural labor force. The model consists of three equations accounting for the interdependency of three household decisions; marriage, fertility and participation in the non-agricultural labor force by females. Non-agricultural labor force participation is assumed

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[9]See the discussion on the various "labor force participation rates" in Appendix B.

to be an approximately linear function of fertility, female unemployment, relative schooling of women to men and a women's wage proxy. Estimates are reported for six five-year age groups of women in addition to an aggregate group of all women between the ages of 14 and 44. Maurer's three simultaneous equations model can be written as:

$$(1)\quad M_i = a_0 + a_1 FNA_i + a_2 FMG_i + a_3 \frac{MP}{FP} + a_4 MED + a_4 \frac{FED}{MED} + u_1$$

$$(2)\quad F_i = b_0 + b_1 M_i + b_2 FNA_i + b_3 CA + b_4 CED + b_5 MED + b_6 FED + u_2$$

$$(3)\quad FNA_i = c_0 + c_1 F_i + c_2 FUN_i + c_3 \frac{FED}{MED} + c_4 WW_i + u_3$$

Where:

M = marriage rate

FNA = female nonagricultural participation rate

FMG = female migration

MP = male population

FP = female population

MED = male years of schooling

FED = female years of schooling

F = fertility rate

CA = child labor force participation rate

CED = child years of schooling

FUN = female unemployment rate

WW = woman's wage proxy

u = stochastic disturbance term

i = age group of women under observation

Table 4 shows Maurer's estimate of female labor force participation equation based on the 1960 Census of Thailand for all 71 regional

TABLE 4

SIMULTANEOUS EQUATION ESTIMATE OF NONAGRICULTURAL PARTICIPATION RATE[a]

Age of Women	Fertility[b]	Female Unemployment (proportion)	Relative Education (Female/Male)	Female Wage	Constant	F(4,7) Significance t-Ratio Adjustment
15-19	-.141 (1.08)	-2.27 (3.35)	-.0512 (0.90)	4.55 (9.43)	.0203 (0.34)	16.08 .001 .513
20-24	-.115 (3.03)	-2.03 (2.76)	-.103 (2.01)	4.93 (9.91)	.151 (2.11)	31.46 .000 .506
25-29	-.129 (3.12)	-2.47 (1.87)	-.0855 (1.50)	4.05 (7.25)	.354 (2.60)	42.94 .000 .581
30-34	-.102 (2.70)	-1.01 (0.48)	.0324 (0.60)	3.37 (5.27)	.336 (2.46)	36.87 .000 .559
35-39	-.0256 (1.14)	-3.32 (1.48)	-.0103 (2.36)	4.40 (7.11)	.110 (0.95)	29.78 .000 .450
40-49	-.0162 (1.20)	-2.66 (1.06)	-.0235 (0.55)	4.20 (8.75)	.0796 (0.95)	23.07 .000 .438
15-49	-.118 (1.96)	-2.31 (1.91)	-.0852 (1.40)	3.83 (5.11)	.379 (2.08)	27.87 .000 .524

[a]Based on instrumental variable technique. t-ratios are in parentheses below each coefficient.

[b]Endogenecus variable.

Source: (Maurer, et al., 21)

divisions or Changwads. The result shows the strong effect of fertility on female participation in the nonagricultural labor force when women are between the ages of 20 and 34 and most likely to be caring for young children. The female wage has a positive effect while the female unemployment rate shows some discouraging effect on the labor force participation. Women's education relative to men seems to be negatively associated with women's participation in the nonagricultural labor force. Maurer's comment was that increasing a woman's educational status relative to men would increase the propensity of women to specialize in non-market or household activities. He argued that factors that increase the women's market relative to home productivity, such as increased formal schooling, should also contribute to market activity. But holding market wages constant, increased years of schooling of women would enhance their productivity in non-market activities and thereby weaken their production incentives to participate in the labor market (Maurer, et al., 15). This coincides with Cain's idea that cultural and biological factors make homework the most important type of work for the wife over her married life, where she specializes in the production of home goods (Cain, 6). Hence, we would expect that increases in women's educational status will result in higher home productivity relative to their market productivity. Yet we must be cautious with Maurer's conclusion that the increase in home productivity will weaken the production incentives to participate in the labor force. Although the conclusion is possible, an alternative effect may be stronger. The increase in the efficiency of the household production of commodities also means that a given amount of housework can be

accomplished in less time. More formally, Becker maintained that the increase in productivity would also produce an income effect. Holding non-labor income, wage rates, and other factors constant, the effect of education on the labor supply decision depends on the income elasticity of demand for time-intensive commodities. If the income-elasticity as such is less than unity, then a positive effect of education on the labor supply is likely (Becker, 1965, 506). In fact, by looking at the respective income elasticities of market goods and home goods, Cain noted that housework should decline more than market work over the long run (Cain, 6 and 17). Additional discussion of the effect of education on the labor supply will be made later in this Chapter.

In addition, Maurer's study is subject to a few limitations in relation to our study. First, the objective of its investigation is not to test conclusively firmly specified hypotheses concerning the propensity of the Thai population to enter the labor force. Rather, only a sub-group of the Thai population, namely, female in the non-agricultural sector, was observed. This renders the study less valuable from the view of the aggregate manpower policy where interests should cover the whole of the labor force, young or old, male or female. Moreover, the model is less useful for the purpose of forecasting the total supply of the labor force.

Second, Maurer's study does not provide a complete evidence of the total response of the labor force, since the labor equation does not include family income. In analyzing labor supply it has been increasingly recognized that the family factor and their income must be taken into account, since the supply of a family member depends not

only on the person's own wage rate but also on the earned income of the other members in the family plus family property income. The income effect of an increase in earning by one family member may be captured by the increase in leisure of another member's. In other words, the participation rates of family members are simultaneously determined depending on the family income level. More precisely, in terms of utility analysis of labor supply, the goal of a household is to maximize a family utility function subject to the family income constraints.[10]

Third, we suspect that there might be some identification problem of the labor force participation or the labor supply equation, since Maurer's model implicitly assumes that wages are exogeneously determined. Even allowing for an imperfectly competitive labor market which may prevail in Thailand, one cannot argue that wages are set institutionally and without reaction from the labor supply side. In fact, Maurer's own results indicate that the labor force participation rate of women is highly sensitive to wages.

Finally, with respect to the fertility variable, in a cross-section analysis the assumption may be justified on less restrictive grounds that fertility is a "predetermined variable;" that is, "exogeneous" to the family during the period in which the decision to work is made.

Nevertheless, this report has served its purpose as a "preliminary empirical exploration (Maurer, et al., 30)" and has been used as one of the starting points of our research.

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[10]Leaving out a theoretical variable results in a specification bias in the statistical estimate (Rao, 29-32 and 62-63); utility may depend on work--so a family member may work to gain both the utility purchaseable with additional income and the utility that is part of work.

Earlier Theory of Labor Supply

Whether an increase in wage rate will lead to an increase or decrease in the individual worker's supply of market labor (that is, whether the supply curve of labor is positive or negative or backward sloping) has long been discussed and recognized as uncertain.

Marshall, using Jevon's concepts of utility and disutility, maintained that the labor-supply curve is negatively sloped for "the more ignorant and phlegmatic of races." That is, for these groups of workers, the income effect is stronger than the substitution effect. On the other hand, the curve should be positively sloped for those "whose mental horizon is wider, and who have more firmness and elasticity of character."[11] Marshall, however, did not explicitly consider that the same worker can follow both directions for different wage levels.[12] In 1921, Frank Knight contended that the short-run supply curve of labor is always negatively inclined (Blaug, 290). In equilibrium, in Jevon's terms, Knight postulated that the rational worker will equate the marginal disutility of labor and the marginal utility of income.[13] Wage increases will reduce the marginal utility of income. Thus, the marginal disutility of labor will now exceed the marginal utility of wage income.

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[11]Marshall, p. 528.

[12]To be fair, Marshall believed that at a higher wage level a certain amount of leisure, part of "productive consumption" necessary for efficient work, must be preserved. (Marshall, pp. 529-694). This implicitly implies that the individual will generally have a forward sloping supply curve which at some point turns vertical or bends backward.

[13]Implicitly, the marginal disutility of labor is assumed to be positively slope with respect to hours worked.

To attain equilibrium, the worker will want to shorten his working day to increase his marginal utility of labor time; i.e., to decrease his marginal disutility of labor time.

The germ of the income and substitution effects in the analysis of the labor supply can be found in Lionel Robbins' noted 1930 article. In this article, he criticized Knight and Pigou for arguing that the supply curve of labor is negatively sloped. The nature of the curve, he pointed out, is an impirical question, and not to be determined a priori (Robbins, 126, 127, 129). Robbins showed that the labor supply curve may be backward bending, i.e., positively sloped over a range, then becoming negatively sloped. His analysis was developed in terms of the demand for income as a function of the effort-price of income, the inverse of the wage rate, where "effort" means labor-time. Robbins then translated this demand curve into an analytically equivalent offer curve, illustrating the trade-off between effort and income. If the elasticity of demand for income in terms of effort, or the elasticity of the supply of effort is greater than unity, then a unit of extra effort will be expended only if income rises more than proportionately. In that case, the supply curve of labor will be positively sloped. If the elasticity coefficient is less than unity, however, the supply curve will be negatively sloped. In response to the prevailing notion (that the supply schedule of labor would be negatively sloped or backward sloping because at a higher wage and consequently higher income, a worker would wish to "buy" more leisure, along with other goods), Robbins sharply argued that a higher wage, the price of leisure itself has risen. (Robbins, 127-128).

On the one hand, a higher wage rate allows for higher income, which tends to increase the demand for leisure, if leisure is not an inferior good. On the other hand, with a rise in what Robbins called the real income price of leisure, the substitution effect of a wage rise leads to a reduced demand for leisure. Thus, whether the labor-supply schedule will be forward or backward sloping depends on which of the two effects is stronger--income or substitution--an empirical question.

Though Robbins is quite correct when he argued that the nature of the labor-supply schedule could be identified only by observation, and not a priori, he was attacked for making arbitrary assumptions of a supply curve of a different type (the back-bending one) in his drawing of a curve for quantity of effort, related to income, which rises and then falls (Perlman, 8). The conventional demand curve for income, in terms of effort that Robbins used in his analysis has an elasticity greater than unity in its upper reaches and less than unity as it approaches the x-axis, implying that as wages rise effort first increases and then decreases. If the demand curve for income in terms of effort has an elasticity greater than unity over its relevant range, then the consequent supply curve will have a negative-unbending slope. It should be noted, however, that Robbins had carefully stressed the importance of inductive investigation of elasticities; i.e., the empirical testing of the assumptions. Since the advent of the indifference-curve technique, the issue can be put even more simply: It all depends on the relative weight of the substitution effect versus the income effect of a rise in wage rates. This is further discussed in the section that follows.

The Theoretical Underlying Concepts

1. The Neo-Classical Model of Income and Substitution Effects. The utility theory states the relationship between labor supply and income and wages in terms of the work-leisure choice of an individual. The individual worker has a limited amount of time at his disposal. He can use his time for acquiring income (i.e., to work) and for leisure.[14] The greater the amount of time devoted to acquiring income, the less the leisure time retained and the higher income acquired. The price of more leisure time is the wage rate per unit of time devoted to acquiring income.

Now, since a rise in the wage rate is a rise in the price of leisure, we may expect two separate types of effects to result--a substitution effect, which will tend to cause the use of time for leisure purposes to decrease, and an income effect, which is indeterminant in its direction. Since the rise in the wage rate allows any given income to be acquired with fewer hours worked, the income effect may be negative, zero on balance, or positive (if leisure is an inferior good) in terms of the change in hours worked.

Assuming, however, that leisure is a normal good, then the income effect is negative; that is, a higher income implies that more leisure

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[14]"Work" refers to a particular kind of labor performed in the market for pay including self-employment and unpaid-family workers, while "leisure" refers to non-market activities such as housework, child care, and "do-it-yourself" project at home. (Fleisher, 1970, 37; Cain, 1966, 5).

will be bought, less time will be spent at work.[15] But at the higher wage, the price of leisure itself has risen, the substitution effect of a wage rise leads to a reduction in leisure demanded. Thus, whether a rise in wages will lead to a rise in the amount of labor supplied depends on which of the two effects is stronger--income or substitution.[16]

The traditional work-leisure analysis oversimplifies the relationship between individual labor supply and the wage rate. Thus, the concept of work, income and substitution need further clarification and elaboration. With respect to "work" and "leisure," Mincer questioned the implicit assumption of a strictly dichotomous relationship between leisure time and hours of work in the market (Mincer, 1962, 64; 1963, 71). In his view, activities constituting neither gainful employment nor pleasurable leisure such as housework, study time, commuting time, should also be considered.[17] With respect to income, Mincer maintained

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[15]For a mathematical derivation, see Henderson and Quant, Microeconomic Theory, (New York, 1958), Ch. 2, 29-30; for a graphical exposition, see Fleisher, Labor Economics, (New Jersey, 1970), Ch. 2, 37-49.

[16]A prevalent notion by the time of Robbins (1940) was that the supply schedule of labor would be backward-sloping because at higher wages and consequent higher income, the worker would wish to "buy" more leisure, along with other goods. This is the combination of the conclusion of Robbins and Marshall, with the supply of labor increasing and then decreasing with rising wages, and with the turning point dependent on the level of economic development and on the tastes and acquaintance with goods, being at a higher wage the more advanced the economy. (Milton Friedman, Price Theory, Chicago, 1962, 204.)

[17]Perlman showed that the general conclusion is not altered by including these variables. (Perlman, 13-15.)

that the relevant income variable is total family income because in terms of consumption theory the family is the decision-making unit; income is assumed to be pooled.[18] Furthermore, Mincer applied the permanent income hypothesis to the theory of labor supply by making a distinction between "transitory" and "permanent" income effects (Mincer, 1962, 67-9, 73-79).

Gary Becker (1965) revised the traditional theory and introduced the concept of consumption time. His approach recognizes that in fact "hours" are never consumed by themselves, nor are goods. Hours are not enjoyable without goods, and all goods require time to consume. Thus, we may think of consumption decisions as being made among alternative commodities, some of which require more time to consume than others.[19] The family's labor supply then is determined simultaneously with consumption. Furthermore, it is assumed that consumption can be substituted among family members, so that the one member who experiences an increase in earnings works more, while other members allow their consumption to increase (Becker, 1965, 95; King, 23). In summary, the conclusions drawn from Becker's hypothesis are as follows:

(a) An increase in family income leads to an increase in consumption. Labor supply would rise or fall depending on the change in the amount of consumption time. In general, consumption time will rise if

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[18]Mathematical derivation for this respect can be found in (Cohen, Lerman, and Rea, Appendix D).

[19]Becker (1965, 502) divided goods into time-intensive and goods-intensive ones. "Leisure" is considered unproductive and time-intensive whereas "work" is considered productive and goods-intensive (ibid., 508).

time-intensive goods are not inferior. Hence, on this condition, supply of labor to the market will fall.

(b) As wages rise, the substitution effect would operate to increase hours of market work since the price of time or leisure-intensive commodities will be raised relatively to goods-intensive commodities and people would decrease their consumption of time-intensive commodities.

(c) An increase in the productivity of working-time due to the growth in human and physical capital, technological progress, and other factors raises the relative cost of time-intensive commodities; the resultant effect is the same in (b). On the contrary, if the productivity of consumption time increases, it would change relative commodity prices and increase "full income,"[20] which in turn will produce substitution and income effects (Becker, 1965, 506). These effects are precisely the opposite of those produced by improvements in the productivity of working time. If the productivity of both working and consumption increases, there would be no change in relative prices, and thus no substitution effects. The income effect would be neutral only if the income elasticity of demand for time-intensive goods is equal to unity. Supply of market labor would decline if it was above and increase if it was below unity. Becker pointed out that since time-intensive commodities tend to be luxuries, an increase in income would tend to reduce supply of market labor.

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[20]Defined as maximum money income achievable. For an individual full income also implies maximizing physical income for the consumption set is chosen so as to minimize the time content.

The discussion so far allows us to formulate a neoclassical type model as follows:

$$AR_i = f(YF_i, w_i, u_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where AR_i is the labor force participation rate of individual i, YF_i = family income of the individual i, w_i is the wage rate, and u_i is the stochastic term for equation (1).

2. Unemployment and the "Additional Workers" and "Discouraged Workers" Hypotheses. Most econometric work on labor force participation has concentrated on the relationship of the labor force participation rate and unemployment rate (Tella, 1964; Dernberg and Strand, 1966; Barth, 1968; Bowen and Finegan, 1969; Vroman, 1970; Cain, 1966). An underlying hypothesis advanced by Woytinsky (1940), the "Additional Workers Hypothesis," asserted that rising levels of unemployment bring additional or secondary workers pari passu into the labor market. As unemployment rates decline, this argument continues, these additional workers will leave the labor force. Conversely, Humphrey (1940), among others, challenged the theory, and held that although some "additional" workers may seek employment when the usual family breadwinner loses his job, other workers drop out of the work force when they believe no work is available. This is well-known as the "discouraged workers hypothesis." The proponents of this hypothesis maintained that a stimulus to aggregate demand not only would provide more employment opportunities but a swelling of the labor force by workers who earlier had either left the labor force when jobs became scarce or who were prevented from entering it at all. Or, on the contrary, when the

unemployment rate is high, these workers will drop out of the labor force by 'not looking for work.'

It can easily be seen that while the added workers hypothesis puts the argument on the effect of unemployment on family income, the discouraged workers hypothesis argues in terms of the difficulty or costs of job search. An increase in unemployment has a direct effect on family income by reducing the income of the family temporarily below its normal level. In order to maintain consumption at a level consistent with normal income, families experiencing unemployment may resort to drawing on their savings, they may resort to borrowing if their credit is good, and/or family members who typically do not hold jobs may attempt to find them. Increases in the level of unemployment, however, also result in greater difficulty of job search. This effect is hypothesized to influence the amount of labor supplied in the same way as the substitution effect of a wage reduction for job search involves costs--foregone leisure and earning, money costs, psychic costs, and so on. These costs must be balanced against the expected benefits for the worker to decide whether to search at all and, if so, how much to search (McCall, 1970; Uhler and Kunin, 1972). Hence as commented by Cain (1966, 22), the unemployment rate play two roles in the labor supply model modifying both the income and the wage variables and whether the net effect of unemployment will be positive or negative is not known a priori (ibid.).

