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LABOR SUPPLY, DEMAND FOR CHILDREN AND WAGE RATES OF PAID EMPLOYEES IN THAILAND

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OF PAID EMPLOYEES IN THAILAND

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by

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ABSTRACT

The purpose of this study is to analyze the labor supply behavior of paid employees in Thailand. The family model of labor supply suggests that family size, wage rates and the labor supply behavior of each family member are interrelated. Therefore, a simultaneous equations model is developed, consisting of the husband's and the wife's labor supply functions, their wage functions, their demand for children and an income identity. The model is estimated by a two-stage least squares method. The data utilized cover 1631 working couples selected from the total number of households in the Survey of Labor Force, Round 1 (January-March), 1977, the National Statistical Office, Thailand.

This study has demonstrated that R^2 can be used to compare the predictive power of two estimation procedures, namely Heckman's and Kosters' models. Although such comparison proves inconclusive, the former is chosen as our estimation method.

The labor supply models of married male and married female are separately estimated because (a) the aggregation test shows that the labor supply behavior of married women in Bangkok is significantly different from that in non-Bangkok areas, while the behavior of married men in these two areas is not significantly different, (b) an analysis of variance shows no significant differences in the average weekly hours of men between these two areas, while the mean hours of work of women in Bangkok are shorter than those in non-Bangkok, and (c) the F-tests confirm that most of the total variation in the working hours of women is explained by variation within (an area), while variation between plays a larger role in explaining the total variation of men's working hours.

Results of the estimated labor supply of husbands (for the whole nation) show that the substitution and income elasticities are very low. Moreover, the wife's wage rate, household income, the number of children, the family size, and occupational dummy variables are statistically significant. The Neoclassical implication of symmetrical cross-substitution effects and of the implicit assumption that the husband's and the wife's incomes have identical effects on their labor supply cannot be rejected. In the estimated labor supply of married women in both areas, the husband's wage rate, own wage rate, household income, family size, and occupational dummy variables are statistically significant. Moreover, the number of children is also significant in the Bangkok model and so are age and age squared in the non-Bangkok model.

When the assumption of equal income effect is maintained, the hypothesis of identical cross-substitution effects is accepted only in the non-Bangkok model of married women's labor supply. However, when this assumption is relaxed, all of the hypotheses concerning equal income effects and the simultaneous test of equal income and symmetrical cross-substitution effects must be rejected in both areas. This implies that the bargaining theory is a more appropriate model to estimate the labor supply of married women in our data set than the Neoclassical model. When the model is specified by bargaining theory, the estimated substitution and (wife's) income elasticities of the wives' labor supply are greater than one (which is consistent with the secondary workers hypothesis), while the husband's income elasticity of wives' labor supply is much smaller than one.

Except for the husband's wage rate in the Bangkok model, all of the coefficients in the demand for children equations for the whole country and for Bangkok are statistically significant. These include the couple's wage rate, household income, the couple's education, the wife's age and an age square, the dummy variable of government-private sector employee and the maid dummy variable. However, in the non-Bangkok model, the couple's education and the maid variable are not significant. Therefore, children are normal goods and the opportunity cost of the couple's time has a negative effect on their demand for children.

The results of the estimated wage functions of husbands and wives show that the human capital variables, i.e. education and experience, are always significant in every model. College graduates are found to have higher wage rates than non-college graduates. While the wage rates of married women in the government sector in Bangkok are lower than their counterparts in the private sector, the reverse is true in non-Bangkok areas. Finally, the number of children and the hours of work are not found to have any significant effect on wage rates.

In conclusion, since paid employees are the only group of workers who fully pay the income tax, knowledge of the income and substitution elasticities of labor supply can be used to determine the effects of a change in the income tax structure or the effects of an introduction of a negative income tax program on the labor supply effort of paid employees.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Most research on employment in developing countries like Thailand has focused mainly on the issue of underutilization (or unemployment and underemployment problems) on the supply side[1] and labor absorption on the demand side.[2] Labor supply is generally assumed to be so abundant that it has infinite wage elasticity.[3] As a result, analyses of labor supply concentrate only on demographic factors, namely the size, age composition and growth rates of the population. Participation rates play a secondary and relatively minor role (Stolnitz, 1975, pp. 235-245). Hours of work, one of the most important dimensions of labor supply, as well as other factors such an intensity of work and health, play little role in the research literature.

The primary reasons for this shortfall are lack of data, problems of measurement and reliability of data. It is extremely difficult to measure the true number of working hours of self-employed persons--the single largest group in the Thai labor force--since their working time is irregular and because their place of work is usually in or around their own houses or farms. Hence production time is not easily distinguished from house-work time.

However, there is one small group of workers which poses less of a measurement problem. They are paid employees. In Thailand, the proportion of this group of workers has been steadily increasing (from 15% in 1950 to about 24.5% in 1976). The future role of paid employees in the Thai labor market will become even more important as the traditional sector gets smaller as a result of modernization of the economy and its organization. Although this group of workers is currently still proportionally small in the total labor market, to study their behavior is desirable because: (a) it is the largest group of workers in the urban area, (b) the economic organization and system of employment in which this group of labor works are, more or less, the same as those in the developed countries. Given these facts, it is possible to borrow and apply the labor-leisure choice model used in the developed country, with some modifications, to the behavior of the wage-workers in Thailand.

Purposes of the Study

The objective of this study is to analyse the labor supply behavior of paid employees in Thailand by using individual data from the Survey of Labor Force, 1977. Specifically, the purposes are:

1. To estimate the labor supply functions of married males and married females. Towards the design of the research methodology, the following was done: (a) since there are two different popular procedures to estimate the labor supply functions, this study first ran a comparison and the best estimation method was used, (b) for each population subgroup, different but appropriate forms of measurement of variables are used to estimate their labor supply functions, and (c) the same estimation procedure is applied to estimate the labor supply functions as specified by both the classical and the bargaining theories of labor supply.

2. To derive the range of values of income and substitution elasticities and other parameter estimators of the labor supply.

3. To test some implications from the classical and the bargaining theories of labor supply. The implications to be tested from the classical

theory are: (a) that the pure substitution effect must be positive, (b) that the income effect is negative if leisure is a normal good, and (c) that cross-substitution effects are equal. The implications from the bargaining theory are that husband's and wife's incomes do not have the same labor supply effects, and that the symmetry of the cross-substitution effects does not always hold.

4. To estimate the effects of income and wages on married couples' demand for children.

5. To estimate the earnings (or wage) functions as specified by human capital theory for these married couples.

Significance of the Study

The important aspects of the existing literature and of the Thai situation that give this study significance are:

1. This study is the first attempt to analyse Thai data on hours of work and wage rates at a cross-sectional disaggregated level. Previous studies of labor supply in Thailand (Maurer, Ratajczak and T. P. Schultz, 1973; Paitoonpong, 1975) analysed the labor force participation rates by using cross-sectional aggregated data which involve the problems of aggregation (Cain, 1966). Our approach uses the individual and/or family as the unit of observation and avoids the aggregation problems. Moreover, it is theoretically advantageous since it allows a direct application of the theory of utility maximization.

2. Since the income maintenance program has been initiated in the U.S.A. in 1969, there came an onslaught of research efforts to determine the effects of the program on the labor supply. However, the results on income and substitution effects from these studies give too wide a range

of estimates to provide a useful guide for policy. Quantitative magnitudes are critical because it makes a major difference (in terms of budget and welfare) whether the overall net reduction in labor supply (due to the subsidy program) is, say 5 percent or 20 percent. There are several reasons which account for the wide range of estimates among those studies: different methodologies, different sample sets, different measurement of variables, etc. The methodological issue is one of the most important causes of the wide range of estimates. There are two important competing methodologies used in these studies, and yet these two procedures--namely Kosters' (1966) and Heckman's (1971) procedures--have never been directly compared. This study suggests a simple way to compare these two methods. The comparison reveals that the Heckman model has negligibly higher explanatory power than the former for our data set.

Moreover, this study, unlike most of the previous studies which used a single equation approach, employs a system of simultaneous equations which are necessitated by the interrelationship of fertility, and labor supply behavior postulated by the new home economics. In addition to the joint estimation of the labor supply of husband and wife, fertility, wage rate and income are treated as endogenous variables.

3. A knowledge of the wage and income elasticities of labor supply will enable the government policy makers to determine the optimum rates of subsidy and income tax and the amount of budget required if the negative income tax program is to be set up to help the working poor in Thailand. In addition, the model also allows us to identify the economic determinants of fertility and wage rate, which in turn will enable us to say something about the family planning policies.

4. The empirical model developed here can be used as a stepping stone to study the behavior of the other more important groups of labor, namely, the self-employed and the agricultural workers.

Organization of the Study

After a brief review of previous studies on labor supply, Chapter Two will present the structure of various labor markets in Thailand. The chapter is intended as background for further analysis and as a pool of scattered information on the Thai labor market so as to stimulate and direct further research in this field. The remainder of Chapter Two focuses on the labor supply of paid employees. In Chapter Three, the classical theory of labor supply is briefly discussed and the appropriate empirical model is developed. The methodology used and econometric problems are also discussed in this chapter.

Chapter Four presents estimates of labor supply of working married couples. The labor supply of married men is estimated by pooling all observations in the country, while the model of the wives is separately estimated by region--Bangkok and non-Bangkok. The estimates of wage functions and demand for children are also discussed here.

The results are generally consistent with predictions of economic theories of labor supply, fertility and human capital.

Chapter Five discusses tests of some implications derived from both the classical and the bargaining theories of labor supply. The results reveal that the empirical model of married women can be more appropriately specified by game theory, rather than the classical theory of labor supply.

Finally, some conclusions and policy implications, given the limitations of this study, are discussed in Chapter Six.

Previous Studies of Labor Supply

Labor supply has been an interest of economists since introduction of the utility concept. However, it was not until the work of Lionel Robbins in 1930 that economists realized that the nature and slope of the labor supply function is an empirical issue, and not determined a priori. This is because it depends on two opposing forces, i.e. income and substitution effects.

Neoclassical Theory of Labor Supply

After the first formal Neoclassical theory of wage determination by Hicks--in his famous Theory of Wages (1932) in which he fully developed the theory of labor supply--the next major developments in this field did not appear until 1962. Mincer's studies of labor force participation of women (1962, 1963)[4] and Becker's seminal work on allocation of time (1965) realized that the simple and strict dichotomy of leisure time and hours of work was a questionable assumption. Mincer and Becker noted further that some non-employment activities cannot be assumed to be simple leisure, e.g. housework, commuting time, child bearing and child rearing, etc. Another finding was that the notion of time could not be treated as a consumption good. Instead, time and goods are inputs used in the household to produce commodities (e.g. child service) in the process of utility maximization (Becker, 1965; Lancaster, 1966). Some commodities require more time to consume than others. Hence labor supply is determined simultaneously with consumption.

After development of the economic theories of human capital (Becker, 1962), fertility (Becker, 1960), and innovation of the home production function (Becker, 1965; Lancaster, 1966), economists realized that all household decision making concerning uses of a household's goods and services, and the market and non-market uses of time, are interrelated. However, most research on household behavior still treats each aspect of choice largely independent of the wife's labor market behavior. Studies of consumption behavior have assumed wages, family size, and other factors as given (Modigliani and Brumberg, 1954). The labor supply literature treats labor force participation and hours of work as explained by exogenous variables such as family income, wage rates, number of children, etc. (Mincer, 1962; Finegan, 1962). Moreover, in spite of numerous empirical papers on male and female labor supply (Kosters, 1966; Greenberg and Kosters, 1973), there are few that treat the decision jointly (e.g. Heckman, 1971; Ashenfelter and Heckman, 1973; Wales and Woodland, 1976; Brown and Manser, 1977).

Studies of population economics have considered the effect of income and other socioeconomic variables on family size and child-spacing, but ignored the interrelationship of household behavior (O'Hare, 1972). The studies of investment in human capital also focus only on a simple choice between training and earning (Ben-Porath, 1970). However, all of the above variables are, in fact, interrelated.

The recent theoretical work of the new home economics (Willis, 1973) has integrated labor supply and human-capital investment decisions with decisions on the quantity and quality of children through a comparative static framework. To my knowledge, there are only three published empirical papers using a simultaneous equations model of labor supply of married women, fertility and wage rates. Two of them (G. Cain and M. Dooley, 1976; M. Nerlove and T. P. Schultz, 1970) use data aggregated across geographical locations to analyse the labor force participation of married women and their fertility, while the third (Fleisher and Rhodes, 1979) uses individual data although still measuring labor supply by the participation rate. Hence, there is a need to develop a model of the labor supply (measured by hours of work) of both husband and wife, their wage rates, income, and fertility within the context of simultaneous equations.

Beginning in 1972, another major development which attempted to integrate the theory of labor supply with human capital theory in the context of a dynamic life-cycle model (Weiss, 1972; Cohen and Stafford, 1974; Ghez and Becker, 1972; Heckman, 1973). While the traditional comparative static approach is illuminating, "it is not well suited to portraying the time paths of the important decision variables."[5] Some major implications of such integration are: (a) a static analysis of cross-sectional data will result in a failure to clearly separate those effects that are age-related from those that are not, and (b) the numbers of hours of work supplied to the market is positively related to the price of time over the life cycle (Heckman, 1971). The marriage of the neoclassical theory of labor supply with the model of human capital, however, has not been empirically fruitful. This is because of mathematical problems incurred by a dynamic model and of statistical problems accounting for unobservable variables (Heckman, 1975, pp. 227-228). This study will not follow the dynamic approach.

<u>Bargaining Theory of Household Labor Supply Decision</u>

One difficulty with the neoclassical theory of labor supply is its assumption of the existence of household utility function. A couple is assumed to maximize the family utility after they have decided to marry and pool their incomes. "But if the utility functions of the members of the household differ, then an assumption forcing them into this aggregate framework may not be acceptable in all cases."[6] Game or bargaining theory allows for different individual utility functions, and provides a means by which the differences are reconciled (Manser and Brown, 1976).

By assuming (a) that a couple's incomes are pooled and (b) that marriage provides not only the possibility of shared consumption (or a public good such as child service) but also that the couple are committed as an act of "love" and "companionship" (or in Brown-Manser's term "caring," which means that the couple's utilities are interdependent), the problem of household allocation of resources can be viewed as a cooperative, two-person, nonzero-sum game. Manser-Brown (M-B) consider two kinds of solutions, namely, the Nash (1973) and Kalai-Smorodinsky (1977) solutions and dictatorial rule. From these rules, M-B are able to derive and demonstrate the existence of a system of household demand for goods and services, leisure and marriage.

M-B show that the three neoclassical restrictions on demand functions (i.e. Cournot aggregation, Engel aggregation, and a negative semi-definite symmetric Slutsky matrix) do not all hold for the alternative household bargaining models (Manser and Brown, 1977, p. 11; McElroy and Horney, 1978a, p. 32). Further, if incomes are pooled, the neoclassical model implies that male and female exogenous incomes have identical effects on household members. The bargaining approach on the other hand, allows for the possibility that these effects differ. After estimating the parameters of male and female labor supply equations, M-B test two sets of restrictions on the equations: equal effects of male and female exogenous incomes and symmetry of the Slutsky matrix. Their estimates indicate that, based on the bargaining model without equal income effects, symmetry can be rejected. Based on the neoclassical model, with equal income effects imposed (as is done by Ashenfelter and Heckman, 1974), the symmetry conditions do pass.

Major Developments in Methodologies Used in Labor Supply Studies

1. The first study of labor supply using hours of work data is Paul Douglas' work (1934). By assuming identical tastes across geographical groups and constant prices, Douglas applied a simple regression technique to cross-sectional census data and found that the income effect outweighed the substitution effect. The backward-bending supply curve is further supported by the later, but more refined, works of Long (1958) and Finegan (1962), etc.

2. Martin Feldstein (1968) criticized these studies on the ground of identification problem, i.e. there is more than one endogenous variable in the supply equation. Although he suggested several methods to cope with the problem, he chose only a method of drawing data from a single homogeneous labor group to rectify the problem. His empirical results, however, proved inconclusive.

3. Marvin Kosters (1966) was the first to provide a link between the theory of labor-leisure choice and the labor-supply research, bearing on the measurement of income and substitution effects and to predict the impact of income tax on labor supply. He translated empirically estimated wage and income relationships with respect to labor supply into the type of substitution and income parameters that are contained in the labor-leisure choice models of household labor supply. But his empirical model still suffers many statistical problems, e.g. problems of simultaneity, measurement error, etc.

4. After the introduction of Income Maintenance Programs in 1969, there emerged voluminous research on labor supply response of low income

workers. Some of the contributions in those studies are worth mentioning here. First, a study of Hall (1973) solved the problem of measurement error in wage rates by using the predicted wage obtained from a first stage regression. Secondly, the labor supply decision can be hypothetically viewed as a two-stage decision: (a) a person has to decide whether or not he will work, and (b) if he wants to work, how many hours he decides to work. Some economists concentrate on the first stage, while others work on the latter. But Boskin (1973) and Kalachek and Raines (1970) approached the problem in a two-stage fashion: initially, they analysed the binary labor-force-participation choice and then they did a conditional analysis of the hours of work. Later on, Heckman (1974) and T. P. Schultz (1975) employed a Tobit technique which does not require a two-stage estimation. Since it is still extremely difficult to apply the Tobit method to our simultaneous equation model, this study will concentrate on the second stage of the labor supply decision.

5. Ashenfelter and Heckman (1973, 1974) emphasized the restrictions of certain conditions in the Neoclassical theory of demand (i.e. Slutsky symmetry, Cournot aggregation) on the estimated wage and income parameters of labor supply. Moreover, instead of treating the partial derivative of wage rate with respect to labor supply (which is the gross substitution effect) as a constant, they assumed, like the previous work on the Rotterdam model of market demand, that the compensated substitution effect is constant. This approach allows one to test the substitution parameter statistically, while Kosters' approach does not.[7] Moreover, the latter method may produce a negative compensated substitution effect which is contradictory to the utility theory of choice.

Although Ashenfelter and Heckman obtain joint estimates of male and female labor supply equations, their model still treats wage rates as exogenous variables.

6. In the empirical parts of studies on the bargaining theory of household labor supply decisions, Manser-Brown (1976) employed the Rotterdam (or Barten-Theil) model to estimate their labor supply functions. So the functional form used is double logarithmic. Although McElroy and Horney approached the problem by using the same approach of a system of demand functions, they used the linear expenditure system developed by R. Stone. However, both of them treated the system of equations as seemingly unrelated equations so that the estimation technique was much simplified, at the cost of simultaneity bias.

In summary, it is possible to improve the previous empirical models of labor supply in the following fashion: (a) estimating the husband's and wife's labor supply jointly, (b) treating wage rates and income as endogenous variables, and (c) including the fertility behavior in the same model since labor supply choices and fertility choices have been demonstrated to be interrelated.

NOTES TO CHAPTER I

1. For example, see F. W. Fuhs and J. Vingerhoets, Rural Manpower, Rural Institutions and Rural Employment in Thailand, National Economic Development Board, Bangkok, 1972.

2. See H. T. Oshima, "The Labor Force Explosion and the Labor-Intensive Sector in Asia Growth," Economic Development and Cultural Change (January 1971); N. Spoelstra and C. Isarangkun, "Labor Absorption in Thailand," The Philippine Economic Journal, Vol. XV, Nos. 1 & 2, 1976, pp. 238-272.

3. G. Ranis and J. C. H. Fei, "A Theory of Economic Development," American Economic Review, Vol. LI (1961), pp. 533-556.

4. Mincer's emphasis on a family as the appropriate unit of analysis, instead of an individual, provides a rationalization for the large positive wage effect on the wife's labor supply, relative to the effect on the husband.

5. Cohen and Stafford, "A Life Cycle Model of the Household's Time Allocation," Annals of Economics and Social Measurement, 3/3, 1974, p. 447.

6. M. Manser and M. Brown, Marriage and Household Decision-Making: A Bargaining Analysis. Discussion Paper Number 376, Department of Economics, State University of New York at Buffalo, March 1976. Samuelson (1956) discusses the alternative sets of assumptions which imply the existence of a social welfare function in general, and a household utility function in particular.

7. However, Ashenfelter-Heckman's approach has one major weakness, i.e. the constant income and substitution parameters, while convenient for local approximation, are generally mutually and globally inconsistent properties (except for a zero income effect case) of utility maximizing labor supply functions over a range of income and wage rates (J. Dickinson, 1977).

CHAPTER II

THE LABOR MARKET IN THAILAND: SOME BACKGROUND

The labor supply of non-agricultural paid employees in Thailand is estimated and analysed in this study. This group of workers comprises 24.5 percent of all employed persons (N.S.O., 1976, p. 29), but in order to put their behavior into a context, one has to understand the structure of the whole labor market before he can meaningfully draw any analysis.

The purpose of this chapter is to provide some background on the Thai labor market as well as to present a review of some of the previous studies relating thereto. The first section provides a background on the Thai economy and her labor market. The second section gives a brief review of the previous studies of the labor supply in Thailand. The third section discusses the distribution of hours of work, and the fourth section gives the structure of wages of paid employees.

Background

The Kingdom of Thailand covers 514,000 square kilometers of the Indo-Chinese peninsula. It has four major physiographic regions, each of which is further subdivided into administrative units called changwads.