Customarily, the added workers and discouraged workers hypotheses refer to a particular class of labor, the secondary workers. For the primary workers such as the head of the family, prime-age males, their

unemployment rate is supposed to represent the general state of demand for labor which varies from place to place because areas are affected differently by fluctuations in the general level of business activity and by the expansions and contractions of different industries. The coefficient of the unemployment rate of primary workers will shed light on an important question of the level of excess supply of labor.

By introducing the unemployment rate variable, our model then becomes:

$$AR_i = f(YF_i, w_i, UN, u_2) \qquad (2)$$

Where UN is the unemployment rate, other notations are the same as in (1).

3. Industrial Development and Related Economic Changes. To my knowledge, there is no received economic theory which explains the direct effect of economic change on labor force participation, the variable which is controlled for population growth. Duesenberry concluded in this respect that "Labor-force participation rates are largely determined by social attitudes, by techniques of production, and by economic factors which are only indirectly related to the balance of supply and demand in the labor market; e.g., the effect of the level of real income on the school leaving and retirement ages (Duesenberry, 1958, 310)."

This shrewd conclusion needs some qualification. Lebergott (1965, 335-339) implicitly argued that if the labor force participation rates are indifferent to economic fluctuations then the course of labor supply would at times grossly exacerbate the course of the

cycle.[21] In fact, as evidence in the U.S. suggested, Lebergott maintained that the state of the labor market was disturbed by the economic cycles, and workers did respond to the changing unemployment rate resulting from the disturbed labor market. Duesenberry would be perfectly correct if he had stated that economic changes produce only "indirect effects" on labor force participation; for economic changes are always associated with the reallocation of labor and capital in accordance with changes in aggregate demand and comparative advantage. Changes in unemployment, urbanization, real income, wages and prices, industrial composition, techniques of production and educational standards are such phenomena of economic changes and transformation. In turn, these factors can affect the labor force participation (e.g., Bancroft, 1958, 28-29).

In the cross-sectional analysis, variation in the degree of industrialization among areas is found associated with variation of participation rates (e.g., Bogue, 1969, 219-225; Durand, 1971, 67; __, 1973). Durand, by using cross-sectional mean levels of crude activity rates (CAR), found the relationship of a U-shaped relationship between activity rates and development levels, suggesting that the relative size of the labor force might commonly diminish during early stages of economic development and increase again during later stages (Durand, 1973, 3). However, after taking some problems of measurement into account, by using the mean intercentral changes of age-standardized CAR,

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[21] That is "in depression years we would see an enormous flood of workers entering the labor market; in prosperity years we would find a sudden calm an overwhelming shortage of workers in all occupations (Lebergott, 337)."

Durand suggested that instead of a U-curve, a logistic trend of decreasing rates in the course of development might be more typical; relatively slow decline in the early stages, faster in the middle stages, and slower again in the later stages, with a tendency to level off when an advanced state of development is reached.

The age-standardized activity rates of males shows some difference from the female in their relationship to the level of industrialization. While a decreasing trend of participation by male in the labor force appears to be an almost inseparable companion of economic modernization, the female age-standardized activity rates show an inconsistent trend over the period of economic transition: the patterns of variations associated with economic development are less clear-cut and consistent. The main reason for the decreasing male standardized activity rate is that the years of their participation are shortened by later entry into the labor force due to accelerated promotion of education, and earlier retirement due to higher income and better retirement benefits. The decreasing population growth rate associated with rising economic development also has an effect on the male participation rate by reducing the number of dependents to be supported. On the other hand, participation rates may either increase or decrease in the course of economic transformation depending on transitory circumstances in each country such as employment opportunities and tastes.

The long-term decline in the birth rate also permits some married women to spend their time in paid employment instead of unpaid housework and child care. Increases in productivity which reduce work time at home as well as on the job, too, permits many married women and some

secondary workers both to work and to maintain their households (Bancroft, 1958, 29).

The necessity of the distinction between the crude activity rate and the age-specific should be emphasized. It is interesting that the crude activity rate, if not standardized for age-structure, is higher in industrialized nations than in developing nations while age-specific activity rate for men is higher in developing nations than in industrialized nations (Bogue, 1969, 219). The explanation of this apparent inconsistency is the effect of age composition. Larger proportions of population in the extremely young ages 10 to 19 where the age-specific rates are relatively low, as in the case of less-developed world, tends to lower the crude activity rates. Unless the crude activity rate is standardized for age structure, it is difficult to draw any conclusion from a comparison among areas.

The effect of age-structure, as mentioned earlier, can be controlled by the use of the age-specific activity rates. These rates, being a better measure of labor activity than crude or refined activity rates, are more appropriate for area or international comparisons. The age-specific activity rates in agricultural countries in general, are higher than those of industrialized countries, particularly in younger age groups and in old age groups (Taeuber, 1971, 39). Varying the degree of industrialization, however, does not seem to influence activity rates in the middle age span of 20-54 years (U.N., 1962, Table 12).

This implies that industrialization appears to be accompanied by a tendency to raise the average age at which young men enter the labor force and to lower the average age of retirement. Economic theory

offers a two-fold explanation. First, assuming that income is equally distributed, rising income per capita promises a higher rate of return to education, while at the same time it makes it easier to afford prolonged schooling for the youth. Second, from the demand side, economic and the accompanying technological progress affects the demand for labor by calling for a more educationally qualified or highly trained labor force (Jaffe and Froomkin, 1968, Ch. 8). These factors will keep the youth in schools and delay their entry into the labor force.[22] In addition, industrial development will decrease relatively opportunities for self-employment and family enterprises, thus making it more difficult not only for the youth to enter the labor force but also for the elderly workers to remain in the labor force. Rising per capita income and related benefits also enable the elderly to retire early. Lowell Gallaway shows that for the U.S., the activity rates of males aged 65 and over tend to be inversely related to old-age benefits (Gallaway, 1966).

In the case of females, Sinha (1965) proposes a hypothesis that women's participation in economic activities, in the course of industrialization and related economic development, decreases at first, but increases again when a more advanced stage of development is reached. However, Durand considered such a hypothesis is doubtful and may be valid in some cultural settings while it may be not in other settings. He suggests instead that female activity rates converge not toward a

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[22]Assuming that there is no shortage of supply of education. This assumption is at times not realistic in developing nations where growth is 'imbalanced.' The inadequate supply of education, as a result, is a major cause of the youth-unemployment.

relatively low or high level but toward the centre of the range (Durand, 1971, 70-71). In addition, Durand noted that age-specific activity rates of females over 60 or 65 years of age are typically higher in Asia and Far Eastern countries than in those of the Western industrialized countries. The rates are expected to decrease in Asian and Far Eastern countries in the future in the course of economic development (ibid.).

Extending equation (2) to incorporate these effects yields:

$$AR_i = f(YF_i, w_i, UN, IND, u_3) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Where IND stands for the level of industrial development and related economic structure.

4. Education. The link between education and the labor force participation rate can be interpreted in a few different ways; namely, tastes, productivity, investment in human capital, and informations on the labor market. In the traditional leisure-goods choice model variables other than non-labor income and the wage rage affect labor supply via "tastes." In this sense, a presumably positive effect of education, cetaris paribus, on hours of market work or the labor force participation can be accounted for by stating that education is positively associated with the taste for market work (Bowen and Finegan, 1966, 568). For example, a more educated person, facing the same expected non-labor income and wage rate as a less-educated individual, can be expected to work more hours or have a higher probability to participate in market work.[23]

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[23]Yet, in a society like Thailand, the heterogeneity of jobs may make the 'educated' people choosy. They may prefer not to participate in the labor force if they cannot find a job that suits their educational status.

In Becker's model, on the other hand, it may be argued that a rising level of education increases the efficiency equally of the household production and market production of commodities (Becker, 1971, 45-48). Holding income, wages, other factors constant, the effect of education on labor supply decision depends on the income-elasticity of demand for time-intensive commodities. An inverse effect of education on the labor supply is possible if elasticity is greater than unity. In general, however, Becker's model implies that education generates positive income and substitution effects which, given the pattern of household demand, results in time being reallocated away from household work and towards market work.[24]

Besides representing tastes and productivity of a worker, education and/or training is also considered as the quality of the labor force in a form of human capital stock or human wealth (Mincer, 1968, 87). This variable then may be positively related with permanent income. Interpreting education as a form of human wealth or permanent income, it is conceivable that this form of permanent income is not a "non-labor" type--that is, only if productive or market work is performed is education transformed into income. Nevertheless, a higher level of education can generate both income and substitution effects for it implies higher expected wages. A higher wage rate will shift an individual from the home sector and leisure to the market sector. However, since in this case expected family income increases as a result of the increase in the individual's earning power, total hours of work will tend to decrease. Whether the propensity to "participate" will

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[24]See also (Maurer, Ratajczak, and Schutz, 1973, 11).

increase or decrease depends on whether the job shift from home to market adds more hours of work to the market sector than is subtracted from it by a possibly increased consumption of leisure. Whether the net effect of education is positive or negative is, therefore, an empirical question. It is certainly incorrect to predict that the education effect will necessarily be negative because the derived income effect of education on market work exceeds the derived substitution effect by analogy to the backward-bending supply curve, or vice versa. As a matter of fact, unless the possible permanent income effect is too strong we can expect a positive relationship between levels of education and training and the probability of participating.[25]

However, another support for the likely positive effect of education on participation comes from the effect of education on access to employment or information about labor market--with the ways in which job seekers find jobs. In this case we assume that a better-educated individual is better informed than the less-educated one.[26] This better information about the labor market, in turn, reduces the cost of job search in terms of time foregone as well as reducing the probability of search unemployment for the better-educated persons.[27]

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[25]Bowen and Finegan (1966, 568) put it boldly that "education increases a person's expected market earnings and thus increases the differential return between market and non-market activity; that is, the opportunity cost of staying out of the labor market is greater for a person with considerable education than for a person with relatively little education."

[26]"There are good reasons to think that education attainment is positively related to intelligence, to ambition, and probably to physical and mental health as well . . ." (Bowen and Finegan, 1966, 568); transaction costs of acquiring information about the labor market might be less for a better educated worker.

[27]Note, however, that the foregone earning of the educated during the job-search is higher than the less educated. But it is not in relation to what he is seeking.

In general, the more educated a person is, the more likely he or she is to be in the labor force,[28] except at the young age-groups where formal education is still unfinished and labor force activity is restricted by current school enrollment. It should also be noted, in time-series,[29] that the increased participation of better-educated workers in the labor force could be expected to give rise to increasing competition for jobs particularly in "white-collar" occupations. The feed-back effect is that this will increase the school attendance rate which over time reduces the numbers of workers in the young age groups, an effect similar to that of industrial development mentioned earlier.

By including the effect of education we expand the model in equation (3) to:

$$AR_i = f(YF_i, w_i, UN, IND, ED_i; u_4). \quad (4)$$

Where ED_i is the educational status of the labor force of age groups i.

5. Family Size. An economic explanation of the relationship between family size and the labor force participation rate is analogous to the explanation, in Becker's model, of how the individual makes the choice of working or not working, and of working more hours or less hours. Different consumption patterns will entail different combinations of time-intensive and goods-intensive activities, and if a person

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[28]A few empirical studies which support this hypothesis are, for example, (Bowen and Finegan, ibid.); (King, 1973); (Visaria, 1971); (Bancroft, 1958); and (Long, 1958, 94 and 96); education also increases the utility derived from work (doing the task you trained for yields satisfaction apart from money).

[29]This effect is less likely in the case of cross-sectional data.

chooses activities other than market labor that are highly time intensive perhaps market work must be restricted. The effect of having young or aged dependents or having a large extended family on the probability of participation in the labor force by other working-age family members, particularly women and other working secondary workers,[30] depends more or less on family income and the proportion of dependents in the family.[31] The higher proportion of dependents increases the amount of housework and increases consumption at home. The husband or the head of the household is more likely to work more because of the added responsibility he has undertaken. On the other hand, holding husband's or family income and other factors constant, the wife is less likely to work because of the increasing amount of time required for housework. It is possible also that in a developing socio-economic structure with a greater prevalence of extended families, the housework is readily shared by the other family members.[32] In such a case, the

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[30]Secondary workers commonly refer to workers in a family unit who are not the main earner and/or to workers who regardless of family status, have a casual or part-time commitment to the labor force.

[31]Average family size in Thailand is 5.9 persons whereas the average number of income earners is 1.9 (Socio-Economic Survey, 1968-69).

[32]In some societies, the wife of high income family, and with considerable education attainment, may hire domestic servants to take care of the housework and to look after the dependents, if her relative wage in the market work is higher than the cost of hiring the maid. In this case, the effect of having large family size on female activity rates should also be positive. On the other hand, if family income is low, and the proportion of nonworking-age dependents is small, the probability to participate in the work market of the other family members should increase.

participation rate of female as well as other secondary workers is expected to increase with the family size. Again, the net effect is impossible to predict a priori.

Including this effect into equation (4) yields:

$$AR_i = f(YF_i, w_i, UN, IND, ED_i, FZ_i; u_5). \quad (5)$$

Where FZ_i is the family size of individual i.

6. Population Density. Mincer maintained that the population factor does not directly affect the labor force participation. But, rather it does affect the wage rate. In the absence of strong barriers to downward wage flexibility, an increased population of young age groups and/or female labor force[33] will exert a downward pressure on their wages only to the extent of the inelasticity of substitution between less experienced[34] (secondary) and more experienced (primary) workers. Holding wages constant, however, a relatively low demand for labor can effectively block entry to jobs for many of the disadvantaged or secondary workers. If training or retraining is possible for these workers to improve their productivity, they may be out of labor force during the period of training.[35] If, on the other hand, their way back to training or retraining is blocked for reasons of low productivity, all these factors interact to lock a growing number of the secondary workers out of the labor market.

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[33]This is size by age-sex cohort, not 'population size' on density. Hence, a more appropriate variable should be relative size of secondary workers to the size of primary workers.

[34]'Less ability' or any other terms indicating disadvantages.

[35]'On-the-job training' permits a worker to stay with the job.

Labor force behavior of the primary labor force, particularly of males aged 20-59, is quite insensitive to demand fluctuations. However, since the 'population pressure' will enhance the relative advantage of the primary workers over the secondary, the factors delineated above will work in the opposite direction.

A measure of population density is used to relate population pressure to natural resources. In fact, the desirable variable should be the ratio of population to the available resources or, the less proper one, the ratio of rural population or agricultural workers to the arable land weighted by an index of land fertility and the average number of croppings per year. However, in the absence of data in these directions, we will use population density defined as the ratio of total population to arable land.

The population density concept can also be applied to the stable optimum population theory which refers to a given optimum population size that maximizes the per capita income of a nation for a given set of techniques, resources, tastes and institutions. For a smaller than optimal population the extent of the market is too limited to permit full benefits to be derived from division of labor and economy of scale.[36] With too large a population diminishing returns set in, since fewer cooperating resources are available per worker. In this sense, too large population means a restriction or a resource constraint on the labor supply. A higher ratio of population to resources implies a lower labor force participation rate. And this effect is expected to

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[36]Obviously, this theory either ignores external trade or has an implicit assumption of a closed economy.

be stronger for marginal workers; i.e., secondary workers than the primary workers.

Finally, equation (5) is expanded to include the population effect as:

$$AR_i = f(YF_i, w_i, UN, IND, ED_i, FZ_i, PD; u_6) \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Where PD is the proxy of population-resource ratio. The expected sign of the coefficient in relation to the activity rate should be negative for secondary workers (workers other than males aged 20 to 59) and possibly positive for primary workers (male: aged 20 to 59).

Dependent Variable: The Labor Force Participation Rate. As a part of the theory of labor force participation, given the possibility of unemployment, participants in the labor force are defined as the employed and the unemployed, while non-participants are those unable to work (e.g., the totally disabled) and those desiring not to work. Since the individual is either participating or not, the dependent variable is dichotomous for any given individual. To obtain a continuous dependent variable[37] we must look at a population, as is done in this study, and measure the porportion that participates in the labor force (for each value of the independent variable). This porportion can be interpreted as the individual's probability of participating (Black and Kelejian, 718). In fact, throughout this study it is assumed that participation rates will reflect, say, hours worked per year, or a similar concept that closely approximates the supply-of-labor variable of economic theory (Cain, 19; Crandall, et al., 7).

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[37]The use of dichotomous dependent variables will present the problem of heteroschedastic disturbance term in cross-sectional analysis (Goldberger, 1964, 248-250).

The labor force participation rate or, to use the U.N.'s terms, "activity rate" is defined as the ratio of participants or the "labor force"[38] to the population of the same coverage. A discussion of the use of the "crude activity rate," the "age-standardized activity rate," and "age-sex specific activity rates" are presented in Appendix B.

The participation rate being used as the dependent variable has been disaggregated and standardized by age and sex as mentioned in Chapter 1. The purpose of disaggregation is to control for the effect of age and sex structure. In addition, on theoretical grounds, we expect different degrees of responsiveness to theoretical explanatory variables from individuals of different ages and sexes. For example, we expect that primary males will be less responsive to socio-economic factors than females or other secondary workers in terms of the decision to participate in the labor market. For a male, market work is the main part of his activity over the span of his adult life for biological and cultural reasons.[39] While, for the same reason, there are wider choices of activities for females; namely, market work, home

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[38]The terms "labor force" has been used in this study to relate only to the statistics produced through the decennial population census of Thailand. The definition and discussion of the labor force and the labor force concept is given in the Appendix A.

[39]See Jan L. Sadie, "Statement by the moderator: Demographic aspects of labor supply and employment," U.N., Department of Economic and Social Affairs, World Population Conference, 1965, Vol. 1 (New York, 1966), pp. 219-230. K. J. Penniment, "The influence of cultural and socio-economic factors on labor force participation rates," World Population Conference, 1965, Vol. IV, pp. 318-321; G. Bancroft, The American Labor Force: Its Growth and Changing Composition, pp. 21-22.

work, and leisure. Finally, the dependent variables disaggregated by age and sex are more useful in terms of manpower planning and development policy.

The General Model

From the preceding discussion and by refining equation (6), a general model can be set up as follows:

$$AR_i = f(YF_{ij}, w_{ij}, UN, IND, ED_{ij}, FZ_{ij}, PD; u_{ij}) \quad \ldots\ldots (7)$$

Where,

AR age specific activity rate, the propensity or the probability of an individual to participate in the labor market. Activity rate is defined as the ratio of the labor force to the population of the corresponding age and sex group multiplied by 100. It is assumed that activity rates will reflect, say, hours work per year, or a similar concept that closely approximates the supply-of-labor variable of economic theory (Cain, 19; Crandall, et al., 7).

YF family income, defined as the non-labor income of the family plus the maximum wage and salary earnings available to the family.

w market wage rate prevailing to the corresponding individual.

UN unemployment rate defined as the ratio of unemployed persons to the total labor force. It is considered to be measure of the probability of a worker not finding an

acceptable job offered at a given moment of time, cet. par.

ED educational status of the age-sex specific labor force.

IND level of industrialization and related economic structure.

PD population/resources ratio.

FZ family size of the corresponding age and sex group of the labor force.

u the stochastic disturbance term which implies the effect of factors not included in the model, such as working condition, prices of relevant commodities, technological change, and so forth. It also represents the sampling and measurement errors in the empirical study (Johnston, 5-6).

Where, i refers to age-group, 11-14, 15-19, 20-29, 30-39, 40-49, 50-59, and 60 and over, respectively; j refers to sex groups male, M, and female, F.

From this general model, first, since the direction of some of the effect of theoretical variables on AR_{ij} cannot be identified a priori, I will preliminarily state my hypotheses as follows:

(H-1) $\frac{\partial AR}{\partial YF} < 0$; if leisure is a normal goods or in Becker's terms, if time-intensive goods are not inferior goods. There should be no differences among various age and sex groups.

(H-2) $\frac{\partial AR}{\partial w} > 0$; if substitution effect of the wage increase is stronger than income effect;

< 0 ; if the income effect of the wage increase is stronger.

(H-3) $\frac{\partial AR}{\partial UN} > 0$; if the 'additional worker' effect is stronger. This is especially the case of secondary workers.[40]

< 0 ; if the 'discouraged worker' effect is stronger.

(H-4) $\frac{\partial AR}{\partial IND} < 0$; in the general case. However, in the case of females and other secondary workers the effect can be in the opposite direction; i.e., $\frac{\partial AR}{\partial IND} > 0$ (Sinha).

(H-5) $\frac{\partial AR}{\partial ED} > 0$; in general.[41] For females, based on Becker's analysis, the effect can be negative depending on the income-elasticity of demand for time-intensive commodities.

(H-6) $\frac{\partial AR}{\partial FZ} > 0$; in general.

(H-7) $\frac{\partial AR}{\partial PD} > 0$; for the secondary workers.

0 ; for the primary workers (male aged 20-59).

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[40] In this study, we may assume that males aged 11-19 and 60 and over, and female of all age-groups are secondary workers.

[41] For the youth (11-19), however, if the positive income effect has a feedback effect that make the young stay in school longer, then, the effect will be negative. But this could be expected only in the long run.

Some Comments About the Theoretical Model. First, it is also implicitly hypothesized that the labor force participation rate observed from primary workers (male aged 20-29), will be less sensitive to the socio-economic conditions as compared to secondary workers. "Primary workers, like the head of the family or single men aged 20 to 60, are firmly attached to the labor force over the short run, although they, of course, may move in and out of the status of employed or unemployed (Cain, 62)."

Second, in explaining human behavior, as in our case the decision to participate in the labor market, the list of relevant factors may be extended as long as one's imagination permits. Certain factors such as marital status, migration, health, savings, tastes of all family members, etc., are relevant to our model. Many of these factors, however, will not be quantifiable, and even if they are, it is not usually possible in practice to obtain data on them all. Even if one could do that, in terms of statistical evaluation, the number of factors would still be almost certain to exceed the feasible number of observations, so that no statistical means would exist for estimating their influence. Moreover, many variables may have very slight effect, so that even with substantial quantities of data, the statistical estimation of their influence would be difficult and uncertain. Furthermore, it is desirable to make the theory as simple as possible, taking into explicit account only the main causal factors.[42] Finally,

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[42]In our study, the determination on what are the "main" ones is based mainly on economic theory. Statistical techniques, especially stepwise-regression, can also be helpful but not without economic theoretical judgments.

the causal factors may be highly intercorrelated. Inclusion of a large number of explanatory variables in the model may increase the standard errors of the regression coefficients and tend to obscure the importance of explanatory variables in the equation.

The last but not least problem in our basic model is 'simultaneity bias' since it is clear that there exists joint dependency among activity rate, wage rate, and family income. However, although this is a theoretical problem, we shall postpone the discussion until the next Chapter.

CHAPTER IV

STATISTICAL METHODOLOGY

This Chapter presents the statistical estimation methodology and empirical results of the general model being discussed in the previous chapter. The discussion begins with the single linear equation model, statistical assumptions for ordinary least squares analysis, and the problem of 'simultaneity bias' in using a single equation model to estimate part of a simultaneous equations system.

Accordingly, a relatively simple econometric model of labor force participation in the form of a simultaneous equations system is constructed and estimated by the two-stage least square technique. Finally, the data that were used for the estimation will be briefly described.

The Single Linear Equation Model and Ordinary Least Squares Estimation Techniques

From the implicit function form in equation (7) (see Chapter 3, p. 45) we assume that the model can be linearly approximated. Accordingly, we may have a single linear equation model as follows:

$$AR_{ij} = b_0 + b_1 YF_{ij}, b_2 w_{ij} + b_3 UN + b_4 IND + b_5 ED_{ij} + b_6 FZ_{ij} + b_7 PD + u_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

There is one equation for each sex in each age group. Letting M stands for male and F represents female, we thus have 14 unique equations with the following dependent variables:

MAR11, MAR15, MAR 20, MAR 30, MAR 40, MAR 50 MAR 60 and

FAR11, FAR15, FAR 20, FAR 30, FAR 40, FAR 50 and FAR 60

for the corresponding age group 11-14, 15-19, 20-29, 30-39, 40-49, 50-59 and 60 and over, respectively. Most of the right-hand variables are common to all of the equations except for ED, the education variable.

If we ignore the fact that each equation is a part of a simultaneous equation system of four equations which we shall present next in this chapter, we can estimate the parameters of each equation using ordinary least squares (OLS) regression. The simplest set of assumptions about the generation of the observations for the OLS analysis would be the following:

(a) The error term is normally distributed random variable and independent of the exogeneous variables (Wonnacott, Wonnacott, 38).

(b) The expected value of the error term, u, is zero; i.e.,

$$E(U_i) = 0 \text{ for } i = 1, 2, \ldots\ldots\ldots n$$

Where, n is the number of observations,

(c) $$E(U_iU_j) = \begin{cases} 0 & \\ 6^2_u & \text{for } i = j;\ i, j = 1, 2, \ldots\ldots n. \end{cases}$$

The first part implies that various values of the error terms are uncorrelated to each other while the second part states that the variance of the error term is assumed to be constant with a finite variance 6^2_u.

(d) The exogeneous variables are fixed rather than random in repeated samples and has rank k less than number of coefficients to be estimated.

(e) No exact linear relation exist between any of the independent variables.

With the above assumptions granted, then the OLS technique will yield the best linear unbiased estimators of parameters in our model.[43]

In fact, some relaxation in the above assumptions can be made without undue complication of estimation techniques. For example, assumption (d) is not necessary if the joint distribution of exogeneous variables and the dependent variable is multivariate, that is, if the standard deviation of the distribution is stochastic but distributed independently of the error term, then the least squares estimators are the maximum-likelihood estimators of the regression parameters and has the properties of consistency, efficiency, minimum variance, and sufficiency (Johnston, 1963, 133; Wonnacott and Wonnacott, 38).

With regard to assumption (c), the constant variance of the error term, it is possible that with cros-section data the variance of the disturbance term may vary with one of the independent variables; the problem of so-called "heteroscedasticity." Even so, the OLS estimation of the regression coefficients will still be unbiased, but they will no longer be minimum variance estimators, and significance tests will be based on a biased estimator of the variance of the disturbance term (Johnston, 1963, 207-211). However, the use of the continuous dependent variables, as done in this study, instead of dichotomous dependent variables alleviates the problem of heteroscedasticity (Goldberger, 248-250; Bowen and Finegan, 1969, 644-648).

Violation of assumption (e) results in the problem of multicollinearity. However, examining of the correlation matrix of the independent

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[43]For desirable properties of estimators see (Wonnacott and Wonnacott, 40-47).

variables shows no severe correlations, so that this assumption is not violated.[44] Yet, this does not mean that there are no problems of multicollinearity. All variables may be pairwise independent and yet jointly dependent if one is a linear combination of two or more of the others. Several methods of detecting multicollinearity are available.[45] but solutions to this problem are still topics of research. Therefore, we shall assume the linear independency among exogeneous variables and keep the problem in mind.

Simultaneity Bias

A more serious problem for OLS regressions occurs when the single structural equation to be estimated is part of a system of simultaneous equations. We thus obtain 'simultaneity bias' because of correlation between the error term and the independent variables,[46] and hence assumption (a) is violated. The validity of the single equation model rests on the implicit assumption that the dependent variable is affected by the independent variables of the system but not the other way around. If this assumption is violated or when interrelations exists among the variables, the single equation specification with its one-way implied causality from 'predetermined' to one 'endogeneous,[47] variable

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[44]A personal discussion with Professor Moheb Ghali.

[45]See, for example, (Murphy, 373-387).

[46]For an example of how the error term is correlated to the independent variables, see (Wonnacott and Wonnacott, 158).

[47]For definitions of 'predetermined,' 'endogeneous,' and 'exogeneous' variables, see (Murphy, 16-18), (Wonnacott and Wonnacott, 155).

is not an accurate nor sufficient representation. In other words, if the error term is correlated with the exogeneous variables the OLS estimators will be biased and inconsistent (Wonnacott and Wonnacott, 38 and 152).

Moreover, if one or more exogeneous variables are dependent on the dependent variable, the use of a single-equation model cannot be justified by economic theory. A classic example is the case of the equilibrium of supply and demand for a given commodity. The problem of demand-supply identification occurs when the estimate is made from observed data which are equilibrium prices and quantities sold in the market. In this case, a regression line drawn through these coordinates of prices and quantities cannot be properly identified as a demand or supply curve unless some statistical adjustment has been done.[48]

As mentioned before our study is the study of labor supply. Thus, it is subject to the 'demand-supply identification' problem (Wonnacott and Wonnacott, 190; Murphy, 406). Moreover, assuming family utility maximization in our model, the joint dependency of activity rate, wages, and family income is perhaps obvious and is, therefore, a simultaneous equations estimation problem. As a consequence, the parameters of our general model are estimated by simultaneous equations techniques.

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[48]In fact, the nature of the theoretical model to be estimated itself implies that the parameters of a given equation cannot logically be inferred on the basis of empirical data alone. A priori information concerning the equation to be estimated as well as its relationship to the whole system of equations all of which hold simultaneously have to be obtained.

A Simultaneous Equations Model of Labor Force Participation

A simultaneous equations model is formulated consisting of four structural equations including an identity equation. Except for the identity equation, the following relationships are assumed to be approximately linear in parameters for male and female labor force in seven age groups:

(1) Labor Force Participation Rate Equation

$$AR_{ij} = b_{11} + b_{12}w_{ij} + b_{13}UN + b_{14}YF_{ij} + b_{15}ED_{ij} + b_{16}PD + b_{17}FZ_{ij} + b_{18}IND + u_1 \quad \ldots\ldots\ldots\ldots\ldots (9)$$

(2) Family Income Equation

$$YF_{ij} = b_{21} + b_{22}AR_{ij} + b_{23}ED_{ij} + b_{24}PD + b_{25}APL + b_{26}SXL + b_{27}RES + u_2 \quad \ldots\ldots\ldots\ldots\ldots (10)$$

(3) Labor Utilization Rate Equation

$$AR^d_{ij} = b_{31} + b_{32}w_{ij} + b_{33}ED_{ij} + b_{34}IND + b_{35}APL + u_3 \quad (11)$$

(4) Equilibrium (Identity)

$$AR_{ij} = AR^d_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Notation: All variables should have a subscript k which refers to area k; here, we drop these subscripts for simplicity.

i = age groups: 11-14, 15-19, 20-29, 30-39, 40-49, 50-59 and 60-69 respectively.

j = sex: male and female.

AR_{ij} = activity rate (labor force participation rate) of population of age group i sex j.

w = wage rate (average monthly earning per worker).

YF = family income (GDP_k/number of households) at 1962 constant price.

UN = unemployment rate (total number of open unemployed persons divided by total labor force).

ED_{ij} = average years of schooling of population of age group i and sex j.

PD = population density (total population/land ratio).

FZ = Family size (total population/number of private households).

IND = industrialization index (number of nonagricultural labor force/total labor force).

Y = GDP.

EM = number of employed workers.

APL = Y/EM = labor productivity (average GDP per employed worker).

AR^{d}_{ij} = rate of demand for labor by age and sex.

u_i = disturbance or stochastic terms.

SXL = sex ratio of the labor force (male labor force/female labor force).

RES = dummy variable representing region.

The model is composed of four structural equations: the labor force participation rate equation, the family income equation, the labor utilization rate equation, and finally, the model is completed by the identity whereby in equilibrium the labor force participation rate is equal to the rate of labor utilization. There are four endogeneous variables; namely, AR_{ij}, w_{ij}, and AR^{d}_{ij} and predetermined variables are UN, ED_{ij}, PD, IND, APL, SXL and RES. While the economic hypotheses underlying the labor force participation equation are the same as in

our general model (equation 7), the economic logic of the rest of the structural equations are as follows:

The family income equation states that the level of family income of an individual depends on the person's participation rate (AR_{ij}), his or her education (ED_{ij}), the average income per worker (APL), the population resource ratio (PD), the area sex ratio of the labor force, SXL, and the residence of the worker (RES).

The relationship between family income and the participation rate is straightforward; other things being constant, the more a person participates in the labor market the more income his family earns. We did not attempt to introduce directly the participation rates of other family members into our model for the mathematics of the model becomes cumbersome and make the analysis unnecessarily complicated. Instead, the sex ratio of the labor force, SXL, is being used as a proxy of the participation rates of other family members. The more male workers relative to female workers in a family, it is expected, the more family income can be produced. Obviously, this depends on our assumption that male laborers are more productive than female laborers for some cultural and biological reasons. Thus, the coefficient of this variable is expected to be positive. Education is also expected to bear a positive influence upon family income. In a real sense, education attainment of an individual can be interpreted as a stock of human capital as well as potential income of that person. Besides, we can assume that educational level as well as training is positively related to a

worker's quality and productivity.[49] The GDP per worker variable, APL, is interpreted as an index of average labor productivity, given the level of technology and capital. Therefore, the increase in labor productivity will increase a family's labor income, and hence, the family income. If we define the resource-endowment per capita by the amount of available resources divided by the total population, then PD, the population-resource ratio variable is, in fact, the reciprocal of the resource-endownment per capita. It is assumed that, cet. par., a family with a larger amount of resource-endownment per capita will have a higher family income. Thus, the expected sign of the coefficient PD should be negative. And finally, a dummy variable representing residence of the family, RES, is introduced to account for differences in geological and sociological background of the family.

Since the level of wages is also simultaneously determined by the demand for labor in a market economy, another structural equation has to be included in our model to capture the demand effect on wages. In this study the labor utilization rate equation is employed and interpreted in the same sense as the labor participation rate does for the labor supply equation. While the conventional labor demand equation is derived from a production function,[50] we simplify this complexity

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[49]For more detailed analysis of the positive effect of education on income, see, among others, (Becker, 1965; Hanoch, 1967; Schultz, 1968); Kwanchai Smith estimates that, for Thailand, an extra year of female education can raise individual income by 3.16 percent (Smith, 1971, 115).

[50]An example of the derivation of the demand for labor function from a production function of this type can be found in George E. Johnson, "The demand for Labor by Educational Category," Southern Economic Journal, 37, October, 1970, No. 2, pp. 190-203.

by stating the labor utilization rate as a function of wages, education, economic structure, and labor productivity. The relationship between the labor utilization rate and wages is based on the conventional demand theory where demand is inversely related to wages. As stated earlier, education indicates a worker's quality; hence, its relationship to the labor utilization rate is presumably positive. The average labor productivity variable APL is used in this equation to represent the effect of labor productivity in combination with a given stock of capital and technology, as well as to modify the effect of education. Industrialization index, IND, is assumed to be an indicator of the economic progress as well as the improvement in the labor market condition. Assuming the marginal product of agricultural workers is not negative (implying a positive demand for workers in the agricultural sector); increases in industrialization will increase the total demand for labor. Even when the above assumption is relaxed, IND will stimulate the rate of labor demand by increasing job opportunities bringing unemployed workers to contact with available jobs. The increased job opportunities would obviously require additional workers.[51]

Finally, our model is completed by the identity showing that in equilibrium the labor supply is equal to the demand for labor.

Estimation Technique

A number of consistent estimation techniques for simultaneous equations are available. One relatively simple technique with desirable

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[51]For a more detailed discussion of the logical reasons for including IND in the demand for labor equation see (Cain, 16-19).

properties is the two-stages least-square technique (TSLS).[52] This estimation method has been widely used in empirical work. The fundamental difficulty in our model, as we have discussed, is the correlation between the disturbance term u and the explanatory variables w and YF in the labor force participation equation (9). The objective of the TSLS is to make the explanatory endogeneous variables uncorrelated with the disturbance term,[53] such that the direct application of OLS to structural equations will result in consistent (and asymptotically unbiased) estimates. The method of TSLS is applicable only if the equation being estimated is either exactly identified or over-identified. A necessary condition for a structural equation to be identified is the order condition, which is that the number of predetermined variables, K, excluded from the equation must be at least as large as the number of endogeneous variables included in the equation, m, less one.[54]

In our key equation (9), the number of exogeneous variables excluded, three (APL, SXL and RES), is greater than the number of

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[52]J. Johnston, Econometric Methods (McGraw-Hill, 1963), pp. 223-234; Henry Thiel, Principles of Econometrics (John Wiley & Sons, Inc., 1971), pp. 451-458; TSLS is also the steadiest method in the presence of interdependence of predetermined variables and structural misspecification (Rao and Miller, 215).