Economic development, as measured by the real growth of GDP, since 1950 was impressive at 5.6 percent a year in the 1950s, and it accelerated to 7.6 percent annually in the 1960s, then slowed down to 6.3 percent per annum during the 1970-1976 period. At the same time, the population of Thailand has been rapidly rising at the rate of 3.2 percent, 2.9 percent, and 3.27 percent in 1950s, the 1960s, and the 1970-1976 period, respectively. Hence, the growth rate of per capita real GDP is at more than 3 percent annually during the 1950-1976 period. As is a well-known fact, the per capita income figure obscures large urban-rural and regional differentials. The 1962-1963 Household Expenditure Surveys suggest that in seven changwads of the Central region and in the North-east, the average per capita income of their respective villages were only 66 percent and 40 percent of the average per capita of the towns. For the whole Kingdom, the Gini coefficient of total income (money income plus income in kind) climbed from 0.47 in 1968-1969 to 0.49 in the 1971-1973 period (S. Wattanavitukul, 1977, Table 15), implying widening income disparities.

Thailand has been, and still is, predominantly agricultural. The 1960 Census, for example, reported 79 percent of male and 86 percent of female economically active persons as being engaged in farming activities. By the time of the 1970 Census, the figures were 76 percent and 84 percent respectively. Agricultural households, defined as those with household heads in agricultural occupations, formed 63 percent of all households in 1970.

Employment in Agricultural and Non-Agricultural Sectors

According to the Survey of Labor Force (N.S.O., 1974-1977) which is conducted twice a year, there is a large fluctuation in the size of the labor force for non-municipal areas between the dry season (January-April) and the rainy season in July-August period when the labor force is 30 percent greater than the former period.[1] This is largely due to the influence of the monsoon weather on agricultural production. At the same time, employment in most of the non-agricultural sector plays a counter cyclical role, especially the manufacturing sector which is dominated by agricultural product processing and construction. These usually employ unskilled labor from the agricultural sector who are otherwise idle during the dry season. It also turns out that employment for some other industries, e.g. commerce and transportation, which tend to be located in the urban centers such as Bangkok, also are affected by the same seasonal agricultural pattern. This is due to important linkages with the agricultural sector especially as they are either the main input and consumer goods suppliers to or buyers from the agricultural sector.

Another important pattern of demand for labor in the non-agricultural sector is through the influences of a linkage between agricultural supply and the demand for non-agricultural products. For example, the 1973-1974 rice price was three times higher than that in 1971, hence farmers' income in 1973-1974 was temporarily high and so was their demand for consumer products and services from other sectors. Therefore, the number of employed persons in the non-agricultural sector was much higher than the 1972-1973 and 1975 periods. Furthermore, in 1973, there were 1.5, 0.29 and 1.39 million employed persons in the manufacturing, construction and service sectors, respectively. These figures jumped to 2.13, 0.327 and 1.83 million in 1974, and then declined to the normal level of 1.9, 0.261 and 1.6 million in the corresponding sectors in 1975 (using adjusted growth rates of the labor force.)

Family Enterprises and Wage Employment

The typical farming unit in Thailand has always been characterized by the small subsistence rice farm and not the plantation or large-scale commercial enterprise. Traditionally most people, men and women, worked on the family farm producing for their own consumption instead of for wages. Bartering among households was minimal as well. And less than

6 percent of the total labor force in 1976 were paid employees in agriculture.

Similarly, outside the agricultural sector, a large number of individuals do not work for money wages. In such instances, family operations such as shops, restaurants, and grocery stores take precedence. Such enterprises are called the traditional or informal sector. Only a small number of workers are in the other non-agricultural sector or, so-called modern sector, that essentially consists of public services, modern commerce and industry, etc.

There are some important features which distinguish the family farm or family enterprises in the informal sector from wage employment in the modern sector. First of all, most workers in a family enterprise are unpaid relatives. The industries that tend to employ the highest proportion of family workers are those dealing with footwear (16%), machinery excluding electrical machinery (14.3%), metal products (8.2%), and basic iron and steel industries (7.5%). Note that the proportion of unpaid family workers declines as the employment size of an enterprise increases.

Second, the small scale enterprises are more labor intensive than large scale enterprises. A firm with an employment size of 10 to 49 persons[2] has to invest an extra ฿67,700 in fixed assets so as to add one more person, while the firm with an employment size of 200 or more persons has to invest as much as ฿216,100. The small scale enterprises also tend to be geographically more dispersed than the larger units. They consist of almost every type of business with the largest groups comprising restaurants and textiles. Together these employed 28 percent of all workers in 1976 (S. Sguanruang, S. Tamboonlertchai, et al., 1976, p. 59). Next largest groups are wearing apparel and furniture. More than half of their output is comprised of consumer goods. Only 15 percent of their outputs are intermediate inputs to other industries.

Third, the place of work for the family enterprises is in, or close to, their homes. Cottage industries, especially those requiring the raising of silkworms or weaving, are carried on in the immediate premises of their houses. Shop-houses also double as family activity areas. Many social activities ensue in the course of a work day with neighborly visits and baby-sitting being common. As a general statement it can be said that there is no special segregation of family and work activities.

Fourth, these family workers do not allot special times for work and for family matters. Tending a store can be interrupted at any time for domestic chores. This holds true whether the worker is a family member or not. Even those that are paid employees are not subject to enforced working hours.

Lastly, a family enterprise is not dominated by any one individual. Business is a concern for all. This is because the enterprise's output is directly affected by the performance of each member as their total efforts are affected by the success of the enterprise. As to who may participate in the enterprise, the decision is reached only upon family consensus which often reflects the view of a head of the household.

In summary, for someone self-employed or involved in family oriented industries, occupation is more than a means to income. It is a lifestyle and is likely to be immersed in local tradition and custom.

Population Growth and Labor Force Participation

The widespread control of malaria in the late 1940s and early 1950s substantially reduced the death rate and contributed to the high population growth rate which has accelerated at almost 3 percent a year since 1950.

The distribution of population among regions has changed very little since 1947. The Northeast has the largest share of the population, while the South has the smallest share. In 1970, only 13 percent of the population resided in municipal areas of which Bangkok has the highest share of urbanites with a population of 4.5 million at the end of 1977. In constrast, the next largest city, Chiengmai, has a population of a little more than 100,000.

Despite Thailand's accelerated population growth in the 1950-1976 period, the growth rates of her labor force and employed persons, aged 11 years and over, have been steadily decreasing from 2.7 percent in the 1950-1960 period to 2.4 percent and 1.6 percent in the 1960s and 1970s, respectively (Labor Force Survey, 1950-1976). Such rapid increase in the number of persons aged 11 years and over who stay out of the labor force is a reflection of the government's heavy investment in education since the first national economic development plan, as more and more young people continue to pursue education.

The 1960 Population Census showed 82.7 percent of males and 77.2 percent of females 11 years of age and over as economically active. The census figures for 1970 were 81.5 percent and 71.1 percent. If some adjustment could be made so that international comparisons of labor force participation rates are possible, Thailand would figure high as a country with a high female participation rate. This may be explained in that there are no religious or social barriers discouraging the participation of Thai women in the labor sector. If anything, Buddhism, the religion of

95 percent of the population, urges all individuals to share through honesty and hard work.

Ethnic and Religious Composition

In Thailand, those of Thai ethnicity account for about 80 percent of the population. In the economic arena, the minority Chinese are prominent. Comprising 15 percent of the Thai population, they nonetheless dominate the agricultural marketing system as well as retail and wholesale trades. Thais, on the other hand, dominate the agricultural sector and thereby cultivate almost every crop, save cassava, which is grown mainly by the Chinese.

Before World War II when non-agricultural wages were kept relatively high, most of the non-agricultural jobs, especially hired laborers, were filled by the large influx of Chinese immigrants. Only after 1960, a few decades after restrictions on immigration, have Thai peasants begun to migrate to the cities to become hired workers after the economic situation in the rural area worsened.

Buddhism, as mentioned earlier, is the dominant religion in the Kingdom with 95 percent of the population profession practice thereof. This is one of the major reasons for the high rate of female labor force participation. The South is the only region which is dominantly Islamic.

Education

Traditionally, education in Thailand consisted of studying the Buddhist scriptures in Pali and in the vernacular. This changed after compulsory secular primary (4-year) education was established in 1921, but it had no effect in rural areas because of lack of manpower, budget and poor communication systems. Education was only realized in the rural areas after the 1922 revolution. Today advanced education is contingent on competition. Rural youths are at a great disadvantage in these exams because of their poor preparation at the primary school level and parental reluctance to release them from family responsibilities. Only the persons from the rich and upper-middle income class have the best opportunity to enter the state colleges which are capable of admitting only 10 to 15 percent of the high school graduates who apply for the entrance examination.

Consequently, the distribution of education attainment, if plotted by sex, assumes an age pyramid-like shape, i.e. while about 80 percent of employed population have less than four years of education, less than two percent have more than a high school education.

Previous Studies of Labor Supply in Thailand

Of the very few studies on the labor supply in Thailand, all deal with the determinants of labor force participation. A brief review of these studies will highlight a need for further research in this field.

Rachapaetayakom's demographic work (1972) is a comparative study of the sex and age patterns of labor force participation in the urban and rural areas. Using the 1960 Population Census, she found that the urban population has a lower crude participation rate than does the rural population because of the different age structure between the two populations. Moreover, she also observed that the age-specific participation rates also show the same phenomenon. Her explanation of lower activity rates in urban areas was that most of the young people in the cities are still in school.

Maurer, et al. (1973) used a rigorous econometric method to study the labor force participation of women in the non-agricultural sector and the determinants of fertility and marriage. The three-equation model is developed and is estimated for six five-year age groups of women as well as for an aggregated group of all women. Here are some of their findings. Fertility, women's education (relative to men) and unemployment are found to have a negative effect on women's participation rate. The fertility effect is strongest when women are between the ages of 20 and 29 and is weakened thereafter. The negative effect of education is interpreted as the increase in women's productivity in non-market activities due to higher education, if market wages are held constant. So incentives to participate in the labor market are reduced. Finally, the female wage is found to have an anticipated positive effect on participation.

Oey Meesook (1977) employed an analysis of variance-regression model to estimate the labor force participation function of married women in the whole nation by using data from the Socioeconomic Survey of 1968-1969. The results show that: (a) the probability that a woman with children aged under seven years will work is 7 percentage points lower than that of a man with otherwise identical characteristics. So the hypothesis that household duties constrain the woman's participation rate is confirmed. (b) A woman from the poorest households (defined as the income per capita of the head of the household unit) will enhance her probability of participation by 5 percent. But participation rate of those from rich families is reduced by 3 percent. (c) In general, the larger the number of adults in a household, the higher the likelihood of participation. (d) A woman with nine years of education or less is likely to work more, but one with more than nine years of education has lower participation rate by 8 percent. (e) The existence of a family enterprise increases the probability of working by 2 percentage points. And (f) finally, the participation rate is 17 and 9 percentage points lower in non-agricultural and urban areas than that in agricultural and rural areas, respectively.

Paitoonpong (1976) estimated the age-sex specific participation rate equations within a context of three simultaneous equations: participation rate (or supply function), family income, and wage (or demand) functions. His supply function depends on wage rates, family income, unemployment rates, industrialization, education, population density and family size. He used the cross-sectional data from the 1970 Population Census and estimated his model by two-stage least squares technique. The results show that participation rates of prime age males are less sensitive to socioeconomic variables than those of other groups of the population. The wage elasticity of males in all age groups is not significant, while the female wage elasticity ranges from 0.35 in the 30-39 age group to 2.38 in the 60-69 age group. The female income elasticity is estimated in the range of -0.41 (for the 30-39 age group) to -1.41 (for the 11-14 age group). The male income elasticity estimates are inconclusive because some age groups have negative elasticity, some have positive value, and other have non-significant elasticity. Education is found to have a positive effect on participation rates of the young of both sexes, while it has a large negative effect on participation rates of women 40-59 years of age, but has insignificant effect on the participation of men 15-49 years of age. Other variables are also found to have the anticipated signs, e.g. family size is positively related to the participation rates of women aged 40 and over.

Unfortunately, studies of the labor market in Thailand stop short of an analysis of hours of work. Moreover, none of the studies have estimated the labor supply of husband and wife within a joint-decision model. All of the studies, except Meesook's, used aggregated data to estimate their model. Therefore, it is necessary that a further step should be taken, i.e. a more complete family joint-decision labor supply and fertility model developed from the complete system of household demand functions should be estimated by using the individual household data. Before we present our model of labor supply in Chapter Three, it will be informative if the pattern of hours of work and wage structure are discussed first.

Hours of Work

Table 1 gives a distribution of hours of work of paid employees and self-employed workers in the municipal and non-municipal areas. There are some characteristics that should be noted. First, the distribution is bimodal, i.e. hours of work for both paid employees and self-employed workers peak at 40-49 hours per week in the municipal area and again at 70-79 hours. For the non-municipal area, its first peak is at 50-59 hours per week. One possible explanation for this phenomenon is that some enterprises have modern organization and management with a five or six day work week. Moreover, some people, especially paid employees who hold a second job, may report the working hours for both jobs.

Second, in the metropolitan area, paid employees' working hours are shorter than those of self-employed workers. For the non-metropolitan area, however, the working hours of the latter are shorter because (a) the data presented is from the dry season period (January to March). It is this time

Table 1

Distribution of Hours of Work by Work Status and Area

Hours per Week	Municipal		Non-Municipal	
	Paid Employees	Self-Employed	Paid Employees	Self-Employed
Less than 10	8,989	11,651	31,660	1,939,440
10-19	4,290	5,510	17,720	72,750
20-29	13,440	28,690	64,390	408,120
30-39	245,860	67,790	299,520	951,420
40-49	340,960	204,650	630,840	1,966,410
50-59	168,430	185,540	662,040	2,036,330
60-69	56,150	76,070	187,920	787,480
70-79	88,150	221,300	235,590	1,187,360
80-89	33,230	80,360	48,920	330,850
90+	14,000	27,520	13,350	24,210
Unknown	200	100	20,760	2,960
Total	1,173,700	909,600	2,212,670	9,519,480
Mean	48.13	55.90	50.88	43.32

Source: National Statistical Office, Labor Force Survey Round 1, 1976.

when demand for agricultural labor is at the lowest point and demand for non-agricultural labor in the non-metropolitan area is at its highest. The reverse is true in the rainy season.

Third, paid employees in the non-metropolitan area work longer hours than those in the metropolitan area. The dominant production characteristics of small scale enterprises in the rural area and the important role of the modern sector in the urban area may be the cause of such phenomena.

Finally, although paid employees account for 24.5 percent of all workers, they comprise 56 percent of all workers in the metropolitan area. Therefore, it is significant to study the labor supply behavior of the paid employees in the metropolitan area.

Table 2 gives the average weekly hours by occupation. As is expected, the working hours of workers in the professional, administrative and clerical jobs are much lower than other occupations. Second, in the metropolitan area, men's working hours are longer than women's, but this is not generally true in the non-metropolitan area.

The Structure of Wage

Table 3 reveals that male's average hourly wage is higher than female's. Second, the median wage for men is only ฿3.72 per hour which is about ฿2.05 less than the average values. The female median wage is ฿3.02 per hour which is also less than the female arithmetic mean wage of 4.767. Therefore, there exists the male-female wage differential.

A study on the structure of wages in the industrial sector in Thailand found that 58.8 percent of all workers in the sampled enterprises are paid on a daily basis, while 36 percent receive monthly salary,

Table 2

Average Working Hours Per Week by Occupation

Occupation	Metropolitan		Non-Metropolitan	
	Male	Female	Male	Female
Professional	39.43	37.09	34.78	34.88
Administrative	45.65	42.05	45.26	28.47
Clerical	42.62	42.15	44.27	40.61
Sales Workers	59.89	59.00	61.58	58.37
Farmers	50.91	48.01	38.27	47.10
Transport	57.49	52.10	59.70	52.98
Craftsmen	50.15	49.82	51.45	47.39
Service	51.83	60.10	52.02	59.67

Table 3

Distribution of Real Wage Rate per Hour

Wage (Baht)	Male		Female	
	Number	Percent	Number	Percent
0	32	0.51	29	1.00
1	462	7.43	444	15.30
2	1030	16.53	608	20.95
3	963	15.46	361	12.44
4	899	14.43	280	9.65
5	673	10.80	249	8.58
6	512	8.22	236	8.13
7	378	6.07	201	6.93
8	279	4.48	141	4.86
9	227	3.64	90	3.10
10+	774	12.42	263	9.06
Total	6230	100.00	2902	100.00
Mean	5.778	-	4.767	-

Source: National Statistical Office, <u>Labor Force Survey Tape, Round 1</u>, 1976.

and 5 percent are piecemeal workers (Phasi, et al., 1976). Industries that pay workers on a daily basis tend to hire more labor per factory than other industries. They are non-metallic mineral products (excluding petroleum products), construction, textiles, sawmills, furniture, etc. Industries that pay monthly salary tend to be in the modern sector. They are banking and financial institutions, hotels, education institutions and government.

In Thailand, fringe benefits (both in kind and in money) are a significant part of remuneration which help increase workers' real income. Normally, large companies pay more bonus and also higher money wages than small companies. However, the latter tend to pay more fringe benefits in kind, such as housing and food. Hence, variation in the total wages between workers of similar skill level in different industries may not be as large as the variation in money wages.

NOTES TO CHAPTER II

1. Most studies of rural employment utilization in Thailand argue that the slack demand for agricultural labor in the dry season and limited off-farm employment are the main causes of under-employment. However, a recent careful and detailed study by Trent Bertrand (1977) discounts these findings. Bertrand argued that (a) in the rainy season, there is a large increase in the labor force participation of females and teenagers to meet the high demand for agricultural labor. When the dry season comes, these two groups of workers simply drop out of the labor force to perform non-market activities. They are not idle and (b) farmers who have limited potential for farming in the dry season (due to lack of water) do not stay inactive, but compensate the loss of their farm income by increasing their off-farm employment.

2. The firms of this size or smaller hire the highest proportion of family workers.

CHAPTER III

A THEORY OF LABOR SUPPLY AND MODEL SPECIFICATION

This chapter brings us back to the main focus of the study, namely, the study of the behavioral responses of male and female labor supply in Thailand. The first section presents a brief discussion of a well-known classical theory of demand for leisure. Then, two different procedures of estimation are compared in the pursuit of the best methodology. Next, an empirical model of the family labor supply is specified in the third section. Finally, the fourth section discusses the problems of measurement and aggregation and the model in the third section is modified to fit the behavior of each population group.

A Theory of Family Labor Supply

Since the seminal work of Mincer (1962, 1963) and Becker (1965), the classical theory of labor-leisure choice has been modified in many aspects.[1] One important modification, mentioned early in Chapter One, is a shift of the unit of analysis from an individual to a family.[2] As a result, labor supply decisions are regarded as family decisions, and they are only one aspect of the division of labor among the family members. Each one will allocate his time according to his comparative advantage in market and non-market activities such that the utility of the family is maximized. Comparative advantage in turn depends on each member's marginal productivity in market activities (as measured by the wage rate) as well as on cultural or legal restraints and biological specialization of function. Therefore, the labor-supply choices of each family member will depend not only on his/her own wage rate, but also on that of other family members, on the total resources of the family, and on the marginal productivity of each member in non-market activities.

The Classical Utility Theory of Labor Supply

The theory of labor supply assumes that the family behaves as if it maximizes a well-behaved utility function subject to a budget constraint. If a family of two members, husband and wife, is assumed, its utility function is:

$$(1) \qquad U = U\ (RM,\ RF,\ C,\ X)$$

where RM and RF are the amounts of time spent in non-market activity in one period by husband and wife, respectively. C is the number of children or the services from children and X is a Hicksian composite of all consumption goods[3] (Hicks, 1939, p. 312). The budget constraint is:

$$(2) \qquad P_x X + P_c C = WM\ (T-RM) + WF\ (T-RF) + Y$$

where P_x = price of composite goods, P_c = price of child, WM and WF = the male and female wage rates, respectively, T = each member's total time, Y = non-labor income.

Maximizing (1) subject to (2) yields the following first order conditions.

$$(3) \qquad \begin{aligned} U_{RM} &= \lambda \cdot WM \\ U_{RF} &= \lambda \cdot WF \\ U_C &= \lambda \cdot P_C \\ U_X &= \lambda \cdot P_X \\ U_\lambda &= P_X X + P_c C - WM\ (T-RM) - WF\ (T-RF) - Y \end{aligned}$$

where λ is a Lagrange multiplier interpreted as the marginal utility of income. Assuming the second order conditions for maximum are satisfied, we can solve the above system for five unknowns, RM, RF, C, X, and λ in terms of WM, WF, P_c, P_x, and Y. The resulting system of demand equations is:

$$
\begin{aligned}
R_i &= R_i\ (WM,\ WF,\ P_c,\ P_x,\ Y) \\
(4) \qquad C &= C\ (WM,\ WF,\ P_c,\ P_x,\ Y) \\
X &= X\ (WM,\ WF,\ P_c,\ P_x,\ Y)
\end{aligned}
$$

Since $L_i = T - R_i$, we can transform the demand for leisure in (4) into the corresponding labor supply functions:

(5) $$L_i = L_i\ (WM,\ WF,\ P_c,\ P_x,\ Y)$$

Using the Slutsky equation to predict the effects of changes in income and wage rate on hours of work supplied by decomposing the effect of a change in wage rate into (a) compensated substitution effect, S_{ij}, and (b) income effect or $L_j \frac{\partial L}{\partial Y} j$.

(6) $$\frac{\partial L_i}{\partial W_j} = S_{ij} + L_j \frac{\partial L_j}{\partial Y} \qquad (i=m,\ f;\ j=m,\ f)$$

The classical utility theory predicts that the own substitution (or wage) effect is positive:

(7) $$S_{ii} > 0$$

Secondly, the cross-substitution effects must be equal:

(8) $$S_{mf} = S_{fm}$$

Thirdly, the determinant of the Slutsky matrix is:

(9) $$\begin{vmatrix} S_{mm} & S_{mf} \\ S_{fm} & S_{ff} \end{vmatrix} > 0$$

The determinant in (9) must be in strict inequality because we are dealing with a consumption bundle subset (Samuelson, 1947, p. 115).

Finally, if leisure and non-market activities are not inferior goods then the income effect $\left(\frac{\partial L}{\partial Y}\right)$ is negative.

The Complete Demand System

The system of demand equations in (4) can be viewed as complete demand system.[4] Since system (4) is in a deterministic form, the knowledge of (n-1) equations will enable us to determine the last equation. However, to estimate the demand functions in (4), a disturbance term must be added into each of the equations in model (4). Here, we employ a variant of the Rotterdam demand model developed by Heckman (1971) to estimate the demand functions. Moreover, we have chosen to omit one of the demand functions, namely the demand for goods and services, from our statistical model.[5] System 4, hence, becomes:

(10) $LM = LM\ (WM,\ WF,\ P_c,\ P_x,\ Y)$

(11) $LF = LF\ (WM,\ WF,\ P_c,\ P_x,\ Y)$

(12) $C\ = C\ (WM,\ WF,\ P_c,\ P_x,\ Y)$

Following Heckman (1971, p. 6), conditions (7) and (8) will be tested. Since condition (7) does not hold as a strict inequality "because of sampling, and because the actual parameter values may be close, or equal to zero[6]," we will simply test that the inequality is not reversed. Moreover, if these conditions pass the test, restriction (8) will be imposed onto the data to improve the efficiency of the estimates.

Estimation Procedure

> The principal unsettled issue in the classical labor supply analysis is the manner of its empirical implementation. In practice, this involves a choice of which functions to treat as constant parameters for purposes of estimation (Ashenfelter and Heckman, 1973, p. 269).

Unfortunately, economic theory does not determine any specific functional form of the labor supply function. As a consequence, various functional forms have been employed in the labor supply research, e.g. a linear model, a semi-logarithmic model, or a Cob-Douglas model. This study does not intend to solve this unsettled issue of functional form. Instead, it assumes, as in many studies, e.g. Kosters (1967), Heckman (1971), Greenberg and Kosters (1973), etc., that the labor supply relation is linear. However, there are two popular estimation methods within this family of linear models; namely Kosters' model and Heckman's procedure. This section provides a simple way to compare them.

The first most frequently used approach, suggested by Kosters (1966), is a linear approximation of the labor supply functions in (10) and (11):[7]

(13) $$L_{ik} = a_0 + a_1 WM_k + a_2 WF_k + a_3 Y_k \qquad (i = m, f;\ k = 1, \ldots, N)$$

where L is the hours of work, WM is the husband's wage rate, WF is the wife's wage rate, Y is non-labor income, subscript i represents the ith family member, k is the kth observation, and a_1, a_2, and a_3 are partial derivatives which are assumed to be constant for estimation purposes. There are two disadvantages with this approach. First, persons who work longer hours would have a numerically larger value of substitution effect, S, (if a_3 is negative). This can be seen by rearranging the Slutsky equation:

(14) $$\frac{\partial L_i}{\partial Wj} = S_{ijk} + L_{jk} \frac{\partial L_i}{\partial Y} \qquad (i = m, f;\ j = m, f)$$

so that it becomes:

(15) $$S_{ijk} = a_1 - a_3 L_{jk}$$

Secondly, it is possible to choose a non-negative value of L_{jk} such that the substitution effect S_{ijk} in (15) is negative. This violates the crucial prediction of classical theory (Ashenfelter and Heckman, 1973, p. 270).

Heckman (1971) and Ashenfelter and Heckman (1973, 1974) proposed an alternative scheme which treats the income effect and substitution effect as constant. Their basic function can be derived by differentiating equation (5) totally and also assuming the dP = 0:

$$(16) \qquad dL_i = \frac{\partial L_i}{\partial WM} dWM + \frac{\partial L_i}{\partial WF} dWF + \frac{\partial L_i}{\partial Y} dY + \frac{\partial L_i}{\partial P_c} dP_c \qquad (i=m,\ f)$$

After the substitution of equation (14), denoting $\frac{\partial L_i}{\partial Y}$ by B_i, and ignoring subscript K, equation (16) becomes:

$$(17) \qquad dL_i = S_{im}\, dWM + S_{if}\, dWF + B_i\,(LM^*(dWM) + LF^*(dWF) + dY) + \frac{\partial L_i}{\partial P_c} \cdot dP_c \qquad (i=m,\ f)$$

However, equation (17) is still in terms of unobservable infinitesimal changes which have to be replaced by the deviations of the variables from their mean value in cross-sectional data, i.e., replacing dWM, dWF, dY, and dL_i by CWM, CWF, CY, and CL_i, respectively. Moreover, the empirical counterpart of LM^* and LF^*, which are the points of compensation for a wage change of size CWM (or CWF), must be specified.[8] The two obvious choices are between L_i (or observed equilibrium hours) and $\overline{L}_i$ (or the mean values). If the second choice is selected, "the points of compensation would be the same for all observation, which unduly strains the interpretation of equation (17) as first-order approximations. A consequence of either choice would be the asymmetry accorded the treatment of changes from $\overline{L}_i$ to L_i, and vice versa."[9] The problem occurs only because of the finite nature of the wage change. A natural way to avoid this asymmetry is to use a simple average of these two possible values, i.e., $L^*_i = (\bar{L} + L_i)/2$.

(18) $$CL_i = S_{im}\,CWM + S_{if}\,CWF + B_i \left\{\frac{(LM + \overline{LM})}{2} \times CWM + \frac{(LF + \overline{LF})}{2} \times CWF + CY\right\}$$

If Koster's formulation is rewritten in terms of the full income concept, i.e., F = WM x T + WF x T + Y where T is total available time, then the only difference between the linear model in (13) and Heckman's formulation in (18) is the measurement of the income variable which enters the former model linearly, but enters non-linearly in equation (18). Since the dependent variable in Heckman's model is measured as deviation from mean, while that in Kosters' model is a level (hours of work per period), the total variation (TV) of the dependent variable is the same in both methods. The total variation of working hours in (13) is:

(19) $$TV^K = \sum_{k=1}^{n} (L_k - \bar{L})^2$$

The total variation of the dependent variable in equation (18) is:

(20) $$TV^H = \sum_{k=1} (CL_k - \overline{CL})^2$$

Substituting $\overline{CL} = \overline{L_k - \bar{L}}$ and $CL_k = L_k - \bar{L}$ into (20):

(21) $$TV^H = \sum_k \left\{(L_k - \bar{L}) - (\overline{L_k - \bar{L}})\right\}^2$$

Since $(\overline{L_k - \bar{L}}) = \frac{\Sigma(L_k - \bar{L})}{n} = 0$, equation (21) becomes:

(22) $$TV = \sum_k (L_k - \bar{L})^2$$

Therefore, total variation in (19) must equal that in (22).

Following Friedman's argument, the two models can be compared on the basis of their power of explanation, i.e., comparing R^2. Such comparison, however, proves inconclusive.[10]

Still, Heckman's model has the advantage of allowing us to test statistically the predictions of the classical theory in equations (7) and (8). And if they pass the test, these restrictions can be imposed onto the data to improve the efficiency of estimates. Therefore, Heckman's formulation is preferred to Kosters' model, and equation (18) will be employed to estimate the labor supply throughout this study.

But, as mentioned in Chapter One, Heckman's procedure is not without any weakness. Dickinson (1977) has shown that the estimation method of assuming constant income and substitution parameters provides only a good local approximation.

Model Specification

To transform the above theoretical model into an empirical model, two modifications must be made: (a) the problems of simultaneity and measurement errors must be corrected for; and (b) since the model is developed within the context of the developed countries, some underlying behavioral assumptions may not be appropriate for developing countries. They must be modified to make the model more applicable to Thailand.

Simultaneity and Error of Measurement Problems

There are several conceptual as well as statistical problems with the labor supply model developed above. First, the wage rate should be treated as an endogeneous variable because (a) a worker can choose among a variety of employment compensation packages of which money wage rate is only one component (Cain and Watts, 1973, p. 354); (b) the wage rate not only determines but is also determined by hours of work because employers often include restraints on the choice of hours in their employment offer. Hence, full-time workers may be able to command a higher wage than part-time workers if their skills and job characteristics are the same;[11] and (c) a woman's human capital investment is affected by her desired and actual number of children.

Secondly, as Hall (1973, p. 109) pointed out, regressing labor supply on the wage rate faces the problem of a biased estimated wage coefficient if the observed wage rate is measured with error.

One way to handle these problems is to replace the observed wage variable in the supply function by its predicted value obtained by instrumental variable technique or equivalently from the first stage of the two-stage least squares technique (T. P. Schultz, 1975). Hence, two wage equations must be added to the model. The specification of the wage functions is discussed in the next section.

Thirdly, the number of children demanded is an endogenous variable because our model treats the decision making concerning labor supply and fertility as interrelated.

Finally, income is treated as endogenous because the way it is measured in equation (28) below makes it correlate with the error terms in both the husband's and the wife's labor supply functions. If income were treated as exogenous, the least squares estimates of the regression parameters would be biased and inconsistent, with the degree of bias and inconsistency being related to the variance of the error terms in the estimated regression (Pindyck and Rubinfeld, 1976, p. 129). When income is replaced by its predicted values (from the 2SLS), which are uncorrelated with the error term, the estimated parameters are asymptotically consistent. Therefore, one income identity must be added to the model.

Consequently, our labor supply model consists of one income identity, and a set of five simultaneous equations which are: two labor supply functions, two wage functions for husband and wife, and the demand for children equation. The system has six endogenous variables, namely husband's working hours and wage rate, wife's working hours and wage rate, number of children and income.

Modification of the Model

Two elements that necessitate modifying the model are:

1. Income Pooling Behavior. One of the common practices among the family members in the extended family, which is still quite common in Thailand,[12] is to pool their income (on both a formal and informal basis) to meet household expenses. Such behavior may affect household income. Therefore, the family's budget constraint must be redefined to include the other family member's income. Failure to do so is equivalent to committing a measurement error in the income variable which will result in biased and inconsistent least squares estimates.

Moreover, the presence of other family members may increase or decrease the time available for the production of home goods and services (including child rearing). Therefore, the price of time of the couples and shadow prices of home goods and services are affected by the extended family via a shift in the production function of home goods. This makes it necessary to include family size as another explanatory variable in the labory supply function,[13] if unbiased results are to be obtained.

2. The Thai labor market in the cities has a dualistic structure, i.e., it consists of two subsectors, namely a modern sector and the

traditional (or "murky") sector. The modern sector consists, essentially, of the public services, education, modern commerce and industry. It is characterized by modern organization, management, fixed working hours and employment contracts; it is usually dynamic and uses a relatively large amount of capital per worker (J. Gaude, 1972, p. 475). The traditional sector which consists largely of shop-houses, small scale construction, cottage industries, petty trade such as vendors, etc. is noted for its poor organization, ease of entry, lack of a stable employer-employee relationship and little capital per worker (G. S. Fields, 1975, p. 1972). Most of these activities operate seven days a week, more than ten hours a day. The working hours of both the self-employed workers and paid employees in this sector are longer than the paid employees in the modern sector.[14] Therefore, it is necessary to include a variable which is a proxy of such a structure. The variable used in this study is discussed in the next section.

Functional Form and Controlled Variables

The functional form of all five equations in our model is assumed to be linear. The complete specification of each equation and the definitions of variables are given in Tables 4 and 5, respectively. The specified exogenous variables are supposed to control for the individual differences in tastes, for the systematic life cycle pattern, and for the differences in the amount of human capital stock. The expected signs of all variables are discussed below.

1. The dependent variable in the labor supply function is measured by number of hours worked in the survey week.[15] The pure substitution (wage) effect on hours of work supplied must be positive and the income effect should be negative if leisure is a normal good. However, the

Table 4

MODEL SPECIFICATION[1]

(19) $CLM = a_o + a_1CWM + a_2CWF + a_3CHI + a_4C + a_5EDM + a_6AGEM + a_7SQAGEM + a_8MIGM + a_9GOVM + a_{10}OCPM + a_{11}UN + a_{12}FSIZE$

(20) $CLF = b_o + b_1CWM + b_2CWF + b_3CHI + b_4C + b_5EDF + b_6AGEF + b_7SQAGEF + b_8GOVF + b_9OCPF + b_{10}UN + a_{11}FSIZE$

(21) $CWM = c_o + c_1CLM + c_2C + c_3EDM + c_4EXPM + c_5SQEXPM + c_6COLM + c_7GOVM + c_8FRINGM + c_9BKK$

(22) $CWF = d_o + d_1CLF + d_2C + d_3EDF + d_4EXPF + d_5SQEXPM + d_6COLF + d_7GOVF + d_8FRINGF + d_9BKK$

(23) $C = e_o + e_1CWM + e_2CWF + e_3CHI + e_4EDM + e_5EDF + e_6GOVM + e_7SEV + e_8NORTH + e_9N\text{-}EAST + e_{10}SOUTH + e_{11}BKK + e_{12}AGEF + e_{13}SQAGEF$

(24) $CHI = CY + \frac{(LM + \overline{LM})}{2} \times CWM + \frac{(LF + \overline{LF})}{2} \times CWM$

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[1] Some of the variables, which are not significant in the preliminary experiement, are discussed in Appendix B.

Table 5

Names and Definition of Variables

Endogenous Variables

LM	=	husband's hours of work per week
LF	=	wife's hours of work per week
CLM	=	deviation of husband's weekly hours from mean hours ($\overline{LM}$)
CLF	=	deviation of wife's weekly hours from mean hours ($\overline{LF}$)
WM	=	husband's wage rate (baht per hour) deflated by CPI, 1970 = base year
WF	=	wife's wage rate (baht per hour) deflated by CPI, 1970 = base year
CWM	=	deviation of husband's real wage rate from mean wage ($\overline{WM}$)
CWF	=	deviation wife's real wage rate from mean wage ($\overline{WF}$)
HI	=	household labor income (LM x WM + LF x WF + Y, where Y is other family members' labor income) deflated by CPI
CHI	=	$\frac{(LM + \overline{LM})}{2}$ x CWM + $\frac{(LF + \overline{LF})}{2}$ x CWF + CY where CY is deviation of other family members' income from its mean income ($\overline{Y}$) or Y - $\overline{Y}$
C	=	number of children of the couples living in the same household

Exogenous Variables

AGEF	=	wife's age (years)
AGEM	=	husband's age (years)
COLF	=	1 if wife has college or vocational education, 0 otherwise
COLM	=	1 if husband has college or vocational education, 0 otherwise
EDM	=	husband's education (years)
EDF	=	wife's education (years)
EXPF	=	wife's experience (years) = AGEF - 7 - EDF - experience loss due to discontinuous labor participation caused by marriage and child-bearing (see Appendix C)
EXPM	=	husband's experience (years) = age - 7 - years of education
FSIZE	=	number of persons living in the same household
FRINGF	=	1 if wife receives fringe benefits, 0 otherwise
FRINGM	=	1 if husband receives fringe benefits, 0 otherwise

Table 5 (continued), Names and Definitions of Variables

GOVF = 1 if wife is a government employee, 0 otherwise

GOVM = 1 if husband is a government employee, 0 otherwise

MIGM = if husband is a migrant, 0 otherwise (migrant is defined as a person who five years ago did not stay in the province he is staying in on the survey date)

OCPF = 1 if wife is a non-production worker, 0 otherwise

OCPM = 1 if husband is a non-production worker (i.e., professional, administration, and clerks), 0 otherwise

SQAGEF = wife's age square

SQAGEM = husband's age square

SQEXPF = wife's experience square

SQEXPM = husband's experience square

SEV = 1 if a family has a live-in maid, 0 otherwise

UN = unemployment rate by province (or changwad)

Regional Variables

NORTH = 1 if a person lives in the Northern region, 0 otherwise

N-EAST = 1 if a person lives in the Northeastern region, 0 otherwise

SOUTH = 1 if a person lives in the Southern region, 0 otherwise

CENTRAL= central region which is the base region

BKK = 1 if a person lives in Bangkok, 0 otherwise

Occupational Variables

HOC1 = 1 if husband's occupation is professional or administrative, 0 otherwise

HOC2 = 1 if husband's occupation is clerical, 0 otherwise

HOC3 = 1 if husband's occupation is trade or transport workers, 0 otherwise

HOC4 = 1 if husband's occupation is laborers, craftsmen, or skilled workers, 0 otherwise

HOC5 = reference group (all other occupations)

WOC1 = 1 if wife's occupation is professional or administrative, 0 otherwise

WOC2 = 1 if wife's occupation is clerical, 0 otherwise

WOC3 = 1 if wife's occupation is trade or transportation, 0 otherwise

WOC4 = 1 if wife's occupation is laborer, craftsman, or skilled worker, 0 otherwise

WOC5 = reference group (all other occupations) uncompensated substitution affect can be of either sign, depending upon the size of two opposing income and substitution effects.

Number of children is expected to have a negative effect on wife's hours of work because childbearing and child-rearing which are time-intensive activities, are supposed to inhibit market work by wives. However, it is not clear what the effect of children will be on husband's labor supply. It may be positive if the large number of children places more financial pressure on him.

To control for the differences in the number of working hours of workers in the modern and the traditional sectors, a dummy variable for non-production worker is used as a proxy because the information on the type of sector a person is working in is unavailable, and because in much of the traditional sector non-production employees are not hired for managerial or clerical purposes. Moreover, this dummy variable may capture other effects like interoccupational differences in psychic income, institutional constraints on work activities, inter-skill differences in the relative demand for labor, etc. (Kalachek and Raines, 1970, p. 169).

Family size, as mentioned above, is included as a measurement of the time of other family members. The labor supply response to a change in family size is ambiguous because the presence of other family members can either increase or decrease the time available for market work and the production of home goods. This will affect each member's marginal productivities in home production and market work which, in turn, will cause the family to reallocate the time used of its family members. If most of the other family members are dependents, there will be less time left to produce other home goods because of the increasing amount of time required in caring for them (e.g., babysitting, etc.). There will be two effects. First, if full income is constant, one member of our couple, perhaps the wife, has to work less in the labor market in order to increase household production. Second, the burden of dependents will reduce family income and increase consumption at home. So some family members, especially the head of the household, are likely to work more in the labor market. On the other hand, if other family members can help in producing more home goods, the couple will be able to supply more hours of market work.

Unemployment rate (by province) is used as a proxy for the period of unemployment that each individual may have experienced. There are two opposing effects of unemployment on the hours of work. First, an increase in the period of unemployment will result in a loss of the family's full income which in turn will induce an increase in hours of work. The extent of loss depends on the value attached to time and the amount of time spent searching. Second, if during a period of unemployment, there is some leisure foregone when one looks for work, then he will choose to reduce his hours of work (after getting a job) as unemployment increases. This will produce a substitution of leisure for hours of work (Rea, 1974, p. 282). The net effect, hence, is not known a priori.

In general, education may have a positive effect on hours of work because 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. Second, more educated persons probably tend to obtain jobs with higher non-pecuniary returns (e.g., freedom in working time for college professors) than do less educated persons. Moreover, a taste for education might be positively correlated with a taste for work.

Migration is another important phenomenon that one cannot afford to ignore in a developing economy like Thailand. So a migrant dummy variable is included. There is no a priori basis determining the sign of this variable. If migrants lack information about jobs in the shorter working-hours modern sector, or do not have the kind of skill-training that this sector requires, then this variable may have a positive effect. On the other hand, if migrants from rural areas take temporary refuge in the traditional sector in order to search for a better job in the modern sector, they may decide to work less in order to have enough time for job searching.

Since almost half of our sample are work in the government sector which offers relatively shorter working hours and some non-pecuniary benefits (e.g., security and prestige), a dummy variable on whether or not a person is a government worker is included to capture the inter-occupational differences in non-pecuniary factors as well as institutional factors.

2. In the demand for children equation, the dependent variable is measured by the number of children living in the household.

The opportunity cost of time of both husband and wife is measured by their wage rate. These variables are expected to have negative effects on the number of children demanded.

Household income should have a positive effect on demand for children if children are normal good, _ceteris paribus_. However, if children and consumer durables are substitute sources of satisfaction, then, since many consumer durables require long periods of saving (especially in countries with limited sources of credit) and the initial cost of children involves time only, low income (wealth) families may demand more children than higher income (wealth) families who can see the possibility of saving successfully to acquire expensive durable goods. In this instance, children could turn out to be an "inferior good."

Education is supposed to reflect contraceptive knowledge which has high variation in Thailand since family planning has only recently been introduced. Moreover, in a developing economy which has a dualistic character, people in the society may have wide variations in tastes for children. Highly educated people may be oriented toward western materialism or may regard child quality as more important than the number of children. On the other hand, uneducated people may still expect to depend on the services of children in their old days. We propose to use education as a proxy for these factors. But education can also be a proxy for the couple's opportunity cost of time. So education is anticipated to have a negative sign. But the effect may be weakened if education also captures wealth effects.

A dummy variable for the presence of domestic workers is a proxy for assets as well as for the availability of child care services. Four regional dummy variables are also included to account for inter-regional differences, e.g., the Southern dummy variables may capture the fertility effect of religious belief because it is the predominantly Islamic region.

Wife's age and age squared are also incorporated to reflect the life-cycle differences in the number of children.

The dummy for government employees is included because the government provides many kinds of benefits to its employees if they have children. For example, until 1978 a government employee received $2.50 extra cash each month for each child he/she had. Moreover, they can also be reimbursed for tuition and children's educational fees. Hence, we would expect this program to have a positive effect on the demand for children because this program is equivalent to a decrease in the price of children.

3. The specification of the wage function follows the human capital theory. Education and experience are the two most important factors in human capital theory that explain an increase in wage rate. The square of experience is also entered into the wage equation to allow for life-cycle changes in wage rate. This variable is expected to have a negative effect on the wage rate because after a certain age is reached, gross human capital depreciation is larger than gross human capital investment.