[53]By making use of 'reduced form' equations, the explanatory variables involved in the correlation with u are expressed in terms of exogeneous instrumental variables which, by assumption, are not correlated with u.

[54]The sufficient condition called 'the rank condition of identifiability' must also be satisfied. The drawback of the rank condition is that one has to form a reduced form matrix and then examine the relevant submatrix. The process is somewhat tedious. Thus, in most of the cases the order condition is more widely used than the rank condition. Interested students may refer to (Goldberger, 306-314).

endogeneous variables, three (YF, w, AR), less one. So the equation is overidentified and can be estimated by TSLS.

At the first stage of TSLS, the classical least-squares will yield $\hat{w}_{ij}$, $\hat{YF}_{ij}$, and AR_{ij} from the reduced form equations. The implicit functions of the reduced form are:

$$\hat{w}_{ij} = f_1(UN, ED_{ij}, PD, FZ, IND, APL, SXL, RES; v_1). \quad (13)$$

$$\hat{YF}_{ij} = f_2(UN, ED_{ij}, PD, FZ, IND, APL, SXL, RES; v_2). \quad (14)$$

$$\hat{AR}_{ij} = AR^d_{ij} = f_3(UN, ED_{ij}, PD, FZ, IND, APL, SXL, RES; v_3) . \quad (15)$$

The second stage is to substitute $\hat{w}_{ij}$, $\hat{YF}_{ij}$ and $\hat{AR}_{ij}$ respectively into the structural equations and estimate for the second time by the classical least-square technique. The estimated structural parameters will then be consistent.

The Data

The variables that have been used in the TSLS estimation of the labor force participation are already mentioned in pages 45-46 and 55-56, and are listed in Table 5.1 while the basic variables used in calculations of the regression variables are given in Table 5.2. As mentioned in Chapter 1, pages 5-6, most of the variables are derived from cross-sectional data from the 1970 Population and Housing Census of Thailand. The 71 administrative units of Thailand (Changwads) will be the basic observations. Data on wage rates are obtained from the Department of Labor's Labor Statistics and Employment Market Information: April 1968, which is a survey covering 49 Changwads of Thailand. This is the best source available. The data provided in the average monthly pre-tax wage rate of persons working in the establishments, which employ five employees or more, for wages or salaries

Table 5.1

DEFINITION OF VARIABLES USED IN TSLS ESTIMATION OF LABOR FORCE PARTICIPATION RATE EQUATION

DEFINITION	BASIC DATA	SOURCE
Endogeneous Variables		
AR_{ij} = Age-sex Specific Activity Rate	$\frac{LF_{ij}}{N_{ij}} \times 100$	PHC
YF_{ij} = Family income, thousand of Bahts	$\frac{GDP}{HH}$	EST. (NESDB, PHC)
w = Average monthly wage rates, hundred of Bahts.		DOL
Exogeneous Variables		
a) Exogeneous Variables Included in the equation		
UN = open-unemployment rate	$\frac{LF - (EM-WFS)}{LF} \times 100$	PHC
ED_{ij} = education; age-sex specific average years of schooling	$\frac{\sum_{k=1}^{18} (YS_k \times N_{ijk})}{N_{ij}}$	PHC
FZ = family size; average number of population per private household.	$\frac{N}{HH}$	PHC
PD = population-reserve ratio; hundred persons per square kilometer of areable land	$\frac{N}{AL \times 100}$	PHC, NSO
IND = industrialization rate	$\frac{NALF}{LF} \times 100$	PHC
b) Exogeneous variables excluded from the equation		
APL = GDP per worker, thousands of Bahts	$\frac{\sum_{s=1}^{8} (\overline{GDP}_s \times EW_s)}{\sum_{s=1}^{8} EW_s}$	
	= GDP/EW	NESDB, PHC
SXL = sex ratio of the labor force	$\frac{MLF}{FLF}$	PHC
RES = region of residence; dummy variables	Central = 0 North-east = 1 North = 2 South = 3	

Note: PHC = 1970 Population and Housing Census of Thailand
NESDB = National Economic and Social Development Board of Thailand
DOL = Department of Labor, Thailand
NSO = National Statistical Office, Statistical Yearbook, Vol. 29, 1970-1971.
EST.= Estimated.

Table 5.2

Notation For Basic Variables

LF	=	labor force; economically active population age 11 to 69
LF_{ij}	=	age-sex specific labor force
N	=	population
HH	=	private households
EM	=	employed workers
WFS	=	workers waiting for farming season during the census date
NALF	=	nonagricultural labor force
MLF	=	male labor force
FLF	=	female labor force
GDP	=	gross demestic product of a province
YS_k	=	year of schooling to complete level-k education
AL	=	areable land in square kilometers

(excluding working proprietors, unpaid family workers, and administrative, executive and managerial workers). Given the inadequacy-of-data situation we used these data as our proxy for 'market wage rate.' The use of average monthly wage rates instead of hourly wage rates is legitimate for two major reasons. First, since our dependent variable is not in terms of hours worked, hourly wage rates do not serve our present purpose. Second, a substantial number of workers in Thailand are salaried and not hourly rated employees.

The family income variable used was mean gross provincial income (GPP), per private household. Data on gross provincial income from the National Economic and Social Development Board of Thailand are for only 15 provinces in the Northeast. Therefore, attempts have been made to estimate the GPP for the remaining provinces based on the available data on regional GDP by industry from the same source.

Let X_{ij} be the GDP per worker in the j^{th} industry in region i, $x_{ij}c$ stand for the GDP per worker in the j^{th} industry of province c in region i, $EM_{ij}c$ the number of employed workers in the corresponding industry, province, and region, and GPP_c be the gross domestic product of province c.

Assuming that $x_{ij}c = x_{ij}$, we have

$$GPP_c = \sum_{j=1}^{n} X_{ij}x \cdot EM_{ij}c \; ; \; N = 1, 2, \ldots\ldots 8,$$

Which could be estimated through the use of the available data on regional GDP per worker by industry.

Let HH_c be the number of private household in province c, we obtain the family income in province c, YF_c, as

$$YF_c = \frac{GPP_c}{HH_c}$$

(See Appendix D for a more detailed discussion.)

We have discussed in detail the problem of measuring the unemployment variable in Appendix D. It is concluded that the most appropriate variable to be used in our study is the open-unemployment rate which is defined as follows:

$$UN = \frac{(LF - EM - WFS)}{LF} \times 100$$

Where UN is the unemployment rate, LF stands for the number of economically active population aged 11 to 69, EM is the number of employed workers and WFS is the number of farm workers waiting for farm season.

The interpretation of unemployment rates used in this study has some limitations in that it does not include the effect of "disguised-unemployment." In fact, as was mentioned in a recent government report,[55] Thailand also experiences some level of disguised unemployment especially in the rural area and also in services and trade. But, unfortunately, according to the same source the existing survey and other statistical techniques are not adequate to measure such unemployment; hence, no reliable estimates exist for Thailand.[56] However, if we are concerned with the unemployment rate as being a measure of employment opportunities, the open-unemployment rate variable should serve the purpose since the disguised unemployed are, in fact,

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[55]The National Economic and Social Development Board, the National Statistical Office, and the Institute of Population Studies, The Population of Thailand, 1974, p. 43.

[56]Ibid.

"participants" with relatively low productivity.

The overall unemployment rate, rather than the age-sex specific unemployment rate was used for two reasons. First, our concern is to evaluate the impact of the labor market in general on various age and sex classes. Secondly, the age-sex specific unemployment rate may not be as relevant to a worker in a particular age-sex subset as the rate prevailing for other classes or the rate in general. For example, a wife may seek employment after her husband becomes unemployed, regardless of the unemployment rate for female in her age class.

In Appendix D, the variables listed in Table 5.1 including those that are not discussed here are reviewed as well as any adjustments that were made in the data.

Aggregate Data and Aggregation Problem. Since our cross-sectional data are aggregate in nature and the observations are in terms of administrative (provincial) units while the theory underlying the model deals with micro units, i.e., the households and individuals, we are subject to aggregation problems. The problem which is sometimes called the ecological problem in the sociological literature arises when the relationships computed between areas are interpreted as relationships between individuals. In 1950, W. S. Robinson pointed out that individual relationships inferred from area data may be seriously biased and he cautioned against their use (Cohen, Rea, and Lerman, 3). However, later a number of economists advocated the use of aggregate data (see, among others--Duncan; Goodman; Theil; and Wachter, 37). They maintained that first, under particular circumstances and/or if some

strong assumptions[57] were granted we can make inferences about individual behavior from aggregate data; second, if relationships computed among areas are interpreted as area relationships, then no aggregation problem is involved (Cohen, Rea, and Lerman, 3).

In our study, IND, PD, and UN are obviously area variables while the remaining explanatory variables (w, YF, ED, and FZ) can be interpreted within a close concept of area variables. For example, w is view as a proxy of market wages which faces individuals in general. Thus it could be considered a macrovariable as well as a microvariable.[58] Average family income can also be interpreted as an area variable representing an average long-run income level of a family in a given area.[59] How valid such an assumption is is open to question. ED should be interpreted in terms of the expectation of an individual worker in an age-sex specific cohort to have a certain level of education, while FZ should also be interpreted in the sense (see Theil, 1973, 573).

In conclusion, first, we would like to emphasize here that the results from aggregate data do not exactly depict the results of a

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[57]See, for example, (Theil, 1973, 556-562; Goodman, 664).

[58]"Microvariables" are variables of equations postulated by theory of individual households (the microtheory); "macrovariables" are variables postulated by macrotheory. "Macrovariables" in general are certain functions of the microvariables (Theil, 1954, 2).

[59]Cain (1966, 19) has argued in favor of the use of areal-average family income such as ours that it represents an income concept relatively free of transitory or error components and closer to a 'permanent' or 'normal' income concept. Therefore, it is a long-run concept of income and appropriate to assessment of the income effect overtime. (See also Cain and Weininger, 1973, 209.)

single individual.[60] Therefore, variables in our study should be interpreted in terms of areal relationships using areas as observation units.[61] Further, an additional advantage of using aggregate data should be mentioned. It has been argued that since tastes variation which is wide among individuals but may be nearly unvarying across areal averages, the use of aggregate data allows the suppression of this variable, tastes for market work, from the model (Cain, 1966, 19; Cain and Weininger, 208).

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[60]For an example of how the conclusion drawn from aggregate data can be different from the conclusion drawn from microdata, see (King, 54-55); for an extensive statistical discussion over aggregation theory, see (Theil, 1954; __, 1973, 556-569; Gupta, 1969).

[61]Wachter has pointed out that "the aggregation biases are of less importance if implications about aggregate participation behavior instead of individual participation or hours behavior are made (Wachter, 37)."

CHAPTER V

EMPIRICAL RESULTS

In this chapter the simultaneous equation model of labor force participation formulated in the preceding discussion has been estimated by the TSLS technique. The estimation and discussion is limited to the Labor Force Participation Rate Equation. Considering the test statistics, since the distribution of structural-form estimators based on a small finite sample is not known, no precise statistical statements about the test statistics can be made. It is merely assumed in the discussion below that a coefficient is different from zero if the absolute value of the coefficient estimate is more than twice the size of the estimate of its approximate standard error. In other words, in the discussion below a coefficient estimate will be said to be significant if the absolute value of its t-statistics is greater than two. A variable will be said to be significant if its coefficient estimate is significant.[62]

For each estimated equation of an age and sex specific participation rate, the coefficient estimates are presented with the absolute values of their t-statistics in parenthesis underneath. The standard error of the regression (S.E.) and $\bar{R}^2$ are also presented. The $\bar{R}$-squared should be regarded as a measure of percentage correlation between

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[62]From a personal discussion with Prof. Moheb Ghali.

the observed and predicted estimates of the dependent variable.[63]

The data for the estimate are cross-sectionally aggregate using 71 provinces of Thailand in 1970 as observation units. The demographic data derived from the PHC have been adjusted for the unknown age group. Table 13, Appendix D, gives mean value, standard deviation, and the extreme values of each variable used in the regression.

Since the data on wage rates are available for only 49 provinces, in the first stage the reduced form of $\hat{w}$ is estimated based on 49 observations. Then, for the second stage or the structural equation regression, $\hat{w}$ has been predicted based on the information from the reduced form for the remaining 22 provinces under the assumption that the coefficients of the observed variables are the true values. See Table 14, Appendix E, for the reduced form equations for $\hat{w}$.

The estimated structural equations of age-sex specific activity rates are given in Table 6 below. The theory underlying the model that was stated in Chapter 3 relates age-sex specific participation rates to family income, wage rate, unemployment rate, educational status, industrialization, family size and population density. The list of variables and definitions is given in Table 5.

Family Income and Wage Variables

The coefficients of both income and wage variables are in general consistent with the hypothesis specified by the model. The effect of

[63]Murphy has pointed out that "In particular, the coefficient of determination, R^2, is frequently given as a summary statistics only. It is not useful for making specific confidence statements since its sampling characteristics are unknown in the simultaneous equations case." (Murphy, 492.)

TABLE 6

SIMULTANEOUS EQUATION ESTIMATE OF

LABOR FORCE PARTICIPATION RATE EQUATION

DEPENDENT VARIABLE	ED_{ij}	UN	IND	FZ	PD	w	YF	CONSTANT	$\bar{R}^2$/S.E.	(F. ratio)
MAR 11	5.4838	-0.0791	0.5975	10.6883	-0.5838	0.9470	-2.6324	-8.8480	0.8101	43.6658
	(2.0175)	(-0.0453)	(2.3001)	(4.7155)	(-1.8066)	(0.2732)	(-5.0599)	(-0.4736)	(5.8246)	
MAR 15	-1.3883	-1.6750	0.4419	8.1468	-0.5729	-3.2767	-1.1563	74.3760	0.7452	30.2408
	(-0.5347)	(-1.1375)	(1.9519)	(4.4919)	(-2.2827)	(-0.9967)	(-2.7487)	(4.9242)	(4.8653)	
MAR 20	-0.4023	-1.1172	-0.0394	0.9853	0.0936	-2.7809	0.1681	104.5826	0.4594	9.4969
	(-0.4166)	(-1.6468)	(-0.3797)	(1.0581)	(0.8650)	(-1.9147)	(0.8211)	(13.3400)	(2.2946)	
MAR 30	-0.1868	-0.7648	-0.1097	-0.1290	0.1812	-0.4928	0.1668	100.4765	0.2398	4.1546
	(-0.2758)	(-1.4291)	(-1.3148)	(-0.1565)	(2.1367)	(-0.4561)	(0.9766)	(14.8164)	(1.7906)	
MAR 40	0.6669	-0.5602	-0.1789	-0.7668	0.1817	-0.9074	0.2836	103.1838	0.4992	10.9688
	(1.4386)	(-1.5118)	(-3.5316)	(-1.3002)	(3.6782)	(-1.4335)	(2.9170)	(21.2852)	(1.2412)	
MAR 50	1.5443	-0.5284	-0.3088	-1.2638	0.0959	-1.3086	0.5288	101.2019	0.6943	23.7108
	(2.7618)	(-2.0768)	(-5.0515)	(-1.7763)	(1.6089)	(-1.7137)	(4.5081)	(17.3051)	(1.4974)	
MAR 60	2.1679	-3.3365	-0.6144	0.1823	-0.2007	-0.9890	1.3907	51.0711	0.5193	11.8034
	(1.2661)	(-2.4373)	(-3.2819)	(0.0836)	(-1.0998)	(-0.4229)	(3.8714)	(2.8518)	(4.5853)	
FAR 11	7.6527	1.1701	0.8271	8.7998	-0.9935	7.2106	-3.9343	-19.1318	0.8510	58.1268
	(2.8628)	(0.6518)	(3.2785)	(3.7197)	(-3.2889)	(2.1819)	(-7.8554)	(-1.0084)	(5.9899)	
FAR 15	-1.3932	-1.0748	0.9530	6.7449	-1.2207	10.4462	-3.7922	34.1180	0.9069	98.4669
	(-0.8818)	(-0.8947)	(5.6983)	(4.3184)	(-6.7615)	(4.7116)	(-11.7363)	(2.6834)	(3.9942)	
FAR 20	2.8656	-2.9449	0.3775	1.6549	-0.4400	4.9370	-2.2377	64.5593	0.8118	44.1452
	(2.0674)	(-1.9772)	(1.8048)	(0.8217)	(-2.2010)	(3.1780)	(-6.3384)	(4.5434)	(5.0044)	
FAR 30	2.7403	-4.9641	0.3250	-0.5843	-0.3725	4.4907	-1.8207	79.8728	0.7958	39.9846
	(2.0276)	(-3.2642)	(1.4567)	(-0.2726)	(-1.7716)	(2.8008)	(-4.6722)	(5.2938)	(5.1328)	
FAR 40	-8.5706	-8.0593	0.7159	6.9153	-0.8889	16.9172	-2.9236	-1.7686	0.8903	82.1698
	(-3.7513)	(-7.1624)	(4.4685)	(3.8369)	(-6.2121)	(8.7770)	(-9.2266)	(-0.1161)	(3.5667)	
FAR 50	-8.1324	-8.3834	0.6353	6.2536	-1.4073	19.1329	-2.6636	-20.8904	0.8491	57.2641
	(-2.9000)	(-6.0701)	(3.2310)	(2.8269)	(-8.0128)	(8.0874)	(-6.8488)	(-1.1170)	(4.3778)	
FAR 60	-4.2022	-7.1583	0.2571	5.2822	-0.9207	12.2086	-0.9522	-43.0625	0.6555	20.0287
	(-1.5334)	(-5.3036)	(1.3379)	(2.4433)	(-5.3644)	(5.2807)	(-2.5052)	(-2.3562)	(4.2781)	

NOTE: a) The numbers in parentheses below each coefficient are the coefficient/standard error ratios.

b) For notations and units see Table 5.1.

wage variable is negative but as expected it is not significant for males of various age groups while it is positive and significant for females of every age groups. The result agrees well with the common acception that the labor force participation rate of primary workers (males) is less sensitive to market factors as compared to the secondary workers (females, youngsters, and the aged) (Fair, 1971, 102-103; Wachter, 40). The coefficients of wage rates for secondary males aged, 11-14, 15-19, and 60 and over are not significantly different from zero; thus, we cannot draw a meaningful conclusion on the wage effect on these groups of workers.

The significant positive wage coefficient of female rates of participation indicate strong substitution effects, since in our model these wage coefficients are interpreted as pure substitution effects.[64] Consider the simplified linear, additive model employed in this study. Let b represent the income effect and c the substitution effect of wage rates. Family income YF, is equal to the sum of income of other family members and unearned income, Yo, and an individual i's earnings.

$$YF = Y_o + L_i W_i$$

Where L_i is the equilibrium time spent at work by the individual i, and w_i is his (her) wage rate. Stripped of other variables and the error term, we have the participation rate, AR, determined by:

$$\begin{aligned} AR_i &= a + bYF_i + cW_i, \\ &= a + b(Y_o + L_i W_i) + cW_i, \\ &= a + bY_o + bL_i W_i + cW_i. \end{aligned}$$

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[64]The foregoing derivation is drawn freely from Cain and Weininger's study: See (Cain and Weininger, 216).

Holding Y_o and L_iW_i constant, c is the pure substitution effects or the compensated wage effect.

The strong substitution effects of wages on female participation rates is consistent with theoretical expectation. Generally, the substitution effect for women is supposed to be stronger and larger compared to men because, as Cain pointed out, women (especially housewives) have a wider choice of time allocation among market work, leisure, and housework while for men their choices of time allocation seem to be limited to market work and leisure (Cain, 6-7).

Quantitatively speaking, we can interpret the result of the wage effect on female labor force participation rate as follows. A $100 increase in monthly wage rates will increase the participation rate of females aged 11-14 by 7.2 percent, females aged 15-19 by 10.4 percent, females aged 20-29 by 4.9 percent, females aged 30-39 by 4.5 percent, females aged 40-49 by 16.9 percent, females aged 50-59 by 19.1 percent and females aged 60 and over by 12.2 percent. The average wage elasticity (computed at the means) as presented in Table 7 for women aged 11 to 39 is less than unity while for women aged 40 to 60 and over are greater than unity, indicating that the supply of labor of the latter groups of females are elastic and more sensitive to wage changes than the former. The elasticities for men of different age groups are also presented in Table 7 but they are obviously less meaningful since they were computed from insignificant wage coefficients.

The effects of family income are generally weak (insignificant) for males aged 20-29 and 30-39 while they are significant for the rest of males and for females in every age group. This more or less confirms

Table 7

The Average Elasticity of Labor Force Participation Rate With Respect to Family Income, Wage Rates, Unemployment Rate, Education Level, Industrialization, Family Size, and Population Density

Dependent Variable	Explanatory Variable						
	YF	w	UN	ED	IND	FZ	PD
Male							
MAR11	-1.09	(0.14)	(-0.003)	0.49	0.29	1.45	(-0.06)
MAR15	-0.26	(-0.25)	(-0.029)	(-0.08	0.12	0.59	-0.03
MAR20	(0.03)	-0.18	(-0.017)	(-0.02)	(-0.01)	(0.06)	(0.01)
MAR30	(0.03)	(-0.03)	(-0.011)	(-0.01)	(-0.02)	(-0.01)	0.01
MAR40	0.05	(-0.06)	(-0.008)	(-.02)	-0.59	(-0.05)	0.01
MAR50	0.10	(-0.09)	-0.014	0.04	-0.07	(-0.08)	(0.01)
MAR60	0.42	(-0.11)	-0.080	(0.10)	-0.22	(0.02)	(-0.02)
Female							
FAR11	-1.41	0.90	(0.033)	0.58	0.35	1.03	-0.09
FAR15	-0.86	0.83	(-0.019)	(-0.08)	0.26	0.50	-0.07
FAR20	-0.50	0.83	0.052	0.14	(0.10)	(0.12)	-0.03
FAR30	-0.41	0.35	-0.087	0.11	(0.09)	(-0.04)	(-0.02)
FAR40	-0.65	1.30	-0.140	-0.13	0.19	0.50	-0.05
FAR50	-0.66	1.65	-0.045	-0.14	0.19	0.51	-0.09
FAR60	-0.53	2.38	-0.317	(-0.16)	(0.17)	0.97	-0.14

Note: (1) Parentheses indicates that the elasticity is computed from the insignificant coefficient.

(2) The elasticity is computed at the mean (from the regression results in Table 6 and the mean values of explanatory variables in Table 1, Appendix D) as follows:

$$E_{X_{ij}} = b_X \left(\bar{X} / \overline{AR}_{ij}\right)$$

where X refers to explanatory variable X, b_X is the coefficient of X, and ij refers to the age-sex group.

the implicit hypothesis that males of prime ages are invariant to economic factors such as wage rates and family income while females and other secondary workers are quite responsive to such factors.

The coefficients of the family income are negative and insignificant for females of all ages and for young males (aged 11-19). This indicates the existence of strong impact of family income on seconary workers; that is, if the family income is high the secondary workers will participate less in the labor market and vice versa. Furthermore, the negative effect of family income together with the positive wage-effect implies the possibility of backward bending supply curve of secondary workers to the extent that at a higher wage and a consequently higher family income, all else being constant, a secondary worker would wish to buy more leisure and/or allocate more time for housework (see page 24). So, as the increase in wage rates motivate secondary workers to participate more in the labor market the increase in family income would work in the opposite direction. The average income and wage elasticities in Table 9 show that women aged 11 to 39 have stronger income effects than substitution effects while the opposite is true for women aged 40 to 60 and over.[65] Since these female workers are roughly in child-bearing ages, our finding coincides with Cain's view that the presence of young children results in a stronger income effect relative to wage effect for women of child-bearing ages. Cain pointed out that "market work is not a good substitute for the homework of a

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[65]The outweighting income effect over the substitution effect of females aged 11 to 29 confirmed the "backward bending supply curve" hypothesis. (Porath, 698)

mother of young children, and this implies that the market labor supply curve of the mother would be inelastic with respect to wage rate. Further, although a low family income might compel the mother to work, moderate increases in income would induce her to leave the labor force and remain at home (Cain, 91)." The income elasticity for the extremely young men and women (aged 11-14) is quite large, -1.09 and -1.41 respectively, compared to other groups of workers, suggesting that the time allocation of the young members of a family depends much on how well their family is doing in terms of income.

The positive income effects of males aged 40 to 60 and over should be noted. If the analysis were based solely on the Hicksian income effect-substitution effect apparatus, then the positive effect of income would imply that leisure is inferior goods for this group of workers; i.e., as income increases they will buy less leisure and hence increase the market labor activity. Instead, by applying Becker's hypothesis we can explain that for these groups of workers the increase in family income leads to more consumption of commodity-intensive goods if the income elasticity of demand for such goods is greater than 1. Consequently, less of time-intensive goods, namely leisure, will be consumed. The demonstration effect and the nature of 'consumer-economy' prevailing in a less developed economy should justify this argument.

Becker also offered another dimension of explanation by the distinction between working and consumption productivity and differences between cross-sectional and time series data. In the cross-sectional data, he argued, persons distinguished by money incomes or earnings differ more in working than consumption productivity because they are

essentially distinguished by the former. These productivities in principle are neutral in the case of time-series because persons are distinguished there by calendar time. Hence, the substitution effect towards work is likely to be greater in cross-sectional analysis. This would help explain why the coefficients of family income can be positive for men (Becker, 507). This also indicates that the substitution effect for men is not weak.

The above explanation of the positive elasticity for the over-40 MAR with respect to income would seem to apply even more strongly to males under 40. We found that an even more simple explanation could come from the health factor. On the assumption that health is positively related to average household income and labor force participation among older people is positively related to health, there should be a positive relationship between average household income and the labor force participation rate of older men.

Unemployment Variable

The unemployment variable has been used as an index of employment opportunities in an area. The basic hypotheses underlying the use of this variable emerged from the "discouraged workers" hypothesis and the 'added worker' hypothesis which imply the negative and positive effect on the labor force participation rates respectively. It is interesting that whereas theoretical considerations indicated both a positive and a negative effect, the empirical finding shows that the negative effect tends to predominate. The coefficients of this variable were found to be negative in every age and sex group except for young women aged 11 to 14 whose coefficient is, however, insignificant statistically. The negative coefficients of the unemployment rate are statistically

significant among old men aged 50 to 59 and 60 and over, women aged 20 and up. This shows that the 'discouraged worker effect' is more powerful than the 'added worker effect' for these secondary workers. This result in general does not confirm our expectation concerning the effect of unemployment on the participation rate of secondary workers. However, we have found it is in line with the earlier findings of Bowen and Finegan (1965), Cain (1966, 84), and King (98). Their similar studies for the U.S. labor market consistently suggested that the discouraged worker effect predominates.

However, this net negative effect for secondary workers may come from a problem of measurement. That is, the category of secondary workers, which is imprecisely and roughly defined in our study as males aged 11-19 and 60 and over, and females of all age groups, might have covered a considerable number of primary workers such as single women and other independent workers.[66] As a result, the discouragement effect of primary workers might have outweighed the added-worker effect of secondary workers. To examine this more closely, we need data on labor force by age group and by marital and family status, or microdata covering such information which unfortunately are not available.

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[66]The primary labor force consists of the persons who are normally in the labor market usually as full-time workers. Heads of faimilies and unrelated individuals (that is, single, divorced, or widowed people) who have no other significant source of income are normally members of the primary labor force. They may be full-time or part-time workers depending on the degree of pressure from financial commitments and on the availability of suitable opportunities. (Williams, 35.)

However, to give some rough idea we have presented in Table 8 the approximate age-specific participation rates of married women who constitute the major part of secondary workers. In column (2) and (3) the percentages are computed using the corresponding age-specific female population as bases.

From Table 8, except for the first three age groups, the participation rates of married women are pronounced in the female participation rates. This indicates that in age groups 30-39, 40-49, 50 and over secondary workers; i.e., married women, comprise the major part of female participants. Consequently, we can reject the possibility of the problem of definition especially for the females in the age groups mentioned above. Therefore, our conclusion would be the same--that is, even among the secondary workers the discouragement effect tends to predominate.

Table 6 shows that a one percent increase in the open unemployment rate, other things being equal, causes a decline in participation rates of women aged 20-29 by 2.9 percent, women aged 30-39 by 4.9 prcent, and women aged 40 and over by more than 7 percent. However, in terms of elasticity as shown in Table 7, the (females) labor force is generally less sensitive to the unemployment rate as compared to family income and wage elasticities. In every age and sex group, the estimated elasticity of labor force participation to unemployment is less than unity.

In fact, the unemployment elasticity of participation rates are quite small in every case. Men of old ages (60 and over) are workers

Table 8

The Approximate Age-Specific Participation Rate of Married Women, 1970 (in Percentages of the Corresponding Age-Specific Female Population)

Age Group	Married Women with Husband Present	Homemakers (females, not in Labor force)	Participation Rate of Married Women	Female Labor Force Participation Rate
(1)	(2)	(3)	(4)=(2)-(3)	(5)
11-14	0.53	4.00	(-3.47)[a]	50.9
15-10	9.89	10.41	(-0.52)[a]	77.2
20-29	49.92	17.51	32.41	78.7
30-39	79.03	14.43	60.60	79.4
40-49	77.81	17.17	60.64	80.0
50-59	65.02	18.71	46.31	70.3
60	38.95	9.90	29.05	30.5

[a]In this age group, the percentage of homemakers exceeds the one of the married women implying not only that most of the married women in this age group are not in the labor force but also that housework is readily shared by a considerable number of single women in this age group.

Source: (2) Table 5, 1970 Population and Housing Census of Thailand

(3) Table 16, ibid.

(5) Table 3 of this study

with highest negative elasticity[67] of -0.3 which can imply that either their discouragement effect is relatively strong or the added worker effect is relatively weak. This, of course, points out a limitation of the study in using aggregate data in that we cannot separate the discouragement effect from the added worker effect (Cohen, Rea, and Leman, 3). Thus, the empirical result can give us only the notion of one effect is stronger, not the magnitude of each separate effect, thus give rise to some difficulties in interpretation.

Education Variable

The relationship between educational attainment, measured by the average years of school completed, and the labor force participation rate is purely empirical. As discussed in Chapter 3, educational status of the labor force is a proxy for labor's taste for market work, productivity, level of investment in human capital and expected earnings or long-run income, and the access to the labor market information. The discussion, however, leads to the conclusion that the effect of education on labor force participation rates could be positive in general and negative for females.

But, as can be seen from Table 7, the coefficient of the variable is significant and positive for young workers (males and females aged 11-14), males aged 50 to 59, females aged 20-29 and 30-39 while it is negative and significant for females aged 40 to 49, and 50 to 59.

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[67]As found by (Cohen, Rea, and Lerman, 146), participation of older men is more responsive to differences in employment conditions, compared to prime-age males. This is so, if employment opportunities of older men, as of other less desired workers, are more sensitive to area labor market tightness than are those of prime-age men.

For prime-aged males (aged 20 to 29), the coefficients are not significant. The result in general shows some irregularity of the effect of education on the labor force participation rates of population of various age and sex groups.

Education has a relatively large positive effect on labor supply of the extremely young age groups for both sexes while it has a very large negative effect on labor supply of women in the late child-bearing age (40-49) and in the early old age (50-59). A milder positive effect of education on labor supply occurs in the females of child-bearing ages (20-39) indicating that for these women the increase in home productivity resulting from better education attainment leads to a less-than-unity income-elasticity of demand for time-intensive goods. Consequently, their time is reallocated away from household work and toward market work (see pages 37-38).

In the case of youth, the positive education effect implies that since higher level of education means higher expected earnings, the substitution effect from a higher expected wage rate dominates over the income effect. As a result a young individual will allocate time away from the home sector and leisure to the market sector. The strong effect compared to other groups may be due to the measurement problem of education used in this study. The average years of schooling does not include a person's years of experience on the job. Hence, our education variable tends to undercapture the full effect of education for the older age groups who clearly spend more time on the job than the young.

The significant positive coefficients of educational attainment are consistent with our general expectation and consistent with the findings of other studies,[68] the cases for which this variable had a negative and significant sign, or where it was not significant, might still be consistent with the theory, provided there exists a strong permanent income effect that outweighs, or "neutralizes" the expected wage rate effect, the access to employment effect, and the taste for market work effect, which in theory operate to direct the coefficient in a positive direction. In our study, the negative effect of income which is found significant in women aged 40 to 59 results from the increased consumption of leisure and their time is reallocated away from market work as their permanent income increases.

Finally, we would like to remark that the effect of the education variable should be interpreted with caution since there exists a problem of measurement. The average years of schooling is only a "crude" measure of educational effect and investment in human capital in the sense that (a) it reflects only a particular type of formal training, excluding on-the-job training, supplementary vocational training and adult education courses, (b) there are differences in the quality of education offered in different schools, (c) differing curricula of schools of equal quality may not prepare students equally for a certain job, and (d) the variable does not take account of obsolescence in human capital which in most cases happens among the old age groups.

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[68]For example (Bowen and Finegan, 1966; Cain, 1966; Mincer, 1962; Cohen, Rea and Lerman, 1970, 49, 79, 147).

The responsiveness of participation rates to education for every age group is relatively inelastic, as seen in Table 7. The highest (positive) elasticity is found among young women and young men, 0.58 and 0.49 respectively. One possible reason for the relative inelasticity is that the effect of education involves a variation over time of such factors as expected income and wage rates, tastes, and human capital accumulation. Specifically, educational attainment is a time-consuming process of human capital accumulation of which the effect could be realized only over a long period of time. This is partly the reason why the participation rates among the young are more elastic compared to those of the adults and the aged. Their life span and hence their expected income are greater.

As Cohen, Rea, and Lerman (43) put it, educational attainment also has a large impact on the ease with which a person obtains a job. This is because education reflects ability and motivation and is used as a screening device by most employers. This role of education seems to affect the young more than those in older age brackets who already have jobs and who have gained experiences by years of practice.

Industrialization Variables

The rationale for including this variable in our model is partly an empirical one. In a few cross-sectional analysis, variations in industrialization level among areas are found to be associated with participation rates (see page 32 and also (Cain, 16, 17)). Economic theory explains that this variable causes indirect effects on participation rates by way of reallocations of labor and capital in accordance with changes in aggregate demand and comparative advantage

and changes in unemployment, real income, wages and prices, industrial composition, techniques of production, and educational standards. The detailed argument is already discussed in pages 32 to 36. In summary, we apply this variable to capture the effect of difference in economic structure[69] and occupational composition among areas. To get a measure of this factor a variable, IND, was defined as the percent of nonagricultural labor force in the total labor force. We hypothesized that IND should have a positive relation to the participation rates of secondary workers.

The results, although not very impressive are consistent with our expectations. For prime aged males (aged 20-49), the coefficients of industrialization are negative throughout even though it is not significant in the 20-39 age groups. The coefficients of this variable are positive for young workers (aged 11 to 19) of both sexes and for women in every age group. However, the industrialization effect is not significant for women aged 20-29, 30-39, and 60 and over. For the older males (aged 50-59 and 60 and over) the coefficients are negative and significant implying that industrialization results in earlier retirement of these aged workers.

We can see that industrialization also modifies the effect of education by increasing the labor supplied by young workers and women over time. Long, for example, argued that the increase in the general level of education in the course of industrialization means that younger people had a higher level of education than older people. The

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[69]This includes urbanization. The effect of this factor, however, is not explicitly discussed in this study.

effect of this educational difference was that young workers are hired to replace older men. Long also argued that a shift in the businesses' demand for women occurred because women are both more educated and cheaper than the older men they replace.[70] Our empirical result seems to fit well with Long's argument at first glance. However, the positive effect of industrialization on the young especially males aged 11-14 and 15 to 19 should be interpreted with care. As discussed earlier (in pages 34, 35), industrialization appears to be accompanied by a rise in the average age at which young persons enter the labor force which implies a negative relation between IND and participation rates of young population. Yet, the positive sign of IND indicates that industrialized economic structure is in favor of young workers while it does not raise the average age at which the young enter the labor force. Support for this can be found from time series data presented in Table 3, page 13, which shows that the age-specific participation rate of young workers have increased between 1960 and 1970.[71] Relying on our empirical result we conclude that industrialization increases opportunities of employment of young workers while supply of education is more or less short of keeping pace with the process of industrialization,[72] and hence unable to keep the young in school.