Number of children may negatively affect the wife's wage rate if she has to stay out of the labor market for the purpose of childbearing and child rearing. The effect of children on the husband's wage rate is not clear.

Several dummy variables are also included in the wage equations. A dummy for college graduates is included to capture the possible effects of credentialism, whereby selection of prospective employees and prospects for promotion (of salary and positions) are based on degree acquisition. Moreover, "club" preferences (e.g., an old-school-tie practice) are sometimes exhibited by employers. Therefore, we expect the sign of this variable to be positive.

A dummy variable for government workers in included because of the presence of pecuniary and non-pecuniary benefits in terms of job security, medical reimbursements, retirement fund, and so on, may induce government employees to accept a lower money wage rate.

A dummy for fringe benefits is added on the ground that persons who receive other forms of compensation will tend to have a lower money wage rate. Occupational dummy variables are included to account for the inter-occupational wage differentials. A regional dummy variable (whether or not a person is living in Bangkok) is supposed to control for inter-regional differences.

Finally, hours of work are also expected to affect the wage rate. Although the theory of quasi-fixed labor cost suggests that hours of work positively affect the wage rate (H. Rosen, 1976, p. 490), there is no a priori way of knowing the exact relation if other factors are taken into consideration. For instance, additional output per hour may be a function (possibly an inverted U-shape) of the number of hours worked, i.e., at the beginning of the work period there are delays in getting started, and at the end there is fatigue. In other words, elasticity of output with respect to number of workers need not equal the elasticity with respect to hours per worker (Feldstein, 1967, pp. 375-386). So the wage rate, which depends on output, will be determined by hours of work, although the relation may not always be in a positive direction.

Problems of Measurement and Aggregation

Some modifications to the model in Table 4 are needed if it is to be applied to the behavior of labor supply responses in Thailand. The modifications involve two issues: one is the problem of measuring the wage and income variables; the other is the old but important problem of aggregation. As will be seen below, both problems happen to be interrelated.

National Mean or Regional Means

In the labor supply functions in Table 4, the wage and income variables are measured as deviations from means. The question is which means--national or regional--should be used.

The issue involves the relative influence of the local labor market versus the national market on the person's decision to supply his labor effort. There are two important factors which affect the relative importance of each market. The first factor is migration. If labor is fully mobile among regions, and if non-pecuniary factors are the same in every region, then the regional wage rates will be equalized, and there will be one single national labor market. Since the decision to migrate is determined by the factors that affect the costs and benefits from migration, married women may be less mobile than married men because of higher costs of migration arising from psychic costs, family ties, etc. As a result female wage differentials and working hours differentials among regions may persist over time. The second factor is that if occupational diversity for males is larger than that for female workers,[16] then married women will be less mobile and tend to stay in the region where job opportunities suitable to their skill exist.

Although there are no time-series data to test the wage differential hypothesis, cross-sectional data on hours of work and migrants may shed some light on the issue. First, the Labor Force Survey in 1977 shows that 14.7 percent of paid male employees but only 9.7 percent of married female employees are migrants.[17] Secondly, an analysis of variance (ANOVA) of hours of work shows that husband's average hours are not significantly different between Bangkok metropolis and non-Bangkok areas, while wife's working hours in Bangkok are significantly shorter than elsewhere (see Table 6). However, the test of equality of mean wages in Bangkok and non-Bangkok areas fails to tell the same story because significant wage differentials exist among regions for both married men and married women. Alternative interpretations of these results include: (a) male migration is still not enough to equalize inter-regional wage differentials, (b) larger firms employing relatively more capital per worker and hence paying

Table 6

TEST OF THE EQUALITY OF MEANS

Variables/Region	Mean	S. D.	t-Values[1]
1. Husband's working hours per week			
Bangkok	46.1	14.99	1.61 (accept)
Non-Bangkok	45.1	10.69	
2. Wife's working hours per week			
Bangkok	42.4	12.79	-3.23 (reject)
Non-Bangkok	44.2	9.83	
3. Husband's money wage per hour			
Bangkok	13.2	13.1	-5.19 (reject)
Non-Bangkok	10.2	10.5	
4. Wife's money wage per hour			
Bangkok	9.2	9.4	-3.25 (reject)
Non-Bangkok	7.9	6.4	

[1] Degrees of freedom = 1649.

Source: Calculated from Labor Force Survey Tape, Round 1, 1977.

higher wages, tend to locate in Bangkok, or (c) workers in Bangkok have more human capital.

Therefore, the local labor market may be more important to married women than the national market. If this is true, the appropriate measurement of the wage and income variables in the wife's labor supply should be deviation from "regional" means rather than the "national" mean because:

$$(29) \qquad LF_i - \overline{LF} = (LF_i - \overline{LF}_r) + (\overline{LF}_r - \overline{LF})$$

where LF = wife's working hours, subscript i means <u>ith</u> individual, subscript r is <u>rth</u> region, and bar notation represents mean value, e.g., $\overline{LF}$ is national mean of wife's working hours.

Summing and squaring both sides of (29) yields:

$$(30) \qquad \sum_r\sum_i(LF_i - \overline{LF})^2 = \sum_r\sum_i(LF_i - \overline{LF})^2 + \sum_r\sum_i(\overline{LF}_r - \overline{LF})^2 + 2\sum_r\sum_i(LF_i - \overline{LF}_r) \times (\overline{LF}_r - \overline{LF})$$

but the last term in (30) is zero because $(\overline{LF}_r - \overline{LF})$ is constant for all i in region r, and $\sum_i(LF_i - \overline{LF}_r)$ must be zero

The left-hand side of equation (30) is the total variation which equals variation within plus variation between. Therefore, if the local labor market is more important to women, the major source of variation should be variation within (or the first term on the right side of equation (30)) rather than variation between. The opposite should be true for men if the national market is more relevant to them.

In order to demonstrate this point, equation (18) will be rewritten in terms of deviation from regional means:

$$(31) \qquad L_i - \overline{L}_{ir} = a_0 + a_1(WM - \overline{WM}_r) + a_2(WF - \overline{WF}_r) + a_3\left(\frac{(LM + \overline{LM}_r)}{2} \times (WM - \overline{WM}_r) + \frac{(LF + \overline{LF}_r)}{2} \times (WF - \overline{WF}_r) + (Y - \overline{Y}_r)\right)$$

where i = M, F.

Equation (31) can be transformed into a form of deviation from national mean because $L_i - \overline{L}_{ir}$ equals $(L_i - \overline{L}) + \overline{L} - \overline{L}_{ir}$. Hence, (31) becomes:

$$(32) \qquad L_i - \overline{L}_i = a_0 + a_1(WM - \overline{WM}) + a_2(WF - \overline{WF}) + a_3\left(\frac{(LM + \overline{LM})}{2}(WM - \overline{WM}) + \frac{(LF + \overline{LF})}{2}(WF - \overline{WF}) + (Y - \overline{Y})\right) + \left(a_1^1(\overline{WM} - \overline{WM}_r) + a_2^1 \frac{(LM + \overline{LM})}{2}(\overline{WM} - \overline{WM}_r) + \frac{(LF + \overline{LF})}{2}(\overline{WF} - \overline{WF}_r) + a_3^1 \frac{(\overline{LM}_r - \overline{LM})}{2}(WM - \overline{WM}_r) + a_3^1 \frac{(\overline{LF}_r - \overline{LF})}{2}(WF - \overline{WF}_r) + a_3^1(\overline{Y} - \overline{Y}_r) + a_2^1(\overline{WF} - \overline{WF}_r) - (\overline{L} - \overline{L}_{ir})\right)$$

If women compete locally, we expect that most of the total variation in working hours should be explained by variation within. So the last eight terms in (32), which involve variation between should not be significantly different from zero. On the other hand, the last eight terms in husband's hours of work should contribute significantly to the total variation. Therefore, equation (32) is estimated (in the context of five fully specified simultaneous equations developed in the last section in equations (23) to (28). The significance of the extra terms in (32) can be tested by calculating the F-statistic from two regressions, one without the extra terms, the other with the extra terms. The calculated F-statistics are 8.17 for males and 1.55 for females. Since the critical F-value is 6.64 at 99 percent confidence level, we fail to reject the null hypothesis for females, but reject the hypothesis for males. Hence, the appropriate measure of income and wage variables in the female labor supply model is deviation from "regional means," while the appropriate measurement in the male labor supply is deviation from "national mean."

Aggregation Problem

One of the consequences of the distinctively dualistic structure of the Thai economy is that Bangkok is the only primate city (with a population of more than four million in 1977), while the second largest city --Chiengmai--has a population of only one hundred thousand. Bangkok is the center of every type of economic activity ranging from international trade to a mass of small street vendors. All of the large corporations are located in Bangkok. Moreover, the government, which is the largest employer, is highly centralized. Every ministry and independent government agency is located in Bangkok.

The rest of the country is basically rural, with small trade centers in one or a few cities of each province. Therefore, the economic activities in these cities are restricted mainly to (a) the production and trading of agricultural products produced locally, (b) the production and trading of small items of locally produced consumption goods and (c) inter-provincial trade which is basically the export of agricultural products and the import of consumption and luxury goods from Bangkok.

Therefore, the labor market in Bangkok is expected to be different from the rest of the country. This behavior can be tested by using the variance-covariance analysis (Chow's test) or the dummy-variable test developed by M. Snow (1978). The dummy-variable test can be performed by introducing the slope-change dummy variables (which are products of explanatory variables and Bangkok dummy variable) and/or the intercept-change dummy variable to allow for the fact that the coefficients of the explanatory variables in the labor supply function and/or its intercept for Bangkok differ from those for non-Bangkok areas. Then, one can apply the F-test to see whether the combination of the slope and intercept dummy variables is significantly different from zero. If the test confirms that the behavior in Bangkok is different from non-Bangkok, then the sample set should be broken into two subgroups. The results of this test are:

1. Applying the Snow test to the male labor supply model[18] which measures income and wage variables as deviations from national mean (see Appendix C), the calculated F-statistic is 0.856 indicating that extra slope dummy and intercept dummy variables are not significant at the 99 percent confidence level. Therefore, the husband's labor supply model will be estimated by pooling all observations in the whole country and the model employed is the one in Table 4.

2. For married women, the F-statistic for the dummy variable test is estimated at 12.5 which is significant at the 99 percent confidence level. Therefore, both the F-test and the migration argument above seem to suggest that the labor supply functions of married women in Bangkok should be estimated separately from those for non-Bangkok areas. Another rationale for this disaggregation strategy is in response to Dickinson's criticism of Heckman's model that constant income and substitution parameters provide only a good <u>local</u> approximation for a sample with limited wage variations (Dickinson, 1977, pp. 5-8).

In summary, the labor supply of married women in Bangkok will be separately estimated from that in non-Bangkok areas. The model, which is applied to both areas, is summarized below.

(33) $$CLM = a_0 + a_1CWM + a_2CWF + a_3CHI + a_4EDM + a_6AGEM + a_7SQAGEM + a_8MIGM + a_9GOVM + a_{10}OCPM + a_{11}UN + a_{12}FSIZE + a_4C$$

(34) $$CLF = b_0 + b_1CWM + b_2CWF + b_3CHI + b_4C + b_5EDF + b_6AGEF + b_7SQAGEF + b_8GOVF + b_9OCPF + b_{10}UN + b_{11}FSIZE$$

(35) $$CWM = c_0 + c_1CLM + c_2C + c_3EDM + c_4EXPM + c_5SQEXPM + c_6COLM + c_7OCPM + c_8FRINGM$$

(36) $$CWF = d_0 + d_1CLF + d_2C + d_3EDF + d_4EXPF + d_5SQEXPF + d_6COLF + d_7OCPF + d_8FRINGF$$

(37) $$C = e_0 + e_1CWM + e_2CWF + e_3CHI + e_4EDM + e_5EDF + e_6GOVM + e_7SEV + e_8AGEF + e_9SQAGEF$$

(38) $$CHI = CY + \frac{(LM + \overline{LM}_r)}{2} \times CWM + \frac{(LF + \overline{LF}_r)}{2} \times CWM$$

where the notation is as defined in Table 5 above.

NOTES TO CHAPTER III

1. Another modification mentioned in Chapter One is an addition of a third use of time, namely "time spent in non-market activities," to the simple dichotomy of "time in market activities" and "leisure". This modification provides a rationale for the large wage effect on married women's labor supply.

2. Recently, some economists, interested in the application of game theory to labor supply decisions, alternately argue that an appropriate unit of analysis is an individual.

3. If all consumption goods are not lumped together as the composite good, the available data are insufficient for the estimation of all the $(k^2 + k)$ parameters for k demand functions in the whole system.

4. See the literature on complete demand system in Theil (1971) and Barten (1967). Note that it is possible to expand the model in (4) to include other demand functions, e.g., demand for money, demand for marriage, etc. Given the present state of data, such expansion will result in an unidentified model. Moreover, if the omitted demand functions are highly interrelated with other types of household decisions, estimating the sub-system may result in biased parameter estimates because of the problems of misspecification (e.g., problems of omitted variables).

5. If model (4) is a real complete demand system, then the statistical estimates of the model will be invariant to the choice of dropping any particular demand function. This is so as long as our estimation method is two-stage least squares, because all of the exogenous variables in the system must be used (as a set of instrumental variables) in the reduced form equations. However, if system (4) is only a subset of the complete system, then the above argument does not hold.

6. J. Heckman, "Three Essays on the Supply of Labor and the Demand for Goods," Ph.D. dissertation, University of Chicago, 1971, p. 6.

7. See a derivation of Kosters' estimation procedure in his dissertation (M. Kosters, "Income and Substitution Parameters in a Family Labor Supply Model," unpublished Ph.D. dissertation, University of Chicago, May 1966).

8. In the case of infinitesimal changes, L^*_i is simply the equilibrium hours because the change in wage is approaching zero.

9. If the first point (L_i) is chosen, it implies that we initially raise the wage by some amount from the mean and use the final equilibrium L_i as the point of compensation, and then reduce the wage by the same amount using the original value of L_i as the point of compensation. We

will not leave the consumer at the value of L_i from which he started (Ashenfelter and Heckman, 1973, pp. 271-272).[1]

10. The values of R^2 for the fully specified models of labor supply (given in Table 4) are:

Equation	R^2 in Heckman's Model	R^2 in Kosters' Model
Husband's Labor Supply	0.2358	0.2264
Wife's Labor Supply	0.2610	0.2602
Demand for Children	0.3522	0.3500
Husband's Wage	0.4114	0.4114
Wife's Wage	0.4775	0.4775

In general, the results (which are estimated by a 2SLS method), show that Heckman's income term, which appears in the labor supply and demand for children functions, has negligibly higher "R^2" than Kosters' definition. However, the individual coefficients of wage and income in Heckman's supply functions tend to be significant and of right sign. But this is not generally true with the results from Kosters' model since the wage variables are not significant in both the husband's and the wife's labor supply functions, and wife's wages and income variables have wrong signs in the latter function (see Appendix A).

11. H. Rosen (1976, pp. 485-507) has shown that once the quasi-fixed labor costs are admitted into an analysis of demand for labor, the solution of minimum labor cost can be obtained only if wage rate is a function of hours of work.

12. About 40 percent of our sample are extended families defined as families where parents, in-laws and relatives of the household head live in the same house.

13. In our preliminary runs, the family size and the extended family dummy variables are tried in the labor supply functions. Since the extended family dummy variable is not significant, it is dropped. Only family size is used as a proxy of the time of other family members.

14. The average working hours of self-employed workers in the metropolitan area is 59-60 hours per week (N.S.O., Labor Force Survey, 1976). The average hours of the paid employees in the traditional sector are also in the range of 60 hours per week, while the paid employees in the modern sector work about 45 hours. The phenomenon may be the main cause of the bimodal distribution of hours of work in Thailand.

15. The disadvantage of using working hours per week as a measure of labor supply and all of the related data problems will be discussed in the next chapter.

16. In 1976, the percentage of female workers was 52.8 percent in professions, 14.7 percent in administration and management, 41 percent in clerical jobs, 50 percent in trade, 31 percent in agriculture, 4 percent in transport, 30 percent in labor and craftsmen, and 55 percent in services (Labor Force Survey, 1977, Round 1, p. 7).

17. Migrant is defined as a person who five years ago did not stay in the province he is staying in on the survey date.

18. The list of slope-change dummy variables added to our model to test the aggregation hypotheses is given in Appendix C.

CHAPTER IV

EMPIRICAL RESULTS

This chapter first discusses the sources of data used in this study and some inherent weaknesses in the data set. Section 2 presents the empirical results of the labor supply of husbands, the demand for children and the couple's wage functions. The next section covers the analysis of the labor supply of married women.

Sources of Data and Data Problems

The main data source is the Survey of Labor Force 1977 Round 1 (which is a farm off-season) conducted biannually by the Labor Division of the National Statistical Office, Thailand. This survey obtains information on each individual in the sample households, including such individual characteristics as age, education, hours of work in the week before the survey date, earnings per period, etc.

A stratified three-stage sample is used for the survey. The sampling units are changwats (provinces), blocks (in municipal areas), or villages (in non-municipal areas) and households, respectively. The total sample size from 50 sample changwats (out of 72) is about 16,800 households. Since the survey is conducted on a country-wide basis, and since Thailand is predominantly an agricultural economy, about three-fourths of the sample are farmers, self-employed workers in small family enterprises or unpaid family workers. One one-fourth are paid employees who either work in the private sector or in the public sector. After leaving out families in which any members are self-employed or unpaid family workers,[1] there are 36,548 individuals left. This group of sample, which includes children, other family members, maids, etc., can be classified into 8090 families.

The 8090 families consist of (a) 1631 couples who are both working, (b) 3400 couples of whom only one spouse works, and (c) four groups of single workers, i.e. male and female teenagers (aged 11-19), single adult males and females. This study deals only with the 1631 couples.

Other sources of data are (a) the Department of Business Economics' Consumer Price Index Report 1969-1977 and (b) the Household Socioeconomic Survey 1970-1971, by the National Statistical Office.

There are several problems concerning the use of the Labor Force Survey data set.

1. The only information on labor supply available in the survey is weekly hours. There is no way that other measures of working effort, e.g. weeks worked per year, can be obtained from the information in the survey. Weekly hours may be a poor measure of average lifetime-hours of work because they can vary less proportionately than hours worked per year, which more closely reflect the "normal" tastes and opportunities. Therefore using weekly hours in the regressions may intorduce the problem of measurement error in the dependent variable. However, the estimated parameters will still be unbiased and consistent if there is no correlation between the measurement error and the independent variables. Only the residual variance and hence R^2 will be affected.

2. The measurement of earnings may be exposed to a large degree of error because (a) earnings data on the survey tape is never edited: (b) many persons report that they receive their wage on an hourly or daily basis, but the wage rate reported is too high to be an hourly or daily wage rate. For this reason, the decision to treat the earnings

figure given in the data as the rate per hour or per day or per month is made on the basis of education, occupation, government or private sector employment, and age; (c) for people who do not receive an hourly wage, the wage rates per hour are derived by dividing reported earning by hours of work during the relevant period, either a day or a month. Errors in reporting hours worked are thereby transmitted inversely to the measured market wage rate, biasing down directly estimated effects of the measured wage rate on labor supplied.

These problems of measurement, without systematic error, may be resolved by replacing the observed market wage rate with an instrumental variable estimator inferred from the sample or workers for whom market wages are observed (Pindyck and Rubinfeld, 1976, p. 129).

3. As mentioned in Chapter Two, a significant part of labor remuneration is in the form of fringe benefits like meals, clothes, housing and bonuses. Unfortunately, the Labor Survey does not contain enough information to calculate the value of fringe benefits that each worker receives. Therefore, only the money wage rate deflated by a consumer price index is used in the labor supply model. If the value of fringe benefits is assumed to have the same effect on the hours of work supplied as the money wage rate, then regressing the hours of work only on the money wages is equivalent to committing an error of misspecification which will bias our least squares estimates.[2]

4. The number of children used as the dependent variable in the demand for children equation may be underestimated because it reflects only the number of children who are living with their parents in the same household at the time of the survey. The estimated coefficients may still be unbiased as long as there is no correlation between the measurement

error and the independent variables. However, as will be discussed below, this may not be the case.

When the number of children and the weekly hours appear as dependent variables in the demand for children and the labor supply functions,[3] there will be measurement errors in both the dependent and the independent variables because some independent variables (i.e. both husband's and wife's wage variables) in these two equations are also measured with error. Since more than one, though not all of the independent variables are subject to measurement error, the OLS estimates will be biased in both ways, depending upon the variance-covariance matrix of the observations. As for the coefficients of the variables measured with error, the OLS estimates can also be biased in either direction with the degree of bias being related to the signs of the true variables and the correlation among those variables (Maddala, 1977, p. 294).

Since the variances of the measurement errors (of both the dependent and the independent variables) are not known, it is not possible to solve this estimation problem. Therefore, the results from this study must be interpreted with great care. However, the results on the demand for children below show that the coefficients of the income and wage variables (which are measured with error) are consistent with the results in a previous study on the demand for children in Thailand which employed a well-designed and careful survey of fertility (Phananiramai, 1979).

5. One of the important variables in the study of labor supply is non-labor income because it plays a crucial role in determining the effect of a change in income on the amount of labor supplied. This must be accurately measured if some governmental programs, such as income maintenance or changes in income tax rate structure, are to be initiated.

Unfortunately, the survey does not contain any information on non-labor income.[4] However, since 39.7 percent of the sample in this study can be classified as extended family, we propose to use the wage income of other family members as another form of non-labor income. As mentioned in Chapter Three, pooling income of other family members (like daughters and sons) is not an uncommon practice in a society still influenced (though not dominated) by extended families. Omitting the other family members' income is equivalent to committing specification error as argued in Chapter Three.