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[70](Long, 1958) cited by M. Bidwell, The Family Labor Supply Decision: A Trade Model, unpublished Ph.D. dissertation, Columbia University, 1973, p. 92.

[71]Of course, many factors have been operating at the same time but the net effect of those factors which can be claimed being associated with changing economic structure gives rise to the increase in age specific activity rates of young workers.

[72]See footnote (22), page 36.

Quantitatively, the coefficients in Table 6 show that an increase in one percentage point of industrialization rate will result in only 0.6 percentage point increase in participation rates of young males (aged 11-14), 0.44 for young males aged 15-19, 0.8 for young women aged 11-14, and 0.95 for young women aged 15-19. A one-percentage-point increase in industrialization also causes a decrease in activity rates of males aged 40-49 by 0.18 percentage points, males aged 50-59 by 0.31 percentage points, and males aged 60 and over by 0.61 percentage points. For females aged 40-49 and 50-59 the same effect leads to a decline in their activity rates by 0.72 and 0.64 percentage points respectively. The industrialization-elasticity of labor supply as shown in Table 7 never exceeds unity for any age and sex group.

Family Size Variable

The family size variable has been used to capture the effect of an extended family, a demographic factor, on participation rates of an individual cohort. The importance of the 'size of family' variable in a developing socioeconomic structure is made explicit in the contention that a greater prevalence of extended families and kinship allow the possibility of 'economies of scale' and allow family members to participate more in the labor market as their housework and babysitting are readily shared by the other family members. Moreover, family members of working age as well as the head of the household are more likely to work because of the added responsibility for their dependents. The hypothesis is that in a developing country a member of a larger extended family tends to participate more in the labor market than the one of a smaller family.

The coefficients of this variable are consistent with our hypothesis being positive and significant for the participation rates of seven age-sex specific groups; namely, young males and females aged 11-14 and aged 15-19, middle age women (aged 40-49), and old women (aged 50-59 and 60 and over). For the remaining population their coefficients are difficult to interpret as they are not statistically significant. Young men, according to the result, are more responsive than young women to the size of family. We speculate that this is due to some biological and cultural reasons; women are much more expert than men in house-keeping and babysitting, so their chances of working at home are greater than men's. The measurement in terms of elasticity shows that labor supply of the extremely young workers of both sexes are elastic and most elastic compared to other workers' with respect to family size. Their family size elasticities are 1.45 for men aged 11-14 and 1.03 for women aged 11-14 respectively. The lowest family-size elasticities belong to those female workers aged 15-19 and aged 40-49 who have the same elasticity of 0.5

Population Density Variable

According to prior discussions in pages 41-43, the population size relative to land and other resources, on the average is expected to yield a negative effect on participation rates of secondary workers; namely, the young and females and a positive effect on primary workers or prime-age males. Our empirical finding is consistent with this hypothesis. The coefficients of the population density variable are found to be negative for all women, the young, and the old. And it is

positive for males aged 20 to 59. The coefficients are significant for the following nine age and sex specific groups: males, aged 15-19, 30-39, 40-49, and females aged 11-14, 15-19, 20-29, 40-49, 50-59, and 60 and over.

The result confirms Mincer's hypothesis that, holding other variables constant, the increase in population size can effectively block entry to jobs for many of the disadvantaged or secondary workers while it enhances a relative advantage of the primary workers. In addition, our empirical finding also reflects the negative effect of population pressure upon land resources on the participation rates of secondary workers. However, these effects, in terms of elasticity are quite small, ranging from -0.14 (for women aged 60 and over) to 0.01 (for males aged 30-49).

Explanatory Power of the Equations

By looking at the adjusted $\bar{R}^2$ in Table 6 as summary statistics, we note that the small $\bar{R}^2$ for prime-age males (aged 20-49) are consistent with our implicit hypothesis that the participation rates of these groups of population are less sensitive to the variation in socio-economic variables, compared to the other groups of population. For males aged 20-29, the t-statistics indicate that their participation rates only respond to wage rates. For the next group of males aged 30-39 the response to wage rates become insignificant but their relative advantage due to the size of population variable is now significant although this effect is relatively weak. The prime-age men of 40-49 years of age are more responsive to the socioeconomic variables whose

effects are significant for population density industrialization, and family income. Upon entering an older age (50-59 and 60 and over), males' labor force participation rates are affected more by employment opportunities as represented by the unemployment variable. The analysis u to now clearly though indirectly indicates that the responsiveness of males' labor supply differs by age. It is almost invariant to socioeconomic variations during prime ages and become more responsive when men grew older.

Women, like young and old men, have participation rates that are more responsive to the socioeconomic variables in question than prime-age males. The $\bar{R}^2$ for each equation is relatively high ranging from 0.66 to 0.91. Noticeably, for women aged 40-49 and 50-59, the coefficients are impressively significant for every variable. The coefficients of employment variable are not statistically significant for females aged 11 to 29, otherwise they are highly significant, implying that the added worker effect might balance the discouragement effect for young women or vice versa. For women of all ages, the sign of wage rates and family income coefficients are very consistent and significant throughout. Finally, in the near-retirement age (60 and over), female participation rates are found to be responsive to employment opportunities (unemployment rates), family size, population density, wage rates, and family income.

In general we found that the model is impressively effective in explaining the behavior of the labor force participation rates of the Thai population. Although one might think that the explanatory power of the model is less satisfactory for explaining males' participation

rates, we, on the contrary, believe that the model is quite helpful in confirming the implicit hypothesis that primary workers are relatively invariant to variations in socioeconomic factors.

CHAPTER VI

CONCLUSIONS

Summary

The immediate objective of this study is to explain the variation in labor force participation rates of several age-sex groups of the population of Thailand in 1970 in terms of a model incorporating economic as well as demographic variables. The study is primarily a cross-sectional study based mainly on census data for 71 Changwads of Thailand with supplementary data on income from the Office of the National Economic Development Board, and data on monthly wage rates from the Department of Labor. The basic model incorporates eclectic theories of labor supply; namely, the neoclassical income-leisure choise, model, Becker's hypothesis, the discouraged workers hypothesis, and the added workers hypothesis, with human capital theory as well as economic/demographic theory. In short, the dependent variables are age-sex specific activity rates while the explanatory variables are family income, wage rates, unemployment rates, industrialization, education, population-density, and family size. Because of the problem of identification and the joint dependency of activity rates, wage rates, and family income, a simultaneous equations model is postulated and estimated by the two-stage least squares technique.

The results of the statistical estimation are generally impressive and are generally consistent with the underlying theoretical concepts. The participation rates of prime-age males were found less sensitive

to socioeconomic variations compared to those of other groups of the population. The effect of the wage variable is positive and significant for females of every age group, but it was negative and not statistically significant for males of every age group except the 20-29 age group (where it was negative and significant). The significantly positive wage coefficients of female participation rates indicate strong substitution effects of wage rates upon females. Interpreted in terms of Becker's consumption-time theory the wage increase will raise the price of time or leisure-intensive commodities which leads to a decrease in females' consumption of time-intensive commodities.

The coefficients of the family income variable are negative and significant for females of all ages and young men (aged 11-19), indicating the strong impact of family income on secondary workers. If the family income is high the secondary workers will participate less in the labor market and vice versa. The economic reason behind this behavior is that these workers have a wider choice of time allocation than the primary workers. Whereas women have their choices among leisure, market work, and housework, the young also have those choices plus school attendance. Hence, as family income increases these secondary workers tend to allocate their time away from market work, other things being constant. The positive income effect of males aged 40 and above indicates that the increase in family income leads these workers to consume more of commodity-intensive goods.

Unemployment rates were found to have negative effects upon most workers no matter of what age or sex group except for young women aged 11 to 14 whose coefficient is, however, insignificant statistically.

The results imply that the 'discouraged workers' effect is stronger than the 'added workers' effect in every case. Although we thought there might be a problem caused the implicit definition of "secondary workers" used, a close examination of the data reveals that there is no such problem. In terms of elasticity we found that the labor force participation rate is generally less sensitive to the unemployment rate than to family income and wage rates.

The theory underlying the education variable opens room for some irregularity in its effect on the labor supply of population of different age and sex groups. The empirical findings show that education has a relatively large positive effect on the labor supply of the youngest age group of population for both sexes while it has a large negative effect on labor supply of women 40-49 years of age and old women aged 50-59. A milder positive effect of education on labor supply occurs in the females of child-bearing ages (20-39). This is not surprising. In fact, our impression is that the results are generally consistent with theory. The net effect of education can be either positive or negative depending on, among other things, the balance between the permanent income effect and substitution effect being associated with the level of education.

Industrialization variable is used to capture the effect of difference in economic structure and occupational composition among areas. The variable is defined as the percent of nonagricultural labor force in the total labor force. The positive effect on the secondary worker's participation is found consistent with theoretical expectations. The coefficients of prime-age men are positive as expected, but they

are not statistically significant. In addition, we found that industrialization also modifies the effect of the education variable to some extent by increasing the labor supplied by young workers and women over time.[73]

The hypothesis that in a developing country a member of a larger extended family tends to participate more in the labor market than the one of a smaller family is the rationale for including a family-size variable. The coefficients of this variable are positive and significant for seven age-sex specific groups of population; namely, young men and women aged 11-14 and 15-19, middle age women aged 49-49, and old women aged 50-59 and 60 and over. Otherwise they are not statistically significant.

Population density is another demographic variable we included in the model to primarily test Mincer's hypothesis that, other things being equal, the increase in population size can effectively block entry to jobs for many of the disadvantaged or secondary workers while it enhances a relative advantage for primary workers. Our finding is consistent with this hypothesis. In addition, the finding also reflects the negative effect of population pressure upon land resources on the participation rates of secondary workers. These effects, however, in terms of elasticity are quite small, ranging from -0.14 (for women aged 60 and above) to 0.01 (for males aged 30-49).

In general, the model is relatively successful in explaining the relationship between the participation rates and various socioeconomic

[73]Of course, this conclusion depends much on the obvious assumption that variables in the cross-sectional model will have similar effects over time.

variables. The theory underlying the model helps provide causal interpretations and explanations for the observed relation between participation rates and other socioeconomic variables. In some cases, however, very careful interpretations are required because of complexities and ambiguities. For example, the positive relation observed between industrialization and participation rates of the young. While under some special assumptions the relationship can be negative, the observed relationship was positive. Although we speculated that this may be due to the modifying effect of education, the true explanation is still in the air. In other cases, as in most empirical studies, the results should also be interpreted with care: a meaningful interpretation depends on not only how the model is specified, but also how accurately are the variables measured, and how valid are assumptions that have been made.

Some Implications

This study was designed to examine broad issues involving labor supply. The results are intended to serve as a guide to the effect of various variables on different measures of labor supply. Provided that the parameters of the model remained constant, a planner could use the model to test the effects of various manpower policies of labor supply if he could deduce how a policy change would affect the variables in the model.

The results suggest that in the short run, programs affecting wage rates would be successful in affecting the labor supply of women but that they are not good measures as applied to men. Programs for income maintenance and for increasing income levels should increase the labor

supply of men aged 40 and up while they should decrease the labor supply of young men aged 11 to 19 and of women of all ages. Increasing employment opportunities should increase the participation rates of every worker except for those men aged 11 to 49 and women aged 11 to 19 for whom we could not find a meaningful statistical conclusion.

In the long run,[74] increases in education level of the population will raise the participation rates of young males and females aged 11-14, old men aged 50 to 59, and females aged 20 to 39 while higher education level will reduce the participation rates of females aged 40 to 59. Changes in industrial structure will positively effect the labor supply of young workers of both sexes (aged 11 to 19), and females aged 40 to 59. On the contrary, industrialization will decrease the labor supply of males aged 40 and above. Any programs that result in a decrease in family size should effectively reduce participation rates of young workers of both sexes (aged 11-19) and females aged 40 and above. Finally, a population control program should help reduce the participation rates of males aged 30 to 49 while it should slow down withdrawal rates of female workers. Advances in the means of birth control will also permit greater personal choice in decisions about family size, and the net effect on the labor supply will depend on what happens to population programs.

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[74]It is fairly dangerous to move from a cross-section to the "long run." As pointed out earlier, a strong assumption has to be made that the parameter of the education variable remains constant over time.

APPENDIX A

CONCEPT AND CENSUS DEFINITION OF LABOR FORCE

CONCEPT AND CENSUS DEFINITION OF LABOR FORCE

In essence, the 'labor force' is the total number of laborers who offer their services in all labor markets in the economy. The labor force described in this sense is equivalent to the concept of "economically active population" and comprises all persons who furnish a supply of labor available for the production of economic goods and services including employers, self-employed persons, and those who assist without pay in a family economic enterprise as well as employees.[1]

Two well-known approaches[2] in identifying the labor force or the economically active population are the "gainful worker" approach and the "labor force" or "active population" approach. The labor force as measured by the gainful worker approach consists of persons who reported a "gainful occupation" to the census enumerators in a census or survey.[3] This includes all persons over a certain age (usually over ten years of age) who have an occupation or had one (in the past) from which they derived monetary rewards, or who in some way assist in the process of production. Since there was no specific time referent, this approach

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[1]United Nations, Methods of Analyzing Census Data on Economic Activities of the Population, ST/SOA, Series A/43, New York, 1968, p. 3.

[2]Another very recent concept is known as "labor utilization" approach recommended by Phillip Hauser.

[3]Fifteenth Census of the United States: Population, Vol. V, General Report on Occupations (Washington: Government Printing Office, 1933), p. 29; Alba M. Edwards, Comparative Occupational Statistics for the U.S., 1870-1940 (Washington: Government Printing Office, 1943), Ch. 8.

includes persons who are employed as well as unemployed; i.e., the reporting of a person's occupaton indicated nothing about whether he was actively employed at his occupation. A person who was unemployed at the time of enumeration but who had an occupation before was classified according to that previous occupation.[4] Furthermore, this approach excluded those who were unemployed and never had an occupation before, for example, the 'new worker' looking for his first job who had no "occupation" to report, though they are competing in the labor market. Thus, the number of the unemployed was undercounted because it is taken only from 'gainful workers,' whereas the work force was overcounted because by definition, it included part of the gainful workers no longer actively employed or seeking work, such as retired persons.

The improved concept and method of measurement to ascertain the size and characteristics of a nation's labor force developed in the United States during the depression decade of the 1930s is known as the "labor force" or "active population" approach with a primary objective to measure unemployment.[5] This approach included all potential workers, regardless of previous work status and discriminated more clearly between employed persons, unemployed persons (who seek work), and the armed

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[4]For example, a respondent might report "teacher" as his occupation even though he was retired and had not worked at his trade for years.

[5]It was first used in a national census in the 16th Decennial Census of the United States in 1940, and was subsequently the framework for the Monthly Report on the Labor Force conducted as part of the Current Population Survey by the U. S. Bureau of the Census: Sixteenth Census of the U. S.: Vol. III, The Labor Force, Part 1: United States Summary, pp. 1-14.

forces. That is, this approach introduces, first, the concept of "activity" the person must be actively working (employed) or seeking work (unemployed); second, the activity was given a specific time referent--a given week--usually the week before the enumeration.

According to the United Nations Statisticals Commission for 1960 censuses[6] the measure of the labor force should comprise all persons of either sex who furnish a supply of labor available for the production of economic goods and services including employees, self-employed persons, and those who assist without pay in a family economic enterprise as well as employees. It includes the unemployed and the employed during the period to which the data refer. The category of employed persons should comprise both full-time and part-time workers, provided that the latter work at least a minimum period to be set sufficiently low to exclude those whose contributions are negligible, while the unemployed should be defined as persons who are not at work and are seeking work for pay or profit during the period of reference.[7]

The definition adopted in the 1970 Census was more or less identical to the one in the 1960 Census of Thailand, applying an "active population"

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[6]The United Nations Statistical Commission for 1960 Censuses Principles and Recommendations for National Population Censuses (United Nations Publication, Sales No. 58, XVII.5) Para. 414.

[7]The United Nations, Methods of Analyzing . . . ., op. cit.; the category of persons not in the labor force, on the other hand, should comprise persons engaged only in activities which do not contribute directly to the production of economic goods and services; this includes housewives and students as well as disabled, retired, and other inactive persons. Housewives occupied only with domestic duties are excluded from the labor force because the goods and services which they produce are not considered as "economic" just as the value of their products is excluded from the measure of income in the national accounts.

standard. The minimum age limit for economic enumeration was 11 years of age whereas the time-referent was seven days preceding the census date. All persons 11 years of age and over were asked whether they "worked" on the census day or on any day during the seven days preceding the census date.[8] The total labor force included employed workers, and experienced workers as well as new workers who were looking for work. While the 1960 Census explicitly defined and differentiated between the "employed" and the "unemployed," the 1970 Census did not. In tabulations, however, the 1970 Census followed the same classification as the 1960 Census. With reference to work status, both censuses were in line with the recommendation of the Statistical Office of the United Nations: The economically active population included employers, private and public employees, own-account workers, and unpaid family workers.[9]

In addition, the 1970 Census reports a separate category of workers, waiting for farm season, which is not explicitly stated as being 'employed' or 'unemployed.'

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[8]1960 Population Census of Thailand, p. IV. It should be noted that the 1970 Population Census used "employed" in place for "worked" in its definition.

[9]For detailed definitions of workers in each work status see 1960 Population Census of Thailand, ibid., p. V, and p. XVII, 1970 Population Census of Thailand.

APPENDIX B

CONCEPT OF LABOR FORCE PARTICIPATION RATE

THE CONCEPT OF LABOR FORCE PARTICIPATION RATE

According to Ypsilantis (1966), the labor force of the less developed countries is about twice as large (600 million) as in the non-communist developed countries. Turnham (1971, 23) thus maintained that size of population is the first and most important determinant of the size of the labor force; but, as he also argued, the relationship between population and labor force, the common measure known as the participation or activity rate; i.e., can vary considerably. A country with low participation can have a labor force as large as a country with only half the population. Algeria in 1966, for example, had a labor force of only 2.6 million with a population of 11.8 million while Ghana with a population of 6.3 million had 2.7 million workers in 1960.[1] Hence, given the size of population, what determines the participation rate?