6. Although the survey contains enough information to calculate a proxy of work experience (defined as age less seven, which is the age when compulsory education begins, less years of education), this measure is only a good proxy of male's and single female's experience. It does not adequately measure the experience of married women (Mincer and Polachek, 1974, p. 578). Therefore, the latter variable is redefined as a woman's age minus seven minus years of education and minus years of working experience loss due to childbearing and child rearing. Since the Survey of Labor Force does not have the latter information, the number of years of experience loss is obtained from the World Fertility Survey of Thailand (NSO, 1975) by calculating the distribution of number of children by years of experience loss, which in turn is defined as the length of marriage minus the number of years worked after marriage. Each married woman in our labor survey assumes a value of experience loss depending upon the number of children she has (see Appendix D for the distribution of experience loss).

Results of the Husband's Labor Supply

Since the empirical model specified in Chapter Three is a set of overidentified equations, the appropriate method of estimation yielding consistent parameter estimates, is the two-state least squares technique. The procedure is to regress each endogenous variable on all of the exogenous variables in the model in the first stage, then use the predicted endogenous variables as the respective instrumental variables in the second stage. Therefore, the reported R^2 cannot be interpreted as the proportion of total variation explained by the right-hand side variables. Rather, it is viewed as the square of the correlation coefficient between the actual and the predicted dependent variable. Moreover, the standardization distribution of the estimated coefficients will be asymptotically normal if the sample size is large enough. Because the sample size used in this study can be considered large, tests for significance of the estimated coefficients will be performed based on a normal distribution table.

Husband's Labor Supply Function

Table 7 gives the results of husband's labor supply estimated by equations (23) to (28) in Chapter Three. As mentioned above, the wage and hours of work variables are measured as deviation from national means. The estimated R^2 of the husband's labor supply is 0.236. The estimates of substitution and income effects are consistent with the classical prediction. A one baht[5] increase in the husband's own wage rate leads to an increase of 1.32 hours of labor supplied per week and a one baht increase in the husband's income will reduce his work effort by 0.035 hours per week. This gives a very small substitution elasticity, evaluated at the means which are given with standard deviations in Table 8, of around 0.191 and an income elasticity of -0.399. Differentiating

Table 7

Labor Supply of Husbands in Thailand

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	-0.030	-0.006	16.815*	4.100	-14.652*	-10.66	-8.740*	-11.66	-3.305*	-4.92
CWM	1.316**	3.770	0.800*	2.760					-0.052	-1.79
CWF	1.158*	2.950	0.553**	1.770					-0.169**	-4.53
CHI	-0.035**	-4.390	-0.015**	-2.370					0.004**	11.42
CWI										
UN	-0.516	-1.490	-0.727*	-2.579						
C	-1.467*	-3.090	-1.103*	-2.850	0.075	0.67	0.044	0.64		
EDM	0.116	0.840			0.596*	9.63			-0.125*	-6.30
MIGM	1.523	1.710								
AGEM	-0.134	-0.530								
SQAGEM	0.002	0.750								
OCPM	-4.004*	-4.770								
GOVM	-8.638*	-11.060			-0.220	-0.26			0.418*	4.01

Table 7 (continued), Labor Supply of Husbands in Thailand

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
EDF			-0.345*	2.600			0.444*	9.28	-0.092*	-4.27
AGEF			-0.581*	-2.560					0.390*	11.05
SQAGEF			0.007*	2.240					-0.0048*	-9.80
OCPF			-4.835*	-5.630						
GOVF			-5.339	-8.210			0.609	1.51		
EXPM					0.360*	6.47				
SQEXPM					-0.0043*	-4.28				
FRINGM					0.377	1.13				
COLM					5.610*	9.33				
SEV									-0.600*	-3.70
FSIZE	1.870*	3.820	1.058*	2.750						
EXPF							0.197*	5.71		
SQEXPF							-0.002*	-3.22		
FRINGF							0.420*	2.05		

Table 7 (continued), Labor Supply of Husbands in Thailand

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
COLF							4.730*	9.57		
CLM					0.124	1.36				
CLF							0.101	1.71		
NORTH									-0.042	-0.26
N-EAST									0.430*	2.53
SOUTH									0.311	1.86
BKK					2.671*	6.06	1.072*	5.50	-0.557*	-4.46
HOC1					4.607*	5.33				
HOC2					1.961*	2.60				
HOC3					0.325	0.55				
HOC4					0.833	1.51				
WOC1							2.967*	4.63		
WOC2							1.465*	3.01		
WOC3							0.697	1.43		

Table 7 (continued), Labor Supply of Husbands in Thailand

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
WOC4							0.459	1.55		
R^2	0.2358		0.2610		0.4114		0.4775		0.3522	
Sample Size	1631		1631		1631		1631		1631	

*Significant at 95 percent confidence level for a two-tail test.
**Significant at 95 percent confidence level for a one-tail test.

Table 8

Means and Standard Deviations of Variables
in the Husband's Labor Supply Model

VARIABLES	MEANS	S.D.s
LM	45.633	12.94
LF	43.356	11.38
WM	6.620	6.46
WF	4.822	4.50
HI	520.855	399.84
C	2.011	1.67
EDM	8.799	4.78
MIGM	0.152	0.36
AGEM	36.836	9.08
EDF	8.097	4.89
AGEF	33.283	8.48
EXPM	20.972	10.67
SQEXPM	553.744	555.05
FRINGM	0.656	0.47
BKK	0.517	0.50
NORTH	0.113	0.32
N-EAST	0.107	0.31
SOUTH	0.102	0.30
UN	2.619	0.88
COLM	0.089	0.28
GOVM	0.476	0.50
EXPF	16.664	9.81

Table 8 (continued) Means and Standard Deviations of Variables in the Husband's Labor Supply Model

VARIABLES	MEANS	S.D.s
SQEXPF	373.954	420.16
FRINGF	0.526	0.50
COLF	0.058	0.23
GOVF	0.435	0.49
SEV	0.112	0.31
OCPM	0.480	0.50
OCPF	0.500	0.50
SQAGEM	1439.314	730.74
SQAGEF	1179.671	610.65
FSIZE	5.257	2.54
HOC1	0.323	0.47
HOC2	0.124	0.33
HOC3	0.122	0.33
HOC4	0.315	0.46
WOC1	0.311	0.46
WOC2	0.156	0.36
WOC3	0.052	0.22
WOC4	0.337	0.47

the budget constraint in (2) in Chapter Three with respect to non-labor income (y) gives:

$$(1) \qquad P_x\left(\frac{\partial X}{\partial Y}\right) - WM\left(\frac{\partial L}{\partial Y}\right) = 1$$

where p_x is the price of good X, WM is the husband's wage rate, $\partial X/\partial Y$ and $\partial L/\partial Y$ are the income effects on the demand for X and supply of labor, respectively. Equation (1) implies that consumption goods are normal, i.e. $\partial X/\partial Y > 0$, then the last term in equation (1) must not be less than -1.0. The term $WM(\partial L/\partial Y)$, which is not a constant in our model, is about -0.232, which clearly satisfies the above constraint. This implies that the average worker allocates 0.23 of each additional baht of non-labor income to purchase non-market time and the other 0.77 to the purchase of consumption goods.

The uncompensated wage elasticity of the labor supply function is the sum of the substitution elasticity and $WM(\partial L/\partial Y)$ which is 0.101-0.232 = -0.041 when it is evaluated at the mean wage and hours. The slope of the labor supply function evaluated at mean values is -0.281, calculated from:

$$(2) \qquad \frac{\partial L}{\partial W_i} = S + L_i\left(\frac{\partial L}{\partial Y}\right)$$

where $\partial L/\partial W$ stands for the slope of the labor supply function, S is the substitution effect, L is the hours of work of person i, and $\partial L/\partial Y$ is the income effect. According to (2), the labor supply curve bends backward at 37.60 hours or more per week.[6]

Unlike the previous studies which find that the number of children is irrelevant to male employment (e.g. Dickenson, 1974), our model shows that an extra child will decrease the husband's labor supply by 1.5 hours per week, other things being equal. However, if the family size is not

Table 9

Income and Substitution Effects and Elasticities in the Husband's Labor Supply Model (Evaluated at Means)

Items	Male	Female[1]
<u>Labor Supply</u>		
Own substitution effect	1.316	0.553
Cross-substitution effect	1.158	0.800
Income effect	-0.035	-0.015
Labor supply slope	-0.281	-0.097
Uncompensated substitution elasticity	-0.041	-0.010
Compensated substitution elasticity	-0.191	0.062
Income elasticity	-0.399	-0.180
<u>Demand for Children</u>		
Wage effect	-0.052	-0.169
Income effect	0.004	--
Wage elasticity	-0.171	-0.405
Income elasticity	1.036	--

[1] The estimates of income and substitution effects and their elasticities for married women are not the appropriate parameter estimates of the wife's labor supply. They are presented here just for comparison.

Source: Calculated from Tables 7 and 8.

held constant, the total effect of children, which is the sum of the coefficients of C and FSIZE, i.e. -1.467 + 1.870 = 0.403, is not significant (the t value[7] is 0.87). Moreover, as the family size gets larger, holding the number of children constant, the husband is likely to work harder. This either means the higher the number of other family members, the more total time is available for a family to produce goods, so the husband is free from housework and can spend more time in the labor market, or that more family members mean higher household consumption requiring the breadwinner to work longer hours.

Migration does not seem to have any significant effect on the husband's labor supply.[8] Similarly, education does not appear to affect weekly hours significantly. However, our education variable may be a poor measure of training for adult males, since education reflects only a particular type of formal training. It excludes on-the-job training, informal education, etc.

Surprisingly, the coefficients of age and its square are not significantly different from zero. This implies that persons in all age groups (in the 20-60 year range) have essentially the same average weekly hours. One possible explanation is that most of the husbands in our sample are between 30-45 years of age, the range in which the rate of male labor force participation is highest. The labor supply within this range will not vary much with age.

The dummy variable for "government worker" is negative and significant as expected. The size of the coefficient indicates that government employees work 8.6 hours less than private sector employees, i.e. the average government employee works about 37.0 hours per week.

The proxy for workers in the modern/informal sector (OCPM) also implies that employees in the modern sector work less than those in the informal sector by about 4.0 hours per week.

The unemployment rate does not significantly affect husbands' hours of work partly because the unemployment rate is not a good measure of an individual's unemployed period.

Husband's Wage Equation

The R^2 in this equation is 0.411. Most of the variables are significant and have the anticipated signs, except C, FRINGM, GOVM, HOC3 and HOC4. Education, experience and a dummy variable for college graduates all positively affect the wage rate as predicted by human capital theory. Moreover, the wage rate starts to decline when experience passes 41.86 years.

Government workers' wage rates are not significantly different from those of the workers in the private sector after controlling for human capital and occupational dummy variables.

College graduates receive substantially higher wage rates than non-college workers. This may reflect a non-linear relation between education and wage rates. However, preliminary experiment with the education squared variable has caused both the education and experience variables to become insignificant because of high collinearity between education and experience. There are two more possible explanations of higher wage rates for college graduates besides those given in Chapter Three. First, significant numbers of college graduates are from well-to-do families with better job opportunities for their children either because they operate their own businesses or have connections with some business. Secondly, rapid economic development has resulted in a large increase in demand for college workers while their supply has not yet kept pace with the demand.

The wage rate of workers in Bangkok is about B2.7 per hour higher than non-Bangkok workers. The minimum wage rate law which applies only in the Bangkok metropolis may partly account for this differential. Although there has been a large influx of rural migrants into Bangkok, most of the migrants are unskilled and the number has not been large enough to wipe out the wage gap. Secondly, the firms in Bangkok are relatively larger (in terms of the capital-labor ratio) than those in other provinces. They can pay higher wage because of higher labor productivity.

Children do not have any significant effect on the husband's wage. Hours of work are also not significant because the hypothesis of quasi-fixed labor costs may not be important in Thailand. Moreover, weekly hours may be a poor measure of life-cycle working hours.

The occupational variables show that the administrative, professional, management workers (HOC1) and clerical workers (HOC2) receive higher wage rates than other occupations after controlling for other factors.

Wife's Wage Equation

Most of the variables in this equation are significant and have the same expected signs as those in the husband's wage equation. However, the R^2 in the wife's equation (0.4775) is higher.

The insignificant effect of the number of children may indicate that the effects of childbearing and rearing are already captured by the experience variable because of the way the latter variable is measured.

Education and experience have positive effects on the wage rate as predicted in the human capital theory. The wage effects of each additional year of education and experience are ฿0.44 and ฿0.20, respectively. However, the hourly wage rate starts to decline when experience exceed 49 years. Moreover, experience may reflect age and can measure taste differences, e.g. the majority of women with long experience are in lower and middle income classes because in the past working was culturally ruled out for upper income women.

As in the husband's wage function, a college graduate female worker receives higher wages than a non-graduate worker. Professional and administrative jobs and clerical jobs also pay higher than other occupations.

A female government worker is not paid differently from her counterpart in the private sector. Finally, CLF is not significant and may be a poor measure of the life-cycle working hours.

The Demand for Children

The R^2 for this function is 0.35. All of the variables, except SOUTH and NORTH, are significant and have anticipated signs. The husband's wage rate and the wife's wage rate are negatively significant and are estimated at -0.05 and -0.017, respectively. This implies that the substitution effect dominates the income effect. This is opposite to the positive coefficient of the wife's wage obtained in a recent study of the economic determinants of fertility in Thailand (Phananiramai, 1979, p. 82). In addition, the income effect is significantly positive (0.004) indicating that children consitute a normal good as argued by Becker. Moreover, the magnitude of income elasticity (1.036) evaluated at means, though consistent with Phananiramai's result, is several times larger than her estimate of 0.006 (Phananiramai, 1979, p. 84). Differences in the way the number of children is measured can account for this large discrepancy. Phananiramai uses the desired number of children which is ex ante. Our approach employs the number of children living in the household which, as pointed out in Chapter Four, underestimates the true number of births because of child mortality and children leaving the family. That is:

(3) $C = (1-m)s.B$

where C is the number of children living in the household, m is the probability of dying, s is the proportion of the living children who stay with their parents, and B is the number of births. Taking the total derivative of (3) and dividing through by the change in income (dY), we obtain:

(4) $$\frac{dC}{dY} = \frac{d(1-m)}{dY} + \frac{ds}{dY} + \frac{dB}{dY}$$

Since we expect the child mortality rate to decrease as income increases, and the proportion of children staying with their parents is also likely to increase with their parents income,[9] the sum of the first two terms on the right side of (4) will be positive (even if $\frac{ds}{dY} = 0$). So, our income effect (dC/dY) is greater than the true income effect (dB/dY).

Age and squared age variables show that the number of children demanded will increase with the wife's age until she is 38.1 years old, after which the quantity demanded will be lower, other things being equal. A family with a husband working in the government sector will demand 0.78 more children than other families. This is due to the government pronatal programs described in the previous chapter. Finally, all of the regional dummy variables, except Bangkok, are not statistically different from the central region (which is used as a base). The coefficient of Bangkok variable is negative as postulated. This reflects the fact that the cost of children (e.g. education, child rearing, etc.) is relatively higher in Bangkok and that parents may also demand higher quality of children, rather than higher quantity.

Wife's Labor Supply Models

The estimates of the wife's labor supply models in Bangkok and non-Bangkok are given in Tables 10 and 11, respectively. The model employed is the same as that used to estimate the husband's labor supply, except that the wage and income variables in the women's model are deviations from regional means and the regional dummy variables are left out (see equations (33-38) in Chapter Three).

Wife's Labor Supply Functions in Bangkok and Non-Bangkok

First, the wife's own substitution and income effects in Bangkok are 1.1 and -0.031, respectively. The estimated substitution elasticity evaluated at means (given in Table 12) is very small (0.133), indicating that the working married women in Bangkok may also be essential prime-wage earners in their families. The income and compensated and uncompensated substitution elasticities evaluated at means are given in Table 13. The puzzling result is that the cross-substitution effect is significantly positive at 1.399, which implies that wife's and husband's uses of time are complementary. There are at least two possible explanations. First, for an average couple in our sample, which consists mostly of lower-middle and middle income groups, an increase in the husband's wage rate means that there is a high possibility for them to buy and enjoy more durable goods like a new television set or a new refrigerator if the wife also puts in more effort. Moreover, for a working couple, it is possible that both of them have a full load of work to do either at home or in the labor market. If the husband decides to allocate more of his time to work in the labor market as a result of an increase in his wage rate, the wife has to bear the burden of more housework which used to be her husband's job. If these

Table 10

Labor Supply of Wives in Bangkok

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	1.706	0.25	-1.279	-0.20	-13.914*	-10.44	-7.125*	-7.61	-1.782*	-2.01
CWM	0.357	0.69	1.399*	2.69					0.030	0.99
CWF	-0.157	-0.33	1.104**	2.91					-0.089**	-2.37
CHI	-0.000	-0.33	-0.031**	-2.81					0.003**	7.60
CWI										
C	-0.460	-0.68	-1.997*	-3.07	0.139	-0.93	-0.0008	-0.007		
EDM	-0.265	-1.44			0.650*	8.20			-0.165*	-6.20
MIGM	3.622*	2.78								
AGEM	-0.040	-0.14								
SQAGEM	0.002	0.05								
OCPM	-2.356*	-2.65			1.421*	2.46				
GOVM	-6.772*	-8.15			-1.896*	-2.06			0.455*	3.53
EDF			-0.325	-1.74			0.448*	5.88	-0.110*	-4.11

Table 10 (continued), Labor Supply of Wives in Bangkok

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
AGEF			-0.325	-1.74					0.316*	6.49
SQAGEF			-0.005	1.07					-0.004*	-5.60
OCPF			-2.827*	-2.54			0.496	1.01		
GOVF			-4.797*	-5.55			-1.920*	-1.97		
EXPM					0.477*	6.43				
SQEXPM					-0.006*	-4.55				
FRINGM					0.907*	2.41				
COLM					8.558*	11.88				
SEV									-0.935*	-3.91
UN	1.721	1.53	1.990	1.71						
FSIZE	0.219	0.27	2.119*	2.86						
EXPF							0.242*	4.62		
SQEXPF							-0.003*	-2.84		
FRINGF							0.736*	2.56		

Table 10 (continued), Labor Supply of Wives in Bangkok

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
COLF							6.106*	9.93		
CLM					-0.080	-0.69				
CLF							-0.148	-1.61		
R^2	0.2288		0.2579		0.4941		0.4688		0.3690	
Sample Size	843		843		843		843		843	

*Significant at 95 percent confidence level for a two-tail test.
**Significant at 95 percent confidence level for a one-tail test.

Table 11

Labor Supply of Wives in Non-Bangkok Area

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	10.354	0.99	37.269*	4.06	-10.859*	-6.39	-6.499*	-9.50	-8.439*	-6.98
CWM	1.736*	2.31	1.859*	2.83					-0.370**	-4.75
CWF	1.529	1.42	2.748**	1.89					-0.620**	-5.33
CHI	-0.042**	-2.20	-0.039**	-2.36					0.010**	8.97
CWI										
C	-0.809	-1.09	-1.080	-1.57	-0.107	-0.69	-0.400	-0.58		
EDM	-0.058	-0.23			0.490*	5.11			-0.015	-0.44
MIGM	1.509	1.26							-0.021	-0.42
AGEM	-0.399	-0.82								
SQAGEM	0.0047	0.79								
OCPM	-5.566*	-3.28			2.974*	2.93				
GOVM	-8.020	-5.43			1.791	1.16			0.0008	0.004
EDF			-0.438	-1.16			0.382*	7.80		

Table 11 (continued), Labor Supply of Wives in Non-Bangkok Area

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
AGEF			-1.729*	-3.62					0.609*	10.43
SQAGEF			0.022*	3.36					-0.008*	-9.68
OCPF			-8.744*	-4.78			0.910*	1.97		
GOVF			-6.117*	-3.25			1.518*	3.65		
EXPM					0.317*	4.11				
SQEXPM					-0.0036*	-2.64				
FRINGM					-0.881	-1.26				
COLM					2.320*	2.36				
SEV									-0.185	-0.77
UN	-0.266	-0.67	-0.420	-1.13						
FSIZE	1.296	1.73	1.699*	2.48						
EXPF							0.174*	4.55		
SQEXPF							-0.0024*	-2.92		
FRINGF							0.158	0.65		

Table 11 (continued), Labor Supply of Wives in Non-Bangkok Area

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	CLM		CLF		CWM		CWF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
COLF							2.323*	3.06	-0.185	-0.77
CLM					0.135	1.05				
CLF							0.032	0.74		
R^2	0.3258		0.2649		0.2481		0.4813		0.3692	
Sample Size	788		788		788		788		788	

*Significant at 95 percent confidence level for a two-tail test.
**Significant at 95 percent conficence level for a one-tail test.