A crude measure of labor force participation, the so-called "crude activity rate," is defined as the proportion of the size of the labor force to the total population. This rate can differ for a variety of reasons, the most important of which arise from differences in age structure. A society with a very large proportion of its population in the extremely young age groups, as is almost always the case in less developed countries, tends to have lower crude activity rate than one a society with smaller proportion of young people. To demonstrate the

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[1]Difference in the definition of "labor force" should be considered in the comparison.

effect of age structure, a crude activity rate can be decomposed into two elements: (1) the age-specific activity rate and (2) the corresponding age distribution of the same population. In a formula,

$$C.A.R. = \sum_{i=o} \left(\frac{Ni}{N}\right) (ARi)$$

where Ni is population in age-group i, N stands for total population, ARi represents age-specific activity rates for age group i, which is the proportion of labor force of age-group i to the population of the same age group, and C.A.R. is the crude activity rate.

Because of the obvious effect of population age distribution on the labor force size, comparisons of crude activity rates will not reflect true variations of labor force participation when the age distribution varies across areas. Distortions on this account can be eliminated by using some demographic techniques. First, we may use "refined activity rate," sometimes called "general activity rate," by calculating the proportion of population of working ages (11 years and over) in the labor force. This is a "refined" rate in the sense that it refers only to the population at risk of participating in economic activity.[2]

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[2]A question may arise as to why people 60 or 65 years old and over are not excluded as a significant proportion of them may be dependents. While this may be true in the developed societies, however, in most of the developing ones the proportion of people 60 or 65 years and over, particularly males, in the labor force is great enough to justify their inclusion in the population at risk. Similarly to C.A.R., refined activity rate can be expressed as:

$$R.A.R. = \sum_{i=11} \left(\frac{Ni}{Nw}\right) (ARi)$$

where Nw is the total population of working ages. The age structure effect still remains.

Second, to adjust for the different age structure across areas, we may use an "age-standardized" activity rate which is calculated by applying the same age composition to different sets of age-specific activity rates and observe what the crude rate will then be. The age composition used for standardization is called the standard population. In formula, an age-standardized activity rate is

$$AAR_k = \sum_{i=0} \left(\frac{N_{ji}}{N_j}\right) (ARi_k)$$

where j refers to the standard population, k refers to area k, and i stands for age group i. In this way, we hold constant the effect of the age distribution so that any variations in the overall activity rate must result from real differences in age-specific activity rates among different population. Third, the "age-specific" activity rates is by itself controlled for age composition effect.

The need for disaggregating labor force by age-sex composition is perhaps obvious. Finding from a comparison of international cross-sectional data (The United Nations, 1962) infer different variation in economic activity for male and female, for the young, adult, and the aged. Secondly, in terms of statistical inference, the parameters of each factor affecting an individual's to work in a market is expectedly different (Williams, 1970, 50-51); (The United Nations, 1971, 55-58). In addition, the age-sex composition of the labor force is meaningful in terms of manpower planning policy. Therefore, it is more desirable to use age-specific activity rates as our dependent variables.

APPENDIX C

SUPPORTING TABLES

Table 9

Employment Trends in Thailand, 1960-1970
(In Percentage)

Economic Sector	1960	1963	1966	1969	1970
Total	100.0	100.0	100.0	100.0	100.0
Agriculture	82.9	81.7	79.8	78.1	78.3
Nonagriculture	17.1	18.3	20.2	21.9	21.7
Mining	0.2	0.2	0.3	0.3	0.5
Manufacturing	3.7	3.7	4.5	4.3	4.0
Construction	0.6	0.7	0.8	0.9	1.1
Electricity	0.1	0.1	0.2	0.2	0.2
Commerce	6.0	6.4	6.4	7.1	5.2
Transportation	1.3	1.4	1.5	1.7	1.6
Services	5.2	5.8	6.5	7.3	7.0

Sources: 1960-1969 from Yamada, Saburo. The Measurement and Promotion of Productivity for the Third National Economic and Social Development Plan of Thailand, 1972-1976, National Economic Development Board of Thailand, 1971, Table 3, p. 13.

1970 from Population Census of Thailand, 1970.

Note: There is a slight difference in Yamada and the Census figure due to some data adjustment by Yamada.

Table 10

Real GDP of Thailand 1969-1972 (at Constant 1962 rices)

Year	GDP[a] (Mil. Bht.)	Annual Growth Rate of GDP	Population[b] (,000)	GDP Per Capita (in Baht)	Annual Growth Rate of GDP Per Capita	GDP Per Capita[c] in U.S. $
1760	56,069	---	26,634	2,105	---	103
1961	59,029	5.3	27,446	2,151	2.2	105
1962	63,793	8.1	28,293	2,255	4.8	110
1963	69,125	8.4	29,173	2.369	5.1	116
1964	73,693	6.6	30,082	2,450	3.4	120
1965	79,487	7.9	31,025	2,562	4.6	125
1966	89,190	12.2	31,995	2,788	8.8	136
1967	96,136	7.8	32,996	2,914	4.5	142
1968	104,286	8.5	34,035	3,064	5.1	150
1969	112,546	7.9	35,109	3,206	4.6	157
1970	120,727	7.3	36,215	3,334	4.0	163
1971	127,715	5.9	37,383	3,416	2.5	167
1972	131,604	3.0	38,577	3,411	-0.1	167
1973	143,159	8.8	39,787	3,598	5.5	176
	(Average = 7.5)				(Average = 3.4)	

[a]National Economic and Social Development Board.

[b]National Statistical Office, medium projection.

[c]One U.S. $ = 20.45 Baht.

TABLE 11

Age-specific activity rates of males and females: censuses of 1946-1966
in fifteen countries of Asia and the Far East

Sex and age (years)	Ceylon		China (Taiwan)		Hong Kong	India	Indonesia	Iran		Japan		Japan		Khmer Republic	Korea Republic of		Malaya, Federation of	Nepal	Pakistan	Philippines		Singapore		Thailand
	1946	1953	1963	1956	1961	1961	1961	1956	1966	1950	1955	1960	1965	1962	1955	1960	1957	1961	1961	1948	1960	1957	1966	1960
Males																								
15-19	59.2	46.5	46.3	77.5	54.3	71.4	66.7	80.7	68.0	61.7	54.3	51.6	39.1	58.0	48.2	45.2	60.0	91.6	76.7	34.4	59.2	59.4	44.1	76.8
20-24	83.3	81.4	84.2	91.2	89.2	93.0	87.2	94.2	90.8	90.5	88.1	87.9	87.4	87.9	72.1	75.9	92.7	96.5	89.8	71.7	80.8	92.3	91.7	88.2
25-29	95.0	94.7	95.2	96.1	97.6	97.2	93.2	97.9	96.6	95.5	96.2	95.9	98.0	97.4	88.6	90.8	97.5	98.2	95.4	86.6	91.3	98.0	97.5	96.0
30-34	99.3	95.1	96.5	96.4	98.0	97.5	95.8	98.7	97.7	96.5	97.0	97.6	97.9	98.4	95.2	95.6	97.8	98.3	95.6	92.8	94.5	98.6	95.9	97.5
35-39	98.4	95.8	96.6	96.8	98.2	97.8	96.9	98.9	97.9	97.8	97.3	97.7	97.9	99.1	96.3	96.3	97.7	98.7	95.6	95.2	95.5	98.5	95.7	97.8
40-44	99.0	95.3	96.0	95.9	98.4	97.6	96.6	98.9	97.5	97.6	97.4	98.0	98.0	98.8	96.5	96.9	97.2	98.3	95.6	96.5	95.4	98.0	97.7	97.8
45-49	97.5	95.4	95.6	93.6	97.7	97.4	96.3	98.3	95.9	96.3	97.0	97.1	97.9	98.3	95.7	96.4	96.2	98.0	95.9	95.7	95.1	96.9	95.8	97.3
50-54	92.5	93.8	92.8	84.4	95.7	96.6	94.8	97.2	91.2	93.9	95.5	96.0	97.0	96.5	93.8	91.1	93.7	97.5	95.7	95.0	93.6	93.5	91.9	96.1
55-59	88.7	91.2	87.7	67.9	89.9	93.8	92.4	95.5	86.4	90.4	91.1	90.5	92.6	91.0	90.5	88.4	88.4	94.9	93.2	93.4	91.7	85.1	79.0	92.5
60-64	86.7	84.2	76.4	43.6	78.1	87.5	87.2	91.5	74.1	80.3	82.4	82.5	84.5	78.1	80.3	71.0	81.3	79.1	90.8	83.6	86.4	66.9	58.5	82.9
65-69	58.1	77.7	67.9	25.4	61.3	80.6	81.7	85.4	64.0	69.6	70.8	73.2	71.1	61.8	68.3	50.7	70.0	63.2	86.9	70.7	79.2	49.8	39.4	67.8
70-74	81.5	70.3	51.7	12.5	41.4	69.5	74.3	75.9	43.8	52.2	52.9	52.3	52.0	45.1	52.8	36.4	57.5	48.8	81.7	61.4	71.5	31.0	23.2	49.0
75 and over	62.5	53.3	32.8	5.3	18.5	49.5	61.7	58.6	28.5	33.0	33.4	30.0	29.0	31.1	38.3	18.9	47.8	41.3	71.6	49.3	54.2	17.4	18.0	26.2
Gross years of active life[a]	57.4	54.2	51.4	46.6	51.2	58.0	57.4	60.1	53.4	53.1	52.8	52.4	52.1	53.0	51.2	47.9	54.4	56.9	60.7	51.7	55.4	49.6	46.8	54.9
Females																								
15-19	24.3	27.7	21.7	40.9	47.9	40.7	30.6	12.1	15.5	54.8	50.1	42.7	38.2	66.9	35.0	25.5	27.9	77.2	12.6	18.7	29.6	23.4	25.5	84.6
20-24	23.8	28.7	29.4	26.8	51.1	43.2	27.4	9.3	14.2	64.0	68.2	69.4	69.5	63.7	50.5	30.7	31.2	69.1	14.2	25.5	28.9	22.9	40.9	86.6
25-29	26.3	28.6	27.8	16.4	32.6	44.8	26.6	8.6	12.8	48.3	51.8	50.1	46.8	58.4	51.8	26.6	27.7	64.6	15.4	18.4	26.1	16.4	25.9	84.9
30-34	28.8	30.1	25.2	14.9	35.1	46.7	28.2	8.7	12.1	48.6	49.6	51.3	48.3	61.3	54.9	29.0	30.4	61.4	15.6	18.2	26.3	17.3	21.0	85.2
35-39	31.1	32.2	26.0	14.8	37.0	49.1	31.5	9.4	12.3	51.6	53.4	55.1	57.6	61.3	59.2	32.9	34.1	59.0	15.8	19.2	26.8	20.8	19.2	86.6
40-44	33.7	34.6	26.2	13.3	39.1	50.1	35.5	10.1	12.5	53.7	55.5	56.7	62.2	61.3	61.4	34.8	35.3	55.9	16.1	19.3	27.9	26.2	21.9	83.3
45-49	33.4	35.6	26.3	10.7	43.6	49.3	39.1	10.3	12.1	52.5	54.4	56.8	61.9	61.3	62.4	35.2	36.3	53.9	16.8	18.7	25.9	30.1	20.4	80.7
50-54	31.2	35.8	21.1	7.3	40.2	45.0	40.6	10.0	10.8	51.0	51.3	51.7	57.8	58.0	59.3	32.8	33.7	51.3	16.3	17.9	29.0	28.8	24.4	85.6
55-59	28.7	34.1	17.9	4.7	32.0	39.2	40.2	9.3	8.8	44.8	45.7	46.7	50.0	49.5	52.2	29.3	29.4	45.9	14.0	15.0	26.3	24.7	23.2	77.6
60-64	26.8	30.1	11.3	2.5	23.5	29.7	38.4	7.9	7.6	37.9	38.4	39.1	39.6	32.4	34.8	16.8	22.3	33.4	12.6	12.9	25.5	17.1	18.5	61.8
65-69	24.8	28.1	7.8	1.5	15.8	23.8	34.2	6.9	5.7	29.0	29.5	30.6	27.5	22.7	24.0	12.0	15.6	25.5	11.4	10.9	23.7	10.5	11.7	42.6
70-74	21.7	24.0	5.6	0.6	8.0	15.4	28.9	5.8	4.8	22.2	20.6	21.1	17.1	14.3	15.3	7.9	11.4	16.0	9.9	6.7	21.5	4.7	6.4	26.6
75 and over	15.6	17.4	4.1	0.2	1.7	9.7	20.3	4.6	2.8	10.9	10.0	10.2	6.8	7.8	10.8	5.4	6.8	10.9	8.2	1.6	19.1	2.0	1.9	8.0
Gross years of active life[a]	18.1	19.8	12.7	9.0	20.7	25.5	21.9	6.1	7.3	28.7	29.0	29.5	29.2	32.4	28.9	16.2	17.5	32.4	9.4	10.4	17.6	12.5	13.1	47.4

[a] In ages 10 years and over.

Source : (Durand, 1971, 82-3).

Table 12

Crude, Standardized, and Refined Activity Rates and Age-Structure Indices: Censuses of 1946-1966 in Fifteen Countries of Asia and the Far East

Country	Census Year	Crude Activity Rate	Standardized Activity Rates			Refined Activity Rates			Age Structure Index
			Both Sexes, All Ages	Males 10 and Over	Females 10 and Over	Both Sexes, 10 and Over	Males 10 and Over	Females 10 and Over	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ceylon	1946	39.2	37.8	76.6	25.3	52.4	76.1	24.8	104
	1953	36.8	37.0	72.4	27.2	51.4	72.8	26.7	99
	1963	32.6	34.1	71.5	20.3	45.9	69.3	20.1	96
China (Taiwan)	1956	33.2	35.6	72.3	18.5	50.4	79.8	20.2	93
Hong kong	1961	38.7	39.6	73.4	33.2	54.9	76.5	32.3	98
India	1951	39.1	39.5*	72.8*	31.8*	53.0	72.8	31.8	99*
	1961	43.0	44.9	81.4	39.4	61.2	81.1	39.9	96
Indonesia	1961	35.9	40.0	78.5	29.5	54.1	79.8	29.4	90
Iran	1956	32.0	34.5	83.8	9.2	47.4	83.9	9.2	93
	1966	30.2	33.9	79.2	12.3	45.9	77.0	12.5	89
Japan	1950	44.0	43.9	74.7	43.4	58.7	74.4	43.9	100
	1955	45.1	43.4	73.2	43.8	58.4	73.4	44.1	104
	1960	47.2	43.4	72.7	44.1	57.8	72.4	44.0	109
	1965	49.1	42.5	71.3	43.1	58.7	73.6	44.6	116
Khmer Republic	1962	43.6	74.7	76.0	52.3	62.8	73.0	52.6	91
Korea, Republic of	1955	38.2	41.7	69.7	42.5	53.8	66.1	41.9	92
	1960	31.0	34.4	68.3	24.4	44.2	65.6	24.4	90
	1947	38.9	40.0*	77.0*	26.9*	53.8	77.0	26.9	97*
Malaya, Federation of	1957	34.5	37.8	75.7	26.1	51.5	74.8	26.2	91
Nepal	1952/54	50.0	51.1*	83.7*	54.1*	68.6	83.7	54.1	98*
	1961	49.1	51.0	84.2	53.1	68.7	83.6	54.4	95
Pakistan	1951	31.6	32.9*	77.2*	5.7*	44.2	77.2	5.7	95*
	1961	33.5	36.4	84.5	13.7	51.6	84.4	13.8	92
Philippines	1948	27.0	31.3	68.1	16.2	39.1	62.5	16.1	86
	1960	32.0	37.2	75.3	24.9	47.8	71.1	24.4	85
Singapore	1957	33.2	34.2	73.5	18.8	49.9	76.6	19.2	97
	1966	29.9	33.5	69.6	20.8	42.3	64.4	19.8	89
Thailand	1947	53.6	56.4*	79.6*	72.0*	75.8	79.6	72.0	95*
	1960	52.2	57.7	80.6	74.7	77.5	79.6	75.3	92

*Estimated

Source: Ibid., Table 1, p. 80.

APPENDIX D

DATA AND MEASUREMENT

FAMILY INCOME, YF

Different concepts of income variable have been used in empirical studies of labor force participation; namely, permanent income as against transitory income (Mincer, 1966, 74), "adjusted earings (ibid, 86)," average non-labor income (King, 51), potential family non-labor income (Cain, ibid, 8), income of husband and wife (Hanna, 34), family income less own wage and salary (Cohen, Rea, and Lerman, 14), and so on. Unavailability of data for the cross-country of Thailand leaves us not much choice.[1] Therefore, we have made our estimation of average family income as follows:

Let GDP_{ij} be the Gross Domestic Product of the j^{th} industry of region i and EM_{ij} the number of workers employed in the corresponding region and industry, we have GDP per worker of the j^{th} industry in region i^{th} as

$$X_{ij} = \frac{GDP_{ij}}{EM_{ij}} \qquad (1)$$

and the regional GDP, GDP_r, by definition,

$$= \sum_{j}^{N} (X_{ij} \cdot EM_{ij}), \qquad (2)$$

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[1]Data on GDP by industry is available for all four regions for the years 1960-1973 from the National Economic and Social Development Board of Thailand. GDP data on a Changwad level at the time the research was conducted are available for only 15 Changwads in the Northeast.

where N = number of industrial sectors.

The GDP for the whole kingdom, GDP_w, can also be estimated as

$$GDP_w = \sum_{i}^{K} \sum_{j}^{N} (X_{ij} \cdot EM_{ij}) \tag{3}$$

where K is the number of regions.

Assuming that the average product per employed worker of an industry j in a Changwad of a region i is the same as the average product per employed worker of the same industry j of that region i, i.e., $X_{ijc} = X_{ij}$ where, c stands for Changwad c, the GDP for each Changwad in region i is

$$GDP_{ci} = \sum_{j}^{N} (X_{ijc} \cdot EM_{ijc}). \tag{4}$$

Dividing GDP_{ci} by the number of population in that Changwad we obtain per capita income for a Changwad as:

$$Y_{ci} = \frac{GDP_{ci}}{N_{ci}} \tag{5}$$

where, N_{ci} is the total number of population of the Changwad.