Table 12

Means and Standard Deviations of Variables

Variables	Bangkok		Non-Bangkok	
	Means	S.D.s	Means	S.D.s
LM	45.101	10.70	46.145	14.99
LF	44.214	44.21	42.407	42.41
WM	7.632	7.55	5.518	5.29
WF	5.316	5.44	4.285	3.48
HI	619.682	522.88	413.248	268.21
C	1.887	1.66	2.143	1.67
EDM	8.689	4.80	8.915	4.76
MIGM	0.089	0.28	0.219	0.414
AGEM	36.464	9.10	37.234	9.06
EDF	7.935	4.86	8.270	4.93
AGEF	33.032	8.58	33.552	8.37
EXPM	20.662	10.31	21.303	11.05
SQEXPM	533.062	526.13	575.871	583.93
FRINGM	0.584	0.49	0.734	0.44
UN	2.775	0.30	2.452	1.20
COLM	0.116	0.32	0.061	0.24
GOVM	0.383	0.49	0.576	0.49
EXPF	16.691	9.57	16.635	10.07
SQEXPF	370.153	411.18	378.021	429.78
FRINGF	0.478	0.50	0.577	0.49
FSIZE	5.457	2.84	5.043	2.17

Table 12 (continued) Means and Standard Deviations of Variables

Variables	Bangkok		Non-Bangkok	
	Means	S.D.s	Means	S.D.s
COLF	0.096	0.29	0.018	0.13
GOVF	0.351	0.48	0.524	0.50
SEV	0.125	0.33	0.098	0.30
OCPM	0.442	0.50	0.520	0.50
OCPF	0.441	0.50	0.563	0.50
SQAGEM	1412.255	724.80	1468.261	736.40
SQAGEF	1164.622	613.69	1195.770	607.37

Table 13

Income and Substitution Effects, and Elasticities in the Wife's Labor Supply Model (Evaluated at Means)

VARIABLES	NON-BANGKOK		BANGKOK	
	Male[1]	Female	Male[1]	Female
Own substitution effect	1.736	2.748	0.000	1.104
Cross-substitution effect	0.000	1.859	0.000	1.399
Income effect	-0.042	-0.039	0.000	-0.031
Slope of labor supply	-0.202	1.094	0.000	-1.238
$E_{s_{ii}}$ (uncompensated)[2]	-0.024	0.110	0.000	-0.032
$E_{s_{ii}}$ (compensated)[2]	0.208	0.278	0.000	0.133
E_B	-0.376	-0.380 backward at 70 hrs.	0.000	-0.434 backward at 45 hrs.

[1]The estimates of income and substitution effect and their respective elasticities are not the appropriate parameter estimates of the husband's labor supply function. They are presented here only for comparison.

[2]$E_{s_{ii}}$ = substitution elasticity with respect to own wage rate.

Source: Non-Bangkok parameters are calculated from Tables 11 and 12. Bangkok parameters are calculated from Tables 10 and 12.

extra non-market activities are inferior, she would substitute market work for them.

The estimated income effect also satisfies equation (1) because the product of the income effect and wife's average wage is -0.165 which implies that the average female worker will allocate 0.165 of each additional baht of non-labor income to purchase non-market time and the other 0.835 to purchase consumption goods.

For the average wife in non-Bangkok areas, the substitution effect and its elasticity are relatively larger than those for Bangkok married women. The income effect (-0.039) in non-Bangkok, but not its elasticity, is slightly larger than that of Bangkok. Therefore, the average wife in non-Bangkok areas will allocate 0.167 of each additional baht of income to purchase non-market time.

There are only four other significant independent variables in the wife's supply in Bangkok. They are C, GOVF, OCPF and FSIZE, which all have expected signs.

For the labor supply of married women in non-Bangkok areas, the significant variables are AGEF, SQAGEF, OCPF, GOVF and FSIZE. Since every significant variable has the anticipated sign and since we have already discussed their rationale in the husband's labor supply section, the explanations for these variables, except AGEF AND SQAGEF, will not be repeated here.

The coefficient of age is negative (-1.73) because the taking of leisure for a woman aged less than 39 years (who is also likely to be a prime-wage earner along with her husband) is very costly in terms of forfeiting "not only the income from work but also the productivity-increasing experience which in most pursuits, is a by-product of work (Finegan, 1962, p.

455)." This cost of leisure is greater for younger people than for older ones. After the age of 39 years is reached, the average wife begins to supply more hours because the coefficient of squared age is positive (0.022). So, the age-hours worked profile has a U-shape. One possible explanation is that after a woman has passed her childbearing age and the children can go to school, they tend to spend more of their time in the labor market. Secondly, there may be some inter-generational effects at work, i.e. the older workers may have less education and lower expected lifetime earnings than the younger, and hence have to put in more working hours to compensate for the low earnings.

Wage Functions in Bangkok and Non-Bangkok Areas

Since the labor supply of married women in Bangkok is separately estimated from that in non-Bangkok areas, the following wage and children equations are unlike those in the first section, which presented the model for the whole nation.

In Bangkok, the husband's and the wife's wage functions have an R^2 of 0.4941 and 0.4688, respectively. Most of the coefficients in both functions are significant and have anticipated signs. Since the explanations of the variables in the Bangkok wage functions are the same as those in the model of the husband's labor supply of the second section, we will not explain those variables here.

The insignificant variables in the husband's wage functions are CLM and C. For the wife's wage function, they are CLF, C and OCPF.

In non-Bangkok area, GOVM, FRINGM, CLM and C are not significant in the wife's wage equation.

Comparing male workers in Bangkok and non-Bangkok, we find that the coefficients of human capital variables, like education and experience are larger (in absolute values) for Bangkok than for non-Bangkok. This is not surprising because Bangkok is the largest employment market with modern equipment and technology. So the rate of return to human capital investment is higher in Bangkok.

Secondly, the government male workers' wages in non-Bangkok are not different from their counterpart in the private sector. If they are in Bangkok, their wage rates will be lower than those of private sector employees, other things being equal.

The rates of return to the wife's human capital are also higher in Bangkok than elsewhere. For example, one more year of education of the Bangkok wife will result in an increase of ฿0.45 in hourly wage rate, compared with ฿0.38 in non-Bangkok. The largest difference comes from the effect of COLF. While a college graduate's wage rate in Bangkok is ฿6.1 higher than a non-college worker, a college graduate in non-Bangkok will receive only ฿2.3 higher than other in the same area.

Moreover, if she is a government worker outside Bangkok, a woman will earn ฿1.52 per hour higher than other workers in the same area. However, if she is in Bangkok, her wage rate will be less than that of a woman in the private sector, *ceteris paribus*.

The Demand for Children

The results for the demand for children in Bangkok and non-Bangkok are generally consistent with the economic theory of fertility.[10] All of the individual coefficients of the wage and income variables in the Bangkok demand for children equation are smaller than those in non-Bangkok.

In Bangkok, all variables, except CWM, are significant and have the anticipated signs. The wife's wage rate, which reflects the opportunity cost of her time, has a negative effect on the number of children, i.e.

an increase of ฿1.0 hourly wage will decrease the number of children by 0.09. Therefore, the substitution effect dominates income effect.

An increase of ฿100.0 weekly income will result in 0.3 more children demanded. The income elasticity is about 0.99 (evaluated at means) and so children are normal goods. However, as pointed out in the second section, our estimated income and substitution effects may be biased upward because of the way the demand for children is defined.

In the non-Bangkok area, husband's and wife's wage effects are relatively larger, i.e. -0.37 and -0.62 respectively. The income effect is also positive and larger than that of Bangkok. The income elasticity evaluated at means is 1.92 which implies that children in non-Bangkok are superior goods.

Both husband's and wife's education, which are the proxies for contraceptive knowledge and the opportunity cost of time, have significant negative effects on the number of children demanded in Bangkok. But, they are not statistically different from zero in the case of non-Bangkok.

A typical Bangkok family with the husband being a government employee will demand on the average half a child more than other families because of the pro-natality policy of the government since the 1950s. However, having a husband working with the government in the non-Bangkok area will not significantly increase the family's demand for children. This may be because the average number of children for non-Bangkok is already higher than the Bangkok average (2.14 vs. 1.88).

Age and age square, entered to control for life cycle factors, are statistically significant and have the right signs for both areas.

Moreover, while the number of children demanded in the non-Bangkok area starts decreasing after the wife reaches the age of 38 years, families in the Bangkok area will not decrease their demand until the wife's age is 39.5 years.

The maid dummy variable for Bangkok is significantly negative, which is opposite to our expectation. The reason may be that older children can be employed to take care of smaller children, i.e. they become a substitute for a maid. If a couple wants to have more leisure at home by hiring a maid to do some housework for them, they will have to pay her the average monthly salary of ฿400-฿800, which is about 16 to 32 percent of the average household income for the typical family in Bangkok. Moreover, the families willing to hire a maid may have a strong preference for consumption of more goods and taking more leisure time and/or derive much lower utility from children.

Thirdly, the fact that a couple has a maid can be taken as evidence that the wife gets more pleasure from doing other things than caring for house and/or children (plus the money paid for the maid). This suggest, other things being equal, that a family with a maid would have fewer children. In non-Bangkok areas, SEV is not significant, reflecting that it is the poor proxy of wealth and assets. This is because it is very cheap and easy to hire a maid from the farm which is just a few miles from the city.

NOTES TO CHAPTER IV

1. This omission is necessary because there is no information on the wages and income of self-employed and unpaid family workers. Moreover, their reported hours of work are unreliable since it is not possible to separate the number of business hours from the time they spend for home production. This is because their home is usually their place of business.

2. It is possible to determine the direction of bias under some circumstances. In particular, suppose the correctly specified labor supply model is:

   (1) $L = a + bW + cY + e$

   where L is hours of work, W is total wage (i.e. money wage plus fringe benefits or M+F which is not observed, Y is non-labor income and e is the disturbance term. Suppose that the fringe benefits (F) is nonstoachastic, we substitute W = M+F into (1):

   (2) $L = a + bM + cY + (bF+e)$

   $= a + bM + cY + e^*$

   The mathematical expectations of the least squares estimators of b and c based on (2) are:

   (3) $E(\hat{b}) = b + b(d_1)$

   (4) $E(\hat{c}) = b + b(d_2)$

   where d_1 and d_2 are the least squares coefficients of

   (5) $F = d_0 + d_1M + d_2Y + e'$

   Since b is expected to be positive and c to be negative (if leisure is a normal good), then $\hat{b}$ and $\hat{c}$ are biased upward if d_1 and d_2 are positive (Kmenta, 1971, p. 396).

3. In our model, the labor supply decision, which is measured by the hours of work, is a short-run decision, while the decision about the number of children is long-run. We can reconcile having both equations in the same model on the following grounds: (a) in the long-run, completed fertility and human capital investment decisions are all behaviorally interrelated with current labor supply decisions, and all are probably influenced by common exogenous factors (T. P. Schulz, 1975, p. 2); (b) the economic theory underlying most of the labor supply studies is really correct for relating <u>lifetime average</u> labor

supply to lifetime average wage and wealth. Although the theory requires lifetime averages, the data used usually contain information at only a single point in time. In the cross-sectional data, since individuals are often at different points in their life cycles, we risk confusing true differences in labor supply behavior (lifetime averages) with differences related to the life cycle. If the true relationship between lifetime averages is to be accurately measured, we must purge out independent and dependent variables, in our one-period labor supply model, of life-cycle components. One way of doing this is to assume that hours of work supplied by family members at any point in their life cycle consists of three components--a permanent average lifetime hours of work, a component related to the life-cycle position of the individual, an an error component. This problem can be approached by including age as an independent variable in the labor supply regression. Therefore, with this adjusment, we can have the hours of work and the children equations in the same model.

4. Asset income and wealth data are not available and hence are left out of this study.

5. The exchange rate is approximately \$1.00:฿20.30.

6. Although it is possible to test the significance of the backward-bending hypothesis, the test is complicated and will not be performed here.

7. The formula for this t statistic is:

   $(\beta_C + \beta_{FSIZE})/\sqrt{VAR_C + VAR_{FSIZE} + 2COV(C,FSIZE)}$, where β_i is the estimated coefficient, VAR_i stands for the variance of the estimate of variable i, and COV is the covariance.

8. In the wife's labor supply model, we find that migration positively affects the husband's labor supply in the Bangkok area only. Hence, when we estimate the labor supply of males by pooling the data across the country, the migration variable becomes insignificant.

9. Rich families are able to provide their children with better housing, higher education, etc. So, their children may stay with them longer than children in the poor families. However, this may not be true if poor families need the labor service of their children. Hence, the sign of (ds/dy) cannot be determined a priori.

10. When the demand for children is estimated in the model which measures the income and wage variables as deviations from national means, the results are similar to those using deviations from regional means. The results using national means are given in Table 7.

CHAPTER V

TESTING SOME IMPLICATIONS FROM CLASSICAL AND BARGAINING THEORIES

This chapter attempts to improve the estimates of the coefficients of the wage and income variables in the labor supply model. In the first section, some suppositions derived from the classical theory of labor supply are tested. Those that prove significant are then imposed on the model in Chapter Three to improve the reliability of the hypothesis testing of the estimated parameters. In the second section, the bargaining theory of labor supply is discussed. Since there is no reason, except mathematical necessity, to believe that the Slutsky symmetry condition always hold for a family,[1] the bargaining theory of labor supply is brought in to discuss circumstances in which the Slutsky condition would not be expected to hold. This is especially evident when we relax the assumption of equal income effects of the couples' labor supply. Finally, in the third section, the labor supply model is respecified according to bargaining theory and the regression results obtained in this manner are compared with the results as estimated by using classical theory.

Testing Some Classical Restrictions

In order to test some of the classical limitations, the basic model of the labor supply in Chapter Three and Four is summarized here:

(1) $$CLM = a_0 + a_1 CWM + a_2 CWF + a_3 CHI + \sum_{i=4}^{n} a_i X_i$$

(2) $$CLF = b_0 + b_1 CWM + b_2 CWF + b_3 CHI + \sum_{i=4}^{n} b_i X_i$$

where CLM, CLF are husband's and wife's hours or work, CWM, CWF are their respective wage rates, CHI is household income, X_i is a vector of independent variables.

1. First, we want to test the hypothesis that pure substitution effects of a_1 (or S_{mm} in Chapter Three notation) and b_2 (or S_{ff}) are positive. From Table 7 in Chapter Four, which gives estimates of the husband's labor supply, we have $a_1 = 1.32$ with a "Z" value of 3.77 which is significantly different from zero. The estimated compensated substitution effects of married women in Bangkok and non-Bangkok (from Tables 10 and 11 in Chapter Four) are 1.104 and 2.75 with the respective "Z" values of 2.69 and 1.90 which are again significant at the 95 percent confidence level (for a one-tailed test).

2. To improve the estimates of the wage and income coefficients, the first empirical strategy is to test the hypothesis that cross-substitution effects are equal,[2] i.e. $a_2 = b_1$. This hypothesis can be tested by employing the "F-statistic" which is developed to test the linear constraint across equations (Theil, 1971, pp. 340-344). Further discussion of this statistic is given in Appendix E. To calculate this statistic, equations (1) and (2) and the husband's wage, the wife's wage and the children equations (as specified in Table 5 of Chapter Three) are estimated twice. One estimate assumes no constraint, while the other is generated with the $a_2 = b_1$ constraint. The F-statistic for the husband's labor supply model (which is 0.313 with 1 and 8088 degrees of freedom in the numerator and denominator, respectively) is calculated. As a result, we fail to reject the hypothesis that $a_2 = b_1$ or $S_{fm} = S_{mf}$ and the constrained model is accepted as the more appropriate model of the husband's labor supply. The results of the constrained estimates are given in

Appendix F, and only the estimated substitution, cross-substitution and income effects are presented in Table 14 which indicates that there is some reduction in estimated standard errors and, hence, our ability to test the above hypotheses is enhanced.

Table 14

Income and Substitution Coefficients in the Husband's Labor Supply Model

Labor Supply of:	Unconstrained[1]			Constrained[1]		
	CWM	CWF	CHI	CWM	CWF	CHI
Husband	1.316 (0.349)	1.158 (0.393)	-0.035 (0.008)	1.226 (0.295)	1.002 (0.258)	-0.032 (0.006)
Wife	0.800 (0.290)	0.553 (0.313)	-0.015 (0.006)	0.889 (0.216)	0.614 (0.295)	-0.017 (0.004)

[1]Standard error estimates are in the parenthesis.

3. For the wife's labor supply model in non-Bangkok, the hypothesis that $a_2 = b_1$ also cannot be rejected. On the other hand, for the labor supply of married women in Bangkok, the same hypothesis must be rejected at the 95 percent confidence level.[3] Since the results of these tests are mixed, constrained estimates of the wife's labor supply are not necessarily appropriate.[4] More evidence concerning the equality of cross-substitution effects is necessary. Fortunately, recent applications of game theory to labor supply decisions have provided a theoretical justification for the asymmetry of the cross-substitution effects.

Testing Some Implications from Bargaining Theory of Labor Supply

The Neoclassical theoretical justification of identical cross-substitution effects stems from the basic assumption of the existence of a family utility function and a mathematical postulate, namely Young's Theorem. However, the tests above show that the identical cross-substitution effects may not always hold.

Recent application of game theory to the theory of labor supply decisions provides a theoretical ground for the unequal cross-substitution effects (M. B. McElroy and M. J. Horney, 1978a; Manser and Brown, 1976, 1977, 1978). They find that the above Slutsky symmetry condition, as well as the other two conditions in the classical theory--namely Engel aggregation[5]--may not always hold. Furthermore, game theory allows for the possibility that incomes of the husband and the wife do not have equal effects on their respective labor supply, while the assumption of income pooling is still maintained.

The essential difference of the bargaining theory is that both spouses are assumed to maximize different neoclassical utility functions (instead of one family utility function) subject to the full wealth constraint. In order to determine the potential gains from marriage, from the demands for household goods (some of which are treated as shared or public goods) and demand for leisure (treated as a private good), a set of rules is required. Game theory provides such a set and thus a determinate solution to the problem. One crucial element in gaming is the threat point, which is defined in this context as the utility per period of time the individual would receive if a marriage offer is declined or if the present marriage were to be dissolved.

Our main concern, however, is the appropriate labor supply specification, and not the theory of bargaining. Detailed discussion of the latter will not be presented here. (See Appendix G for a summary of the game theory.) Hence, we proceed to test some implications of game theory. Specifically, these are: (a) that the husband's and the wife's income do not always have equal effects on their labor supply, and (b) that if the equal income effects are not imposed onto the data, the cross-substitution effects on the couples' labor supply may not always be equal.

The model developed in Chapter Three must be modified to fit the bargaining theory before either hypothesis can be tested. We have already found in the first section above that if the couple's incomes are pooled, then the Slutsky symmetrical matrix hypothesis (i.e., the cross-substitution effects are equal) cannot be rejected for both the husband's and the wife's labor supply models. However, if the models are respecified by splitting the couple's income according to the game theory, the conclusions are different.

According to the bargaining theory, incomes of the husband and the wife do not have an equal effect on their respective labor supplies. Hence, the appropriate specification of the labor supply model is to add one more variable, i.e. the wife's income, into equations (1) and (2):

$$(3) \qquad CLM = a_0 + a_1CWM + a_2CWF + a_3CHI + a_3'CWI + \sum_{1=4}^{n} a_iX_i$$

$$(4) \qquad CLF = b_0 + b_1CWM + b_2CWF + b_3CHI + b_3'CWI + \sum_{1=4}^{n} b_iY_i$$

where CLM, CLF, CWM, CWF, and CHI, X_i and Y_i are defined before, CWI is the wife's income. Notice that writing the model in terms of CHI and CWI is equivalent to writing it in terms of (CHI-CWI) and CWI.[6]

Since the household income coefficient can be interpreted as the effect of the husband's income, the first hypothesis from game theory to be tested is the equal income effect hypothesis, i.e. $a'_3 = 0$. This is in fact to test the significance of the coefficient of the wife's income. The results are given in Table 15.

Table 15

Test of Equal Income Effects*

Model	Coefficient of CWI	'z'
Husband's Model		
1. CLM function	-0.093	-1.38
2. CLF function	-0.090	-1.42
Wife's Model in Bangkok		
1. CLM function	-0.159	-1.71
2. CLF function	-0.264**	-2.89
Wife's Model in Non-Bangkok		
1. CLM function	-0.124	-0.93
2. CLF function	-0.274**	-2.02

*If we perform a test of simultaneous income effects in both CLM and and CLF functions, the calculated F statistics are 121.2 for the husband's model, 153.87 for the wife's model in Bangkok, and 47.0 for the wife's model in non-Bangkok. So, the hypothesis is rejected for every model.

**Significant at the 95 percent confidence level.

The test shows that except for the husband's model in which the equal income effect hypothesis is accepted for both CLM and CLF functions, the hypothesis holds true only in the CLM functions of the wife's models. For the wife's labor supply, effect of wife's income are significantly different from the effects of husband's income. Such mixed results are not obtained in the Manser-Brown study. The implications of the results of our tests suggest that each partner may employ different rules of this game in the labor-supply-decision-making process.[7] Next, we are interested in another test, namely whether or not the hypothesis of both equal income effects ($a_3' = 0$ and $b_3' = 0$) and equal cross-substitution effects (or $a_2 = b_1$), imposed at the same time can be maintained. This hypothesis can be tested by either an F-test or a likelihood ratio test. Since the two test yield equivalent results (Theil, 1971, pp. 141-142),[8] the F-test is used. It was chosen because the calculation burden of the F ratio is minimal once the regression results of both the unconstrained and the constrained versions are available.

Equations (3) and (4) are twice estimated by 2SLS;[9] one without constraint and the other with three constraints (i.e., $a_3' = 0$, $b_3' = 0$, and $a_2 = b_1$). Then, the F-statistics are calculated (and presented in Table 16).

Table 16

Tests of Equal Income Effects and Symmetrical Effects[1]

Model	F	D.F.
Husband's model (1631 observations)	69.04	3; 3238
Bangkok wife's model (843 observations)	102.70	3; 1662
Non-Bangkok wife's model (788 observations)	58.51	3; 1552

[1]There are three restrictions in each model.

The results show that in every model the hypothesis that Slutsky symmetry exists can be rejected. This is contrary to the symmetry tests ran in the first section in which equal income effects were affirmed. Now, equal income effects as well as symmetry are subject to test. Since we have already rejected the equal-income effect hypothesis for the wife's labor supply functions (Table 15), we conclude that the classical restrictions of symmetry and equal income effects are not appropriate for the estimation of the wife's labor supply in our sample. However, the classical restrictions are still applicable in the case of the husband's labor supply estimation.

Some Results from the Bargaining Model

The tests of Slutsky symmetrical effects and equal income effects in the above two sections reveal that it is inappropriate to estimate the labor supply model with some a priori restrictions derived from the classical theory imposed onto the data because (a) the labor market for husbands may be different from that of wives and (b) the bargaining model of labor supply predicts that these two conditions do not always hold.

Given these findings, the final question we wish to pursue here is which model, classical or bargaining, is more appropriate for our data set. The preceding tests seem to suggest that the bargaining model is better suited, especially when the labor supply of wife is to be estimated. A final F-test will confirm whether or not the inclusion of an extra variable, namely wife's income, has contributed significantly to the explanation of the variation in hours of work. The results in Table 17 show in fact that the wife's income variable contributes significantly only in the wife's labor supply function.

Table 17

F-Test of the Wife's Income Variable

Model	F	DF 1	DF 2
Husband's Model (National Mean)			
CLM	1.820	1	1617
CLF	1.220	1	1618
Wife's Model			
CLM: Bangkok	3.520	1	763
CLF: Bangkok	8.490*	1	765
CLM: Non-Bangkok	0.862	1	775
CLF: Non-Bangkok	3.902*	1	776

*Significant at the 95 percent confidence level.

Therefcre, the bargaining theory seems to explain married women's labor supply behavior better than the classical theory. On the other hand, classical theory shows to be more powerful in explaining the labor supply behavior of the married male. For this reason, the unconstrained results of the wife's labor supply model specified by the bargaining theory (see Table 18) are discussed and compared with the results in Chapter Four.

Both the family income and the wife's income variables[10] are significant in the CLF function for Bangkok. However, the latter (-0.264) is several times higher than the former (-0.022), and also higher than the effect of family income (-0.031) in the classical model (see Table 10 in Chapter Four). Secondly, the own wage effect has drastically increased from 1.104 to 11.708. These lead to a large elasticity of substitution of 1.39, a (household) income elasticity of -0.308 and a (wife's) income elasticity of -1.403.

Table 18

Wife's Labor Supply in Bangkok and Non-Bangkok Areas:

Results from Game Theory[1]

EQUATIONS	Bangkok Area				Non-Bangkok Areas			
	Husband's Hours		Wife's Hours		Husband's Hours		Wife's Hours	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	-1.924	-0.27	-3.258	-0.59	10.647	1.01	21.377	1.69
CWM	0.237	0.46	1.069*	2.32	1.886**	2.45	1.343*	1.95
CWF	6.436	1.66	11.708**	3.17	7.019	1.17	13.230**	2.11
CHI	-0.002	-0.19	-0.022**	-2.23	-0.046**	-2.35	-0.028	-1.66
CWI	-0.159	-1.71	-0.264**	-2.89	-0.124	-0.93	-0.274**	-2.02
C	-0.370	-0.56	-1.577**	-2.73	-0.847	-1.14	-0.973	-1.49
FSIZE	0.160	0.19	1.629*	2.50	1.400	1.84	1.308	1.91
UN	1.590	1.43	1.581	1.57	-0.221	-0.55	-0.396	-1.13
EDM	-0.124	-0.62			-0.141	-0.52		
MIGM	3.818*	2.97			1.419	-1.18		
AGEM	-0.002	-0.01			-0.506	-1.01		
SQAGEM	0.0002	0.06			0.006	0.98		

Table 18 (continued), Wife's Labor Supply in Bangkok and Non-Bangkok Areas: Results from Game Theory

EQUATIONS	Bangkok Area				Non-Bangkok Areas			
	Husband's Hours		Wife's Hours		Husband's Hours		Wife's Hours	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
OCPM	-2.06*	-2.31			-5.353*	-3.12		
GOVM	-6.90*	-8.43			-7.145*	-4.07		
EDF			-0.265	-1.64			-0.469	-1.31
AGEF			-0.326	-1,18			-0.997	-1.60
SQAGEF			0.005	1.16			0.012	1.46
OCPF			-1.086	-0.96			-5.850*	-2.42
GOVF			-4.991*	-6.71			-4.988*	-2.63
R^2	0.2320		0.2654		0.2366		0.2683	
F-test[2]	3.5200		8.4850		0.8630		3.8500	
t-test[3]	1.6600		3.1700		1.1700		2.1100	

[1]The results on wage and children regressions are the same as those in Tables 10 and 11.

[2]The hypothesis is: CWI = 0.

[3]The hypothesis is: CHI = CWI.

*Significant at the 95 percent confidence level for a two-tail test.
**Significant at the 95 percent confidence level for a one-tail test.

The results for married women in the non-Bangkok area in Table 19 are consistent with those in Bangkok. First, the coefficient of CWI is significant at -0.274 compared with -0.039 in the classical model (see Table 11 in Chapter Four). Second, the coefficient of CHI (-0.028) is much smaller than the wife's income coefficient. Third, the wife's own wage variable becomes significant at 13.231 compared with 2.748 in the classical model.

Table 19

Elasticities Estimated from Classical and Bargaining Models (Evaluated at Mean Values)

Elasticities	Wives in Bangkok		Wives in Non-Bangkok	
	Bargaining	Classical	Bargaining	Classical
Pure substitution	1.390	0.133	1.337	0.278
Family income	--	-0.434	--	-0.380
Wife's income	-1.403	--	-1.174	--
Husband's income	-0.308	--	-0.273	--

Table 19 summarizes the results for both the classical model (taken from Table 13 in Chapter Four) and the bargaining models in terms of elasticity (evaluated at means). These surprisingly contrasted results need further elaboration. First, the large values of elasticities of the wife's labor supply with respect to her own wage and income are the more appropriate estimates of the wage and income parameters in the CLF function. This is because equation (4), not (2), is the correct specification of the wife's labor supply function.[11]

Second, the estimates of the compensated own substitution elasticity, which are greater than one for both Bangkok and non-Bangkok, are consistent with the hypothesis that married women have more alternative uses of their time in non-market production than do their husbands.

Third, a married woman is more responsive to <u>her</u> income than to those of the other family members' (including her husband's) incomes since the estimated wife's income elasticities are -1.52 in Bangkok and -1.294 in non-Bangkok, while the other members' income elasticities are -0.308 in Bangkok and -0.273 in non-Bangkok.[12]

Since the magnitude of the coefficients of other variables, both in the wife's labor supply function and in the wage and children equations, do not differ much from the classical model results in Chapter Four, there is no point in discussing them here.

The following conclusions can be drawn from the section on the bargaining theory.

1. The classical theory of supply of labor can be appropriately applied to explain the behavior of married males because (a) a wife's income does not significantly affect a husband's labor supply, nor does the wife's income coefficient significantly differ from the family income coefficient, and (b) the unconstrained regression results of husband's labor supply (CLM) specified by the bargaining theory (see Appendix F) show that (i) the income of husband and other family members, CHI - CWI, is significant at -0.012 compared with -0.015 (the coefficient of household income, CHI, in the classical model), and (ii) the coefficient of husband's wage rate, which is significant at 1.23, is also very close to the original estimate (about 1.32) under the classical model regime.

2. The behavior of wife's labor supply is consistent with the implications from the bargaining model because: (a) a wife's income contributes significantly to the explanation of the deviation in her weekly hours as well as having a different effect (on her weekly hours) from the family income, (b) the estimated substitution elasticities of wife's labor supply are consistent with the hypothesis of secondary workers, and (c) all of the hypotheses concerning the equal income effects and Slutsky symmetrical effects (postulated implicitly and explicitly in the classical theory) are rejected.

NOTES TO CHAPTER V

1. In the case of an individual demand for goods and services, the equal cross price (or substitution) effects on any two commodities can be justified on the ground that there is no reason to expect the same person to adjust his quantity demanded of i due to a change in the price of j non-symmetrically to the way he adjusts his demand for j when the price of i changes.

2. Ashenfelter and Heckman (1974, pp. 79-80) also tested the hypothesis that the determinant of the Slutsky matrix is positive (see condition 9 in Chapter Three). They employed the ratio of the value of the determinant and the standard error of the determinant. This is not a legitimate test, however, because--although each element in determinant (which is a regression estimate) is normally distributed--the value of the determinant (which is a nonlinear transformation) does not have a "known" distribution.

3. Since the calculated F-value is 4.163, we still fail to reject the null hypothesis at the 99 percent confidence level.

4. Moreover, it should be noted that although the constrained estimates result in a large reduction in the standard error of estimates (SSE) and a large increase in the "t" values of the parameters in the CLM functions, the SSEs in the CLF functions decrease proportionately less than a decrease in the values of the estimated parameters. Consequently, the "t" values of the estimated parameters in the CLF function decrease, instead of increase (see Appendix F).

5. Engel aggregation means that the sum of the products of income elasticities of demand for each good and its budget proportion must equal one. Cournot aggregation is defined as follows: the sum of the products of the cross price elasticities of demand for i due to a change in the price of j, and the budget proportion of the ith good must equal the negative of the budget proportion of good j.

6. This can be demonstrated as follows:

$$CLM = a_0 + a_3CHI + a_3'CWI$$

$$= a_0 + a_3(CHI - CWI + CWI) + a_3'CWI$$

$$= a_0 + a_3(CHI - CWI) + (a_3 + a_3')CWI$$

where (CHI - CWI) is husband's income.

7. That is, while the husband plays the rule of dictator (with no constraint binding or no interdependent utility) or plays the rule of symmetry (with fixed threat points), his wife may employ the

respective strategy of symmetry (with varying threat points) or the strategy of dictator (with constraint binding, or with interdependent utility).

8. Theil (1971) has shown that (a) a likelihood ratio test for the mean of a univariate normal distribution can be based on the t-distribution, and (b) that the F-test for the complete β vector may be regarded as a likelihood ratio test, too. The argument also holds for the test concerning a subset of vector β.

9. The model consists of five equations as specified at the end of Chapter Three, i.e. CLM in (3) and CLF in (4), and husband's wage, wife's wage and children equations. The results of the constrained model are in Appendix H.

10. The wife's income effect of -0.264 is the partial (direct) effect of CWI, holding the household income constant. The total wife's income effect, when CHI is not constant, is the sum of the coefficients of CWI and CHI. It is estimated at 0.286 for Bangkok and 0.302 for non-Bangkok areas. Both are statistically significant at the 95 percent confidence level.

11. The F-test in Table 18 confirms this. To illustrate, we assume that $CLF = b_0 + b_1CWF + b_2CHI + b_3CWI$ is the correct specification (like equation (4)). If we estimate $CLF = a_0 + a_1CWF + a_2CHI$, the least squares estimates of a_1 and a_2 can be shown to be:

$$E(\hat{a}_1) = b_1 + b_3d_{31}$$

$$E(\hat{a}_2) = b_2 + b_3d_{32}$$

where d_{31} and d_{32} are the least squares coefficients of CWF and CWI:

$$CWI = d_{30} + d_{31}CWF + d_{32}CHI$$

In our model, since $b_3 < 0$ if leisure is a normal good, $d_{31} > 0$, and $d_{32} > 0$, both a_1 and a_2 will be biased downward. Finally, if d_{31} is very large, then it is possible that b_1 becomes much larger than a_1. See Kmenta (1971, pp. 394-395).

12. The test in Table 16 already confirmed that the difference between the estimated coefficient of wife's income and the coefficient of husband's and other members' income is significantly different from zero. The t-values are 2.01 and 3.32 for Bangkok and non-Bangkok. Therefore, the hypothesis can be rejected at a conventional confidence level.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Recent development of the new home economics has emphasized the mutual determination of fertility and the labor supply behavior of each family member. The issue involves several questions which arise concurrently; how do the labor market opportunities and the family's demand for children affect each family members' labor supply; how does the family determine the time allocation of its family members; and how do each member's market wage rate and family income affect the number of children desired? This study attempts to answer the above questions within a context of a system of simultaneous equations, i.e. husband's and wife's labor supply functions, husband's and wife's wage functions, and the family's demand for children. The model is estimated by using disaggregated data from the Survey of Labor Force in Thailand in 1977.

This study has demonstrated that (a) Heckman's estimation procedure is negligibly better for our data set than the linear model, (b) that the appropriate measurement of wage and income variables in the husband's labor supply model should be deviations from "national means," while the measurement in the wife's labor supply model should be deviations from "regional means," (c) that the national labor market has relatively more influence than the local labor market on the husband's labor supply decision. However, the reverse is true for married women. Therefore, the labor supply model of married women is separately estimated for Bangkok and non-Bangkok areas. And finally (d) that the husband's and wife's incomes do not have equal effect on the wife's labor supply and, therefore, they should separately enter into the wife's labor supply regressions. Treating the couples' incomes as two separate variables results in a large increase in the substitution effect of wife's labor supply. The qualitative results of the model are summarized below.

Summary of Findings

Married Male

The estimated substitution and income elasticities of supply of labor of husbands are consistent with the classical predictions, i.e. the substitution elasticity is positive and very inelastic, and the income elasticity is negative and quite inelastic. Other things being equal, more children will reduce the husband's hours of work. On the other hand, holding the number of children and other factors constant, an increase in family size will encourage him to work more. Except for the government dummy variable and the occupational dummy variable, all other variables were found to have no significant effects on the husband's labor supply.

The demand for children, estimated by pooling all observations and by measuring wage and income variables as deviations from national means, is consistent with the economic theory of fertility. The income effect is negative implying that the pure substitution effect dominates the income effect. Education of couples is also found to be negatively related to the number of children. Finally, the number of children increases until the wife is 41 years old, after which the number of children demanded will decline.

The estimates of the husband's wage equation are also consistent with predictions of human capital theory. Education and experience positively affect the husband's wage rate, however, when experience exceeds 42 years, skill deterioration will cause the wage rate to decline.

Married Women

The substitution elasticity of the labor supply of married women in Bangkok is estimated at 0.133 if the model is specified under the classical theory and at 1.39 if it is specified under the game theory. For women in the non-Bangkok area, the wage elasticities are in the same range (0.38 and 1.34) as those of Bangkok. Our study has shown that game theory provides a more appropriate specification of the wives' labor supply. This, in effect, means that married women are very responsive: a change in an income tax rate will produce a large change in their labor supply.

In both areas, the number of children is negatively related to the wife's hours of work, but one more child in Bangkok seems to reduce the wife's hours of work more than one more child in non-Bangkok. Family size, on the other hand, negatively affects her working hours, ceteris paribus. Education is not found to have any significant effect. Age and its square are significant in both the Bangkok and non-Bangkok models, implying that young women tend to work less than women 39 years of age or older.

The demand for children is consistently shown to be negatively influenced by the couples' wage rate, education, the availability of maid services, and positively affected by family income, and the benefits that the government provides its employees for every extra child they have. The wage and income elasticities of Bangkok demand for children are smaller (in absolute value) than those of non-Bangkok.

The wife's wage equations for both Bangkok and non-Bangkok are generally impressive and consistent with the predictions of human capital theory. Education and experience are found to be powerful explanatory variables. A Bangkok wife who works with the government tends to receive less than her fellow in the private sector. However, the reverse is true for non-Bangkok wives. Being a non-production worker in Bangkok does not lead to an increase in her wage, while living in a non-Bangkok area will enable her to receive higher wage. Moreover, the rates of return to human capital investment in Bangkok are higher than those in non-Bangkok.

Policy Implications

The results of this study can be used to serve as a guide to the effect of various variables on labor supply, wage rate and demand for children. An outline of the policies concerning these three variables is suggested below.

In recent years, the government, especially the Department of Public Welfare, has expressed more interest in setting up a welfare program to alleviate poverty problems in the urban areas of Thailand. The knowledge of the income and substitution effects on the labor supply can be very helpful in the design of a welfare program--if a "comprehensive" program is to be initiated. That is to say, if all the poor--working or non-working--are included in the program. Such a program is known as a negative income tax scheme. The following hypothetical case will illustrate how the program works.

Suppose the subsidy received by any one family is defined as $S = G-tI$, where S is the subsidy, G is the guaranteed minimum level of income, t is the tax rate, and I is money income before tax. This subsidy will be zero where income equals (G/t) which is also referred to as the break-even income (B). If it is greater than G, then the result is negative subsidies (positive taxes). The negative income tax program will shift the budget constraint from $PX = W \cdot L + Y$ to $PX = G + (1-t)(WL+Y)$, where P is the price of goods and services defined as X, W is wage rate per hour, L is hours of work per period, and Y is non-labor income. If G is increased, holding t constant or vice versa, the break-even income level will increase and thus the coverage of the program. A crucial problem of public policy, therefore, is to find satisfactory values for G and t that do not result in a high level of B.

To illustrate the effect of the negative income tax program on the individual's labor supply, we will now simplify our labor supply model as illustrated in Chapter Three:

(1) $$dLM = S(dWM) + \frac{\partial LM}{\partial Y}[LM(dWM) + dY]$$ [1]

where dL = change in hours of work, S = the substitution effect, dWM = change in the husband's wage rate (WM), $\frac{\partial LM}{\partial Y}$ = income effect, LM = hours of work, and dY = change in non-labor income.

Suppose that the program produces the following effects: dWM = -tWM, dWF = -tWF, and dY = G - tY, then after the substitution of dWM, dWF and dY, equation (1) becomes:

(2) $$dLM = -t(WM)\ S + \frac{\partial LM}{\partial Y}[G-t(WM \times LM + Y)]$$

Consider a plan with a guaranteed income level of G = ฿150 per week and a 50 percent tax rate. Assume that a husband earns ฿2 per hour and works 50 hours, so that he obtains an initial subsidy of ฿50 per week, and finally assume that Y is 20. After making appropriate substitutions of these values and the estimated coefficients obtained in Chapter Four into equation (2), his hours of work will decline by 4.5 hours per week or 234 hours per year. The same person confronting a program with the same G but higher tax rate, say 60 percent, will reduce his working hours by only 4 hours per week as his subsidy would be smaller. A large decline in the individual's hours supplied is not desirable because aggregate output will also decrease while program transfer costs increase.[2]

The same program will have much more effect on the reduction of married women's supply of hours of work since the substitution and income effects of women's labor supply are larger than those of men.

In the case of demand for children, the results suggest that fertility can definitely be reduced by increasing women's opportunity cost of time by either allowing them to realize higher wages or through higher education. Moreover, an increase in the education level of the couples may increase their demand for child quality and further reduce the number of children demanded.

If the government is serious towards its family planning program and goal of a lower population growth rate, it must consider suspending tuition subsidies for the children of the government employees as well as stopping automatic increase in salary for each new additional child they have. Should the goverment still desire salary hikes, this can be accomplished through adjustments in the wage rates or through a cost-of-living allowance. Moreover, this program could be equitably designed such that poorer employees receive subsidies, though caution must be exercised not to tie the money to the number of children.

Since the number of children exerts a negative pressure on both the husband's and wife's labor supply, a successful family planning policy, to reduce the number of children desired, will bring down the population growth rate and increase an individual's labor supply. More than this, it can also increase the work experience of married women as fewer children mean less disruption in the life-cycle experience profile. This, in turn, results in a higher wage rate.

Policies focused toward raising the education level of the population will not only reduce fertility, but increase their wage rate and, hence, their labor income. Since college education can most effectively increase one's earnings, policies that will enable the poorer sector of the population to get more college education will certainly help reduce income disparities. However, expansion of college education, in itself, may be self-defeating if the the economy does not grow fast enough to absorb large increases in the numbers of college graduates. Already, certain academic disciplines such as education and most majors in social sciences, are currently oversupplied with graduates and hence may not be worth expanding any more.

Since workers in Bangkok receive higher wage rates than non-Bangkok workers, Thailand is experiencing a substantial migration of rural people into Bangkok. Despite this, the regional wage differentials persist. This implies that most of the migrants may be unskilled and posses low education. This type of migration can only equalize the regional wages of unskilled workers. Meanwhile, the wage differentials of skilled workers still persist since rural migration does not offset the high demand for skilled workers in Bangkok, which is the largest center of trade.

<u>Limitations of This Research and Further Research Topics Suggested</u>

1. This study is based on a static model. While this approach is illuminating, it ignores the fact that household decision making are

intertemporally dependent as well as interrelated with one another. It will be more fruitful to develop a dynamic model portraying the time paths of these jointly dependent decision variables. However, the unavailability of data and the difficulty of the mathematical solution of the dynamic model prevent us from approaching the problem dynamically.

2. This study also ignores self-employed or unpaid family workers because there is not enough information to calculate their income and wage rate. Further research should concentrate on the labor supply behavior of these self-employed workers for two reasons: (a) self-employed persons are free to make choices about their hours of work and, unlike paid employees, they are not constrained by any institutional restriction or employment contract; and (b) self-employed workers are the single largest group of poor and lower middle-income class workers.

3. Further updating of our model can be done if the data on the complete family size and child quality are available. The model of demand for children obviously has two drawbacks: (a) it deals only with child quantity and does not include child quality, and (b) the dependent variable in the demand for children equation is the number of children living in the household at the time of the survey. This is clearly an underestimate of the true family size which will bias upward the estimates of the effects of income and wages.

4. Since the data on non-labor income such as rent, assets and interests, are not available, the results of this study must be interpreted with caution since the estimates of the labor supply parameters may be biased as discussed in Chapter Four.