For average family income per private household, we divide GDP_{ci} by the number of private households in that Changwad, that is:

$$YF_{ci} = \frac{GDP_{ci}}{HH_{ci}} \tag{6}$$

where, HH_{ci} is the number of private households of Changwad c.

In fact, our family income variable is close to the "family income" variable being used by Cain.[2] Besides, we have also tested the results

[2]Cain defined "family income" as the return to the non-human capital of the family plus the maximum wage and salary earnings available to the family. He viewed this variable as a potential income concept. (Cain, 8)

of our estimated provincial GDP with the existing data on provincial GDP of 15 provinces. The simple correlation coefficient of the relation between the actual data and the estimated data is very close to one (0.91), the R^2 is as high as 0.92 where the F-test is highly significant.

WAGE RATE

The only available cross-sectional data on wage rate comes from the Department of Labor's Labour Statistics and Employment Market Information: April 1968 which is a survey covering 49 provinces in Thailand. This is the best available source we can have: the data provided is the average monthly wage rate, before tax, of persons working in the establishments, which employ five employees or more, for wages or salaries (excluding working proprietors, unpaid family workers, and administrative, executive and managerial workers). The "average monthly wage rate" is defined as the average basic wages and salaries received in the month of the survey (March, 1968) by the employees excluding payment for overtime. This is used as our proxy for "market wage rate."

INDEX OF AREA INDUSTRIALIZATION LEVEL

In the course of economic development, all economies undergo changes in the industrial composition of the labor force for as industrial structure changes labor must be reallocated (shifted) to conform with it.[3]

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[3]For more analytical details of the relationship of industrial transformation and labor reallocation see, for example, (Singelman, 1974); (Kuznets, 1966); (Schultz, 1964).

This is almost self-explanatory. Agricultural employment is steadily declining as a country is moving towards industrialization. Therefore, it is reasonable to choose as an indicator of industrialization the percentage of nonagricultural employment of the labor force. Another possible measure of this variable is to use the percentage of total male workers in nonagricultural activities. In this study we use the former concept of industrialization index. The data used is from the Population Census of Thailand, 1970.

UNEMPLOYMENT RATE

Unemployment is one of the most troublesome variable to measure because, as it seems common, the concepts of unemployment are difficult to apply in less developed countries. Arbitrary measurement procedures result in differences in analytical interpretation and conclusion, and, thus, problems. Nevertheless, so far as the measurement is concerned there seems to be no easy solutions to these problems, apart from arbitrary ones. As a result, we cannot help limit ourselves to some criteria to be used as a guideline for our measurement of unemployment.

In the case of Thailand, the main problem is the fundamental distinction between employment, unemployment, and being out of the labor force (of course, we have left out the problem of underemployment for the moment). The 1970 Population Census (Table 16) reports those population who are economically active,[4] i.e., being in the labor force

[4]All persons 11 years of age and over who were employed on the census date, or who had worked on any day during the seven days preceding the census date (March 25-31, 1970) as well as experienced workers who were looking for work and those waiting for farm season were counted as the economically active population. (P. xvi, 1970 Thailand Population & Housing Census.)

as 'employed,' 'looking for work,' and 'waiting for farm season.' Since the Census does not explicitly classify the 'waiting for farm season' workers as being 'employed' or 'unemployed,' some judgements have to be made for the measurement of the unemployment rate.

Let EAP = total number of 'economically active population' (labor force),

EM = employed workers during the census dates,

WJ = workers looking for jobs during the census dates,

WFS = workers waiting for farm season during the census dates,

and UN = unemployment rate.

Hence, EAP = EM + WJ + WFS.

By treating WFS in different ways we can come out with different rates of unemployment as follows:

I. WFS as employed workers

$$UN_1 = \frac{EAP - (EM + WFS)}{EAP} \times 100$$

$$= \frac{WJ}{EAP} \times 100$$

This is because WFS is a part of labor input contributing to the annual GDP.

II. WFS as (seasonally 'unemployed workers'

$$UN_2 = \frac{EAP - EM}{EAP} \times 100$$

or

$$= \frac{WJ + WFS}{EAP} \times 100$$

since, theoretically, WFS is seasonly unemployed.

III. WFS as being 'out of the labor force'

$$UN_3 = \frac{(EAP - WFS) - EM}{(EAP - WFS)} \times 100$$

or

$$= \frac{WJ}{(EAP - WFS)} \times 100$$

Strictly speaking, by the definition of 'labor force' WFS are not being actively employed (during the census dates), and are not looking for jobs. They are comparable to housewives, students, and other secondary workers.

IV. WFS as 'visible underemployment'

$$UN_4 = \frac{EAP - (EM + k\ (WFS)}{EAP} \times 100$$

or,

$$= \frac{WF + (1 - k)\ WFS}{EAP} \times 100$$

where k is the proportion of time gainfully employed of a worker (WFS) in a year.

For the purpose of our study, we found definition I (UN_1) the most appropriate and reasonable one as compared to the others. It is more reasonable to conceive that WFS are employed workers instead of being unemployed (UN_2) or being out of the labor force (UN_3). First, in the peak harvesting season, these workers are very fully employed[5] while during the slack season they simply enjoy their vacation or leisure

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[5]In Thailand, at least 40 percent of workers worked 60 hours or more during the transplanting season. (Fuhs, Friedrich W. and Jan Vingerhoets, 15)

after a long and hard-working season. Second, given the possibility of underemployment in the sense that some of the working time available during the year is not utilized by WFS we can apply UN_4 as a working definition of unemployment rate. However, taking into account that the data on k are not available by Changwads,[6] if we treat k as a constant then the statistical test of relationship will yield the same result as UN_1 and the difference in unemployment coefficients will be simply a matter of scaling. Finally, it should be noted that the measurement of level of underemployment in Thailand is still the subject of research.[7] Hence, although we realized that underemployment is a problem that can seriously affect the level of economic activity and output in developing countries,[8] lacking of appropriate measurement and data does not permit us to incorporate the level of underemployment in the measurement of unemployment rate. Nevertheless, if the objective such as ours is to use unemployment rates as an index of employment opportunities, then, UN_1 (we now and then called 'open-unemployment rate') should be sufficient.

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[6]We may also define k_i as $(EM/EAP)_i$ where i refers to Changwad i. so the refined definition of UN_1 will become

$$UN_{1a} = \left(1 - \frac{WFS\ (EM/EAP) + EM}{EAP}\right) \times 100$$

Presumably, the rates obtained by using UN_{1a} do not make much difference from UN_1, therefore, we use UN_1.

[7]For an excellent review over this problem see (Siamwala, 5-92); see also (Oshima, 1971).

[8]Philip M. Hauser, The Measurement of Labor Utilization Organization of Demographic Associates, Minila, 1974, p. 6.

FAMILY SIZE, EDUCATION, AND POPULATION DENSITY

The computational procedures for family size, educational attainment, population density and the rest of variables were given in pages 62-63, which are self-explanatory. In addition, all demographic data derived from the Census were adjusted for unknown age groups by assuming that they are distributed by the same proportion of the "known" age-sex specific data.

Table 13 gives the mean, standard deviation, and minimum and maximum values of variables used in the regression analysis. Note that also included in Table 13 are age-sex specific values of wage rates and family income which are derived from the reduced-form equations.

Table 13

Mean, Standard Deviation, Minimum and Maximum Values of Variables Used in Regression (Number of Observations N = 71. Except for w where N = 49; for Notations see Table 5.1)

Variable	Mean	Standard Deviation	Minimum	Maximum
MAR 11	42.22	13.37	11.23	65.46
MAR 15	78.54	9.64	43.17	91.27
MAR 20	92.49	3.12	78.04	96.53
MAR 30	96.44	2.05	81.85	98.06
MAR 40	96.24	1.75	86.74	98.14
MAR 50	91.87	2.71	82.31	96.02
MAR 60+	57.53	6.61	39.25	70.72
FAR 11	48.73	15.52	11.76	74.89
FAR 15	76.76	13.09	40.12	94.01
FAR 20	77.52	11.54	40.26	94.80
FAR 30	78.31	11.36	39.02	94.76
FAR 40	79.24	10.77	42.03	94.02
FAR 50	70.43	11.27	35.52	87.23
FAR 60+	31.13	7.29	13.39	47.95
MED 11	3.78	0.47	2.07	4.76
MED 15	4.58	0.71	2.38	7.14
MED 20	4.47	0.75	2.24	7.26
MED 30	3.78	0.70	1.68	6.06
MED 40+	2.51	0.59	0.86	4.28
FED 11	3.70	0.44	2.14	4.59
FED 15	4.19	0.64	2.14	6.36
FED 20	3.86	0.72	1.58	6.31
FED 30	3.02	0.68	0.86	4.51
FED 40+	1.19	0.41	0.26	2.51
UN	1.38	0.82	0.43	4.61
IND	20.70	16.42	4.04	85.91
FZ	5.71	0.36	4.90	6.30
PD	4.57	4.91	1.62	32.36
w	6.36	0.91	5.11	9.36
YF	18.37	8.25	7.54	42.88
APL	7.07	3.91	1.96	18.29
SXL	1.22	0.28	0.92	2.34
wM 11	6.09	0.71	5.05	9.16
wM 15	6.09	0.72	4.71	9.19
wM 20	6.08	0.72	4.87	9.19
wM 30	6.09	0.72	5.01	9.18
wM 40+	6.10	0.73	5.00	9.16

(Continued)

Table 13 (Continued)

Mean, Standard Deviation, Minimum and Maximum Values
of Variables Used in Regression
(Number of Observations N = 71. Except for w
where N = 49; for Notations see Table 5.1)

Variable	Mean	Standard Deviation	Minimum	Maximum
wF 11	6.09	0.71	5.07	9.14
wF 15	6.09	0.72	4.91	9.15
wF 20	6.04	0.78	3.36	9.14
wF 30	6.05	0.79	3.31	9.15
wF 40+	6.09	0.74	4.93	9.14
YFM 11	17.49	7.63	7.32	42.25
YFM 15	17.48	7.61	7.32	42.34
YFM 20	17.47	7.62	7.21	42.32
YFM 30	17.47	7.62	7.18	42.39
YFM 40+	17.44	7.61	7.66	42.35
YFF 11	17.48	7.63	7.29	42.21
YFF 15	17.48	7.62	7.21	42.29
YFF 20	17.47	7.62	7.17	42.35
YFF 30	17.47	7.62	7.19	42.41
YFF 40+	17.45	7.62	7.57	42.33

Note: wM = male wage rate,
wF = female wage rate,
YFM = male family income
YFF = female family income,
the numerical figure after each of these variables refers to age group.

APPENDIX E

REDUCED FORM EQUATIONS FOR WAGE RATES AND FAMILY INCOME

Table 14

REDUCED FORM EQUATIONS FOR WAGE RATES

DEPENDENT VARIABLE	PREDETERMINED VARIABLES										
	ED	UN	IND	FZ	PD	RES	APL	SXL	CONSTANT	$\bar{R}^2$/S.E.	F-RATIO
wM 11	0.2782 (0.6656)	0.0345 (0.1062)	0.0068 (0.1988)	-0.0289 (-0.0695)	0.0281 (0.8803)	0.0817 (0.5111)	0.1691 (1.9254)	-1.2315 (-1.6058)	5.1228 (2.5240)	0.4685 (0.7456)	6.288
wM 15	0.5049 (1.3145)	0.1174 (0.3624)	-0.0150 (-0.3881)	-0.0925 (-0.2447)	0.0276 (0.8955)	0.0277 (0.1688)	0.1714 (2.0100)	-0.9211 (-1.1476)	4.2458 (1.9818)	0.4848 (0.7341)	6.647
wM 20	0.3790 (1.1314)	0.0821 (0.2556)	-0.0072 (-0.1940)	-0.1544 (-0.3658)	0.0185 (0.5936)	0.0486 (0.2993)	0.1781 (2.0455)	-1.0282 (-1.3010)	5.1969 (2.6233)	0.4793 (0.7380)	6.522
wM 30	0.3532 (1.2332)	0.1076 (00.3315)	-0.0047 (-0.1373)	-0.2700 (-0.5767)	0.0167 (0.5345)	0.0560 (0.3510)	0.1899 (2.1364)	-1.0753 (-1.4040)	6.1121 (2.9678)	0.4823 (0.7359)	6.589
wM 40^+	0.3592 (1.1995)	0.0925 (0.2876)	0.0023 (0.0716)	-0.3158 (-0.6290)	0.0115 (0.3538)	0.0409 (0.2507)	0.1887 (2.1229)	-1.2553 (-1.7105)	6.9562 (2.9300)	0.4813 (0.7366)	6.566
wF 11	0.2457 (0.4022)	0.0243 (0.3224)	0.0092 (0.0332)	-0.151 (0.4159)	0.0258 (0.0314)	0.0841 (0.1596)	0.1696 (0.0884)	-1.3034 (0.7458)	5.2368 (2.0090)	0.4676 (0.7463)	6.269
wF 15	0.3182 (0.9655)	0.0764 (0.2342)	-0.0003 (-0.0085)	-0.0784 (-0.1944)	0.0194 (0.6185)	0.0580 (0.3575)	0.1768 (2.0127)	-1.2254 (-1.6388)	5.2189 (2.6230)	0.4748 (0.7412)	6.425
wF 20	0.2951 (1.0462)	0.0913 (0.2765)	-0.0011 (-0.0330)	-0.1585 (-0.3624)	0.0158 (0.4949)	0.0617 (0.3844)	0.1839 (2.0654)	-1.2067 (-1.6161)	5.8081 (2.8702)	0.4769 (0.7397)	6.470
wF 30	0.2718 (1.1109)	0.0708 (0.2221)	0.0042 (0.1339)	-0.1970 (-0.4388)	0.0177 (0.5632)	0.0841 (0.5355)	0.1847 (2.0830)	-1.2347 (-1.6691)	6.2601 (2.9352)	0.4787 (0.7385)	6.509
wF 40^+	0.6892 (1.6515)	0.1679 (0.5196)	-0.0026 (-0.0845)	-0.3932 (-0.8548)	0.0042 (0.1295)	0.0574 (0.3686)	0.1937 (2.2399)	-1.2028 (-1.6623)	7.3919 (3.2203)	0.4969 (0.7254)	6.926

Note: (a) Numbers in parentheses below each coefficient are t-ratios.

(b) wM = male wage rates, wF = female wage rates, where the post-scripted numbers refer to age-group.

(c) For other notations see Table 5.1.

Table 15

REDUCED FORM EQUATIONS FOR FAMILY INCOME

DEPENDENT VARIABLE	ED	UN	IND	FZ	PD	RES	APL	SXL	CONSTANT	$\bar{R}^2$/S.E.	F-RATIO
YFM 11	0.7237 (0.8696)	-0.1237 (-0.1915)	0.3864 (5.6467)	-0.1027 (-0.1237)	-0.3041 (-4.7865)	1.0662 (3.3514)	0.6783 (3.8794)	-0.5252 (-0.3439)	3.6822 (0.9112)	0.9676 (1.4846)	180.196
YFM 15	0.5661 (0.6488)	-0.1511 (-0.2297)	0.3844 (4.9122)	0.0828 (0.1078)	-0.3118 (-4.9763)	1.0354 (3.1032)	0.6613 (3.8179)	-0.4435 (-0.2721)	3.1975 (0.7349)	0.9673 (1.4908)	178.673
YFM 20	0.2721 (0.4009)	-0.2197 (-0.3375)	0.3997 (5.3465)	0.1008 (0.1178)	-0.3195 (-5.0555)	1.0698 (3.2544)	0.6620 (3.7523)	-0.6495 (-0.4055)	4.1998 (1.0462)	0.9671 (1.4956)	177.490
YFM 30	0.0236 (0.0405)	-0.2941 (-0.4450)	0.4171 (5.9370)	0.2762 (0.2897)	-0.3163 (-4.9670)	1.1014 (3.3894)	0.6490 (3.5850)	-0.8784 (-0.5632)	4.5733 (1.0428)	0.9670 (1.4986)	176.767
YFM 40+	-0.7658 (-1.2828)	-0.5748 (-0.8964)	0.4549 (7.1653)	1.2468 (1.2453)	-0.2900 (-4.4876)	1.2221 (3.7597)	0.5791 (3.2665)	-1.1536 (-0.7884)	0.9402 (0.1986)	0.9683 (1.4687)	184.238
YFF 11	0.7095 (0.887)	-0.1334 (-0.207)	0.3898 (5.898)	-0.1072 (-0.130)	-0.3093 (-4.948)	1.0692 (3.367)	0.6832 (3.885)	-0.6920 (-0.466)	3.9409 (0.9864)	0.9676 (1.4841)	180.335
YFF 15	0.3788 (0.572)	-0.1712 (-0.260)	0.3954 (5.590)	0.0584 (0.071)	-0.3209 (-5.090)	1.0586 (3.239)	0.6704 (-3.790)	-0.7205 (-0.478)	4.1444 (1.0344)	0.9673 (1.4925)	178.240
YFF 20	0.1742 (0.306)	-0.2291 (-0.345)	0.4067 (5.799)	0.1342 (0.151)	-0.3205 (-4.976)	1.0837 (3.337)	0.6627 (3.679)	-0.7991 (-0.528)	4.5835 (1.1191)	0.9671 (1.4969)	177.183
YFF 30	-0.0683 (-0.137)	-0.3300 (-0.509)	0.4225 (6.582)	0.3840 (0.421)	-0.3144 (-4.943)	1.1071 (3.472)	0.6398 (3.556)	-0.9337 (-0.622)	4.1007 (0.9475)	0.9670 (1.4982)	176.846
YFF 40+	-0.9290 (-1.093)	-0.5767 (-0.876)	0.4481 (7.087)	1.0038 (1.072)	-0.2897 (-4.376)	1.1564 (3.646)	0.5972 (3.392)	-1.1305 (-0.767)	1.5982 (0.3418)	0.9679 (1.4767)	182.193

Note: (a) Number in parentheses below each coefficient are t-ratios.

(b) YFM = male family income, YFF = female family income, where the post-script numbers refer to age group.

(c) For other notations see Table 5.1.

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