5. Fringe benefits are not an insignificant part of labor remuneration in Thailand. Although the Labor Force Survey has some information

on the type of fringe benefits that a worker receives, there are several problems: (a) the survey does not ask whether or not a respondent receives bonus or cost-of-living allowances which may be the largest part of fringe benefits of a high wage earner; (b) at the time of our data collection, information on the price of clothing, food and housing was not available; and (c) information on type and quality of clothing, food and housing were not available. Given these shortcomings, it is impossible to approximate the value of fringe benefits. For purposes of this study, though, we have tried to impute the values for food, clothing and housing by using the average cost of expenditure on these items from the Socio-Economic Survey in the 1968-1971 period. These were then recalculated to find the total hourly wage which includes money wage and food, clothing and housing. The preliminary regression results, which use this total hourly wage variable, are not much different from the results in Chapter Four. This may be because (a) the value of food, clothing and housing together account for less than ฿0.20 to ฿0.40 per hour. This is relatively small compared to the average wage of ฿4.50. (b) Most of the workers who receive fringe benefits tend to have the same type of benefits. Thus, this study is restricted to the real money wage rate. Further research should make use of fringe benefits after more data becomes available.

NOTES TO CHAPTER VI

1. Here we omit the cross-substitution effect and assume a family with only one working person for the simplicity of computation.

2. This example illustrates the impact of a hypothetical negative income tax program on the average person in our sample. The more interesting issue is the aggregate impact of alternative negative income tax programs. To calculate such impact we have to estimate (a) the number of participants in each program, (b) the total cost of the subsidy provided by the program, (c) the extent of a reduction in the work effort due to the program, etc. These figures can be calculated once the structure of each program has been drawn up. Then the pre- and post-program budget models must be defined before any simulation of the program impact can be carried out. Since the Thai government does not announce any specific welfare program and since the estimation of the program impact is beyond the scope of this study, we will simply refer to the works edited by Cain and Watts (1973).

APPENDIX A

Regression Results From Kosters' Model

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	LM		LF		WM		WF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	53.911*	10.49	61.373*	16.10	13.676*	-2.61	-8.311*	-2.65	-5.050*	-7.98
WM[1]	0.584	1.63	0.042	0.18					-0.037	-1.31
WF[1]	0.207	0.60	-0.103	-0.39					-0.141**	-3.82
HI[1]	-0.017**	-1.99	0.003	0.60					0.004**	11.42
FSIZE	0.820	1.58	0.021	0.06						
C[1]	-0.690	-1.33	-0.263	-0.74	0.075	0.68	0.044	0.64		
EDM	0.015	0.10			0.596*	9.63			-0.121*	-6.08
MIGM	2.113*	2.30								
AGEM	0.009	0.03								
SQAGEM	0.00005	0.02								
OCPM	-4.474*	-4.74								
GOVM	-0.371*	-8.70							0.698*	6.34
EDF			-0.400*	-3.06			0.444*	9.28	-0.085*	-3.94

Appendix A (continued), Regression Results From Kosters' Model

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	LM		LF		WM		WF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
AGEF			-0.443*	-1.97					0.398*	11.18
SQAGEF			0.005	1.52					-0.005*	-9.87
OCPF			-4.340*	-4.89						
GOVF			-5.394*	-7.98			0.609	1.51		
EXPM					0.361*	6.47				
SQEXPM					-0.004*	-4.28				
FRINGM					0.377	1.13				
COLM					5.615	9.33				
SEV									-0.637*	-3.91
UN	-0.648	-1.78	-0.740*	-2.64						
EXPF							0.198*	5.71		
SQEXPF							-0.002*	-3.23		
FRINGF							0.420*	22.05		
COLF							4.730*	9.57		

Appendix A (continued), Regression Results From Kosters' Model

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	LM		LF		WM		WF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
CLM					0.124	1.36				
CLF							0.101	1.71		
NORTH									-0.035	-0.21
N-EAST									0.490*	2.85
SOUTH									0.352*	2.09
BKK					2.671*	6.06	1.072*	5.50	-0.567*	-4.52
HOC1					4.610*	5.33				
HOC2					1.960*	2.60				
HOC3					0.330	0.55				
HOC4					0.830	1.51				
WOC1							2.967*	4.63		
WOC2							1.465*	3.02		
WOC3							0.697	1.43		
WOC4							0.460	1.55		

APPENDIX A (continued), Regression Results From Kosters' Model

EQUATIONS	Husband's Hours		Wife's Hours		Husband's Wage		Wife's Wage		Demand for Children	
	LM		LF		WM		WF		C	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'	β	'z'
R^2	0.2264		0.2602		0.4114		0.4775		0.3500	
Sample Size	1631		1631		1631		1631		1631	

[1]The endogenous variables are LM, LF, WM, WF, HI, and C.

*Significant at the 95 percent confidence level for a two-tail test.
**Significant at the 95 percent confidence level for a one-tail test.

APPENDIX B

DISCUSSION OF SOME INSIGNIFICANT VARIABLES

In the preliminary run, we experimented with several independent variables which have been used in previous research. Some of them are worth mentioning here.

Labor Supply Functions. As discussed in Chapter Three, EXFAM was tried as a measure of the presence of the other family members in the CLM and CLF functions. Since it was not always significant, it was replaced by FSIZE.

Several measures of the age composition of children (e.g. a dummy variable on the presence of pre-school children in a family) have been experimented with to capture the effect of the child-rearing burden on a wife's labor supply. But, none of them is significant.

Some dummy variables on the size of a city in which a person is working was also tried without any success. Regional dummy variables were also used experimentally. It was found that all regions, except Bangkok, are not significantly different from each other. Although the Bangkok dummy variable is significant in the CLM regressions, it caused the CWM and CHI variables to become insignificant. This means that all variation in the hours of work is totally explained by a shift in the intercept of this regression. Therefore, we decided to drop the Bangkok dummy variable from the CLM regression.

A dummy variable equalling 1 if a woman migrated from other provinces five years ago was also tried in the CLF regression. Since it was never significant, it was dropped.

Wage Functions. Besides a dummy variable on Bangkok, some dummy variables on other regions were included in the wage equations. However, all regions, except Bangkok, were not significant.

A dummy variable equalling one if a person is living in the metropolitan area was also tried but was not significant.

Migration variables were also not significant and so they were dropped.

APPENDIX C

AGGREGATION TEST

A problem which often occurs in empirical research is the the aggregation problem, i.e. when a regression is estimated, should we pool all the observations across the sample; or should we separate the observations by some criteria, say, regions? The dummy variable test is one of the techniques that helps in answering the question.

In our case, we simply add dummy variables to allow for intercept-change and slope change due to differences in the coefficients of the parameters in, say, two regions. Therefore, the following variables are added to the model in Table 4:

BKK = 1 if a person lives in Bangkok, 0 otherwise
BWM = BKK x CWM, BWF = BKK x CWF
BHI = BKK x CHI, BC = BKK x C
BEDM = BKK x EDM, BEDF = BKK x EDF
BAGEM = BKK x AGEM, BAGEF = BKK x AGEF
BSQAGEM = BKK x SQAGEM, BSQAGEF = BKK x SQAGEF
BGOVM = BKK x GOVM, BGOVF = BKK x GOVF
BOCPM = BKK x OCPM, BOCPF = BKK x OCPF
BMIGM = BKK x MIGM, BUN = BKK x UN
BFSIZE = BKK x FSIZE

Then, the F-statistic is used to test the following hypotheses:

For CLM function: BKK=BWM=BWF=BHI=BEDM=BAGEM=BSQAGEM=BOCPM=BMIGM=BGOVM=BC=BFSIZE=BUN = 0

For CLF function: BKK=BWM=BWF=BHI=BEDF=BAGEF=BSQAGEF=BOCPF=BGOVF=BC=BFSIZE=BUN = 0

The calculated F-statistic and regression results are given below.

APPENDIX C (continued), Test of Aggregation

EQUATIONS	"National Mean" Model[1]				"Regional Mean" Model[2]			
	Husband's Hours		Wife's Hours		Hubsand's Hours		Wife's Hours	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	3.27	0.30	23.58	3.03	-6.89	-0.56	26.64	3.20
CWM	0.92	1.24	1.60	3.00	0.16	0.16	2.76	3.76
CWF	0.79	0.87	0.03	0.03	0.79	0.69	1.43	0.99
CHI	-0.03	-1.72	-0.02	-1.72	-0.03	-1.35	-0.05	-2.87
FSIZE	0.89	1.40	1.08	1.87	0.96	1.22	2.02	2.74
C	-0.70	-0.99	-0.96	-1.51	-0.82	-1.07		
EDM	0.06	0.23			0.38	1.27		
MIGM	1.23	1.12						
AGEM	0.03	0.07			0.28	0.52		
SQAGEM	-0.0004	-0.07			-0.002	-0.37		
OCPM	-5.64	-3.46			-3.72	-2.09		
GOVM	-8.64	-6.47			-8.22	-6.18		
EDF			0.09	0.34			0.17	0.54
AGEF			-1.18	-2.92			-1.67	-3.61

APPENDIX C (continued), Test of Aggregation

EQUATIONS	"National Mean" Model[1]				"Regional Mean" Model[2]			
	Husband's Hours		Wife's Hours		Husband's Hours		Wife's Hours	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
SQAGEF			0.02	2.89			0.02	3.65
OCPF			-8.45	-5.39			-8.92	-5.30
GOVF			-3.98	-2.79			-0.39	-2.15
UN	-0.51	-1.37	-0.92	-2.96	-0.40	-1.10	-0.50	-1.56
BWM	0.67	0.55	-0.55	-0.58	1.36	0.81	-2.26	-1.79
BWF	0.18	0.15	0.86	0.68	-0.15	-0.10	-0.64	-0.38
BHI	-0.01	-0.38	-0.002	-0.08	0.0008	0.02	0.04	1.38
BC	-1.13	-1.02	-0.49	-0.51	-0.72	-0.57	-0.46	0.40
BEDM	-0.001	-0.003			-0.65	-1.51		
BAGEM	-0.34	-0.56			-0.60	-0.84		
BSQAGEM	0.005	0.67			0.006	0.72		
BGOVM	0.89	0.52			1.28	0.75		
BOCPM	3.34	1.65			1.17	0.54		
BMIGM	1.42	0.72			1.28	0.65		

APPENDIX C (continued), Test of Aggregation

EQUATIONS	"National Mean" Model[1]				"Regional Mean" Model[2]			
	Husband's Hours		Wife's Hours		Husband's Hours		Wife's Hours	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
BEDF			-0.36	-1.01			-0.57	-1.40
BAGEF			0.82	1.48			1.48	2.32
BSQAGEF			-0.01	-1.50			-0.02	-2.41
BGOVF			-1.06	-0.64			-1.71	-0.94
BOCPF			5.66	2.89			6.26	3.01
BFSIZE	1.34	1.01	0.58	0.53	0.74	0.45	-0.997	-0.71
BUN	2.52	1.79	2.82	2.26	2.57	1.78	2.25	1.73
BKK	-9.71	-0.67	-21.87	-2.19	6.42	0.42	-24.87	-2.36
R^2	0.144		0.193		0.193		0.132	
F-test	0.856		12.500		0.749		11.381	

[1] This model measures LM, LF, WM, and WF as deviations from national means.

[2] This model measures LM, LF, WM, and WF as deviations from regional means.

APPENDIX D

DISTRIBUTION OF YEARS OF EXPERIENCE LOSS OF MARRIED WOMEN
(By Number of Children)

Number of Children	Average Years of Experience Lost[1]
0	0.31
1	1.13
2	1.16
3	2.60
4 and over	2.65

[1] Average years of experience lost by married women is calculated by subtracting the number of years an average married woman works after marriage from the average number of years she has been married.

Source: National Statistical Office and Population Institute of Chulalongkorn University, Survey of Fertility in Thailand, 1973, Data Tape.

APPENDIX E

THEIL'S F-STATISTIC FOR A TEST OF A LINEAR CONSTRAINT ACROSS EQUATIONS

Sometimes economists want to test the relationship of two or more variables in different equations as postulated by economic theory. Consider a set of L equations combined to $Y_i = X_i\beta_i + e_i$, where Y is a column vector of n values taken by the dependent variables of ith equation, X_i is a n x K_i matrix of the K_i explanatory variables, β_i is the corresponding parameter vector, and e_i is a disturbance vector. If the relationship between the variables in which we are interested is linear, the hypothesis that we want to test is:

$$r = R\beta$$

where r is a known q-element vector and R a known matrix of full row rank and of order q x $(K_1 + \ldots + K_L)$.

The statistic which is used to test this hypothesis is distributed as F (Theil, 1971, pp. 340-341):

$$F = \frac{Ln - \sum_{j=1}^{L} K}{q} \times \frac{b'R'[R(\Omega \otimes (\bar{X}'\bar{X})\ R']^{-1}\ Rb}{(y-Xb)'(\Omega^{-1} \otimes I)(y-Xb)}$$

where L = number of equations, n = number of observations, K_j = number of explanatory variables in jth equation, q = the dimension number of a vector r which is a linear constraint we wish to test (i.e. $r = R\beta$), R = a known full row-rank matrix (of order q x $(K_1 + K_2 + \ldots + K_L)$) which is used to transform a β-vector into linear constraint, b is an unconstrained matrix of order n x n, Ω is a covariance matrix, $\otimes$ stands for a Kronecker product.

APPENDIX F(1)

CONSTRAINED ESTIMATES OF THE HUSBAND'S LABOR SUPPLY*

Equations	Husband's Hours CLM		Wife's Hours CLF	
Variables	β	'z'	β	'z'
INTERCEPT	0.647	0.13	15.227	3.75
CWM	1.204	3.99	0.961	4.46
CWF	0.961	3.72	0.640	2.18
CHI	-0.032	-5.32	-0.018	-3.72
C	-1.310	-3.21	-1.305	-3.81
EDM	0.102	0.75		
MIGM	1.613	1.87		
AGEM	-0.113	-0.46		
SQAGEM	0.002	0.66		
OCPM	-3.985	-4.84		
GOVM	-8.530	-11.36		
EDF			-0.323	-2.46
AGEF			-0.568	-2.54
SQAGEF			0.007	2.29
OCPF			-4.982	-5.87
GOVF			-5.318	-8.24
FSIZE	1.666	4.41	1.254	3.98
UN	-0.526	-1.55	-0.594	-2.11
R^2	0.1629		0.2414	
F-test**	0.535		0.535	

* The wage and children functions are the same as those in Table 1, so they are not presented here nor in Appendix F(2).

** The hypothesis is: "CWF" in the CLM-model equals "CWM" in the CLF model.

APPENDIX F(2)

CONSTRAINED ESTIMATES OF THE WIFE'S LABOR SUPPLY FUNCTIONS IN BANGKOK AND NON-BANGKOK AREAS*

EQUATIONS	BANGKOK				NON-BANGKOK			
	Husband's Hours CLM		Wife's Hours CLF		Husband's Hours CLM		Wife's Hours CLF	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	-4.050	-0.57	1.720	0.31	12.772	1.20	34.774	3.89
CWM	1,183	2,42	0.673	2,02	1.857	2.83	1.546	2.80
CWF	0.673	1,70	0,718	2,46	1,546	2.49	2.515	1.77
CHI	-0,026	-2,31	-0.016	-2.21	-0.041	-3.32	-0.033	-2.20
FSIZE	1.600	2.17	1.140	2.32	1.273	2.30	1.540	2.38
C	-1,470	-2,30	-1.230	-2.63	-0.777	-1.18	-1.100	-1.66
EDM	-0.092	-0.49			-0.129	-0.49		
MIGM	2.890	2,08						
AGEM	-0,205	-0.69			-0.461	-0.97		
SQAGEM	0.003	0,77			0.005	0.93		
OCPM	-2.360	-2,44			-5.873	-3.46		
GOVM	-7,299	-8,33			-8.083	-5.45		
EDF			-0.411	-2.57				

APPENDIX F(2) (continued), CONSTRAINED ESTIMATES OF THE WIFE'S LABOR SUPPLY FUNCTIONS IN BANGKOK AND NON-BANGKOK AREAS*

EQUATIONS	BANGKOK				NON-BANGKOK			
	Husband's Hours CLM		Wife's Hours CLF		Husband's Hours CLM		Wife's Hours CLF	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
AGEF			-0.211	-0.77			-1.524	-3.33
SQAGEF			0.002	0.53			0.019	3.08
OCPF			-2.780	-2.84			-8.657	-4.92
GOVF			-5.030	-6.67			-6.438	-3.54
UN	1.961	1.60	1.790	1.75	-0.252	-0.62	-0.276	-0.76
R^2	0.1408		0.1888		0.1946		0.1153	
F-test**	4.1600				0.6840			

*The regression results of the wage and children equations are the same as those in Tables 10 and 11.
**The hypothesis is: CWF in CLM equation equals CWM in CLF equation.

APPENDIX G

THE GAME THEORY OF LABOR SUPPLY[1]

Assuming that two persons who are contemplating forming a household possess different utility functions U^k, (k = m, F), which are defined over a vector of consumption goods, X^k, and leisure, R^k. Each individual faces a time constraint given by:

$$T = R^k + L^k$$

where T is total time available, and L^k is time devoted to market work. Individual k also faces a budget constraint which is:

$$I^k = P^k X^k + W^k R^k$$

where I is full income, P is a vector of prices of X, and W^k is k's wage rate.

Suppose that k maximizes his utility subject to the above two constraints, we can derive his demand for goods, X^k and leisure, R^k which are functions of P, W and I. Inserting the demand functions into U^k yields the indirect utility functions, $F^k = V^k(P^k, W^k, I^k)$.

Since there exist one or more goods (called shared goods) which can be shared by married individuals, but not by single individuals, there are gains possible to both individuals if they decide to marry. The marriage bargain can, therefore, be viewed as a two-person, non-zero sum game. Moreover, since the marriage decision involves a degree of cooperation, a cooperative game approach is an appropriate one.

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[1]This appendix is based heavily on two papers by M. Manser and M. Brown, 1976 and 1977.

Instead of assuming that these two individuals, by pooling their incomes, maximize a neoclassical household utility function subject to the constraints, we assume that they agree to a bargaining rule and also maintain the assumption of income pooling. This allows us to apply bargaining theory to the problem of household allocation and distribution of gains while taking account of differences in the two individual's utility function.

A crucial element in this game approach is a threat point for each individual, defined as the utility level which is guaranteed to him/her if no agreement of bargain is achieved. In this two-person game, no one will accept an outcome which yields less utility than the single state utility, V_o^k. So V_o^k is k's threat point. Each of the bargaining models discussed below provides a rule which maps the threat points into a particular point (which is a pair of utility associated with some consumption bundles available to these two persons) in the bargaining areas.

Manser and Brown consider two polar types of bargaining which are the next issues to be discussed.

1. The first rule of the game considered by Manser-Brown, henceforth M-B, is the dictatorial marriage in which one partner k has dictatorial power to determine the household demands and thus the gains each partner obtains from the union. In effect, each partner is assumed to maximize his (her) utility:

(1) $$U^k = U^k(X_k - Y_k, X_3 - Y_3) \qquad (k = 1 \text{ if M, } 2 \text{ if F})$$

which is assumed to be of the following form:

(2) $$U^k = U^k(\alpha_k(X_k - Y_k), X_3 - Y_3)$$

subject to:

(3) $$\sum_{i=1}^{3} P_i X_i = I$$

(4) $$X_k + L_k = T$$

(5) $$U^l\ (\alpha_k(X_k - Y_k,\ X_3 - Y_3) - Z^l \geq 0 \qquad (k \neq l)$$

where X_k is kth partner's leisure time (treated as a private good), X_3 is a shared or "public" household good (i.e. child service), Y_k and Y_3 are the committed consumption of X_k and X_3, respectively, α_k is an index of individual k's characteristics, P_i is price of X_i, I is full income, L_k is k's labor supply, T is total available time, k = 1 for husband (M) and 2 for wife (F), l = 1 for M and 2 for F. The first constraint is the budget requirement, the second is the total time constraint and the third says that the utility per period the individual would receive if a marriage offer is accepted must be greater than if it is declined.

If U^M and U^F are strictly concave, and if constraint (5) is not a binding constraint, the household demand functions will satisfy all of the three classical conditions stated above. These results follow directly from Kalman-Intrilligator (1973). Moreover, the effects on the demand of M's and F's incomes are the same.

Second, if the outcome is such that constraint (5) is binding, the solution is Pareto optimal. By applying the Kalman-Intrilligator theorem, it can be shown that the demand functions for this case do not have the properties of the three classical conditions, nor do the equal-income effects restrictions.

Third, if the utility functions are interdependent and if constraint (5) is non-binding, the demand functions cannot be distinguished from those of the classical model. If (5) is binding, the results are the same as case (2) above.

2. The other extreme rule is the symmetrical bargain, the solution to which is independent of the labels assigned to the two individuals. Two symmetrical solutions are analysed in M-B. The first is the well-known Nash bargain which is the two-person nonzero sum cooperative gain. Each partner is assumed to maximize the household objective function defined as:

$$(6) \qquad N = \ln (U^M - Z^M) + \ln (U^F - Z^F)$$

subject to (2), (3), (4) and (5). The solution for the household demand functions is unique if (a) the individual utility functions are concave, or (b) if the objective function is strictly quasi-concave. If the threat points are fixed, then the Nash demand functions are identical with the classical demand in terms of the above three restrictions (McElroy and Horney, 1977). If the threat points vary, only the Cournot aggregation holds. M's and F's income will not have symmetrical effects on their respective labor supply.

The second solution to the two-person cooperative game is the Kalai-Smorodinsky (1975) which maximizes:[1]

$$(7) \qquad S = U^k - Z^k$$

subject to (2), (3), (4) and to:

$$(8) \qquad U^k - Z^k = (Y^k - Z^k)/V^l - Z^l) * (U^l - Z^l) \qquad (k \neq l)$$

[1]The Kalai-Smorodinsky game also assumes the properties of Pareto optimality and invariance with respect to affined transformation of U^M and U^F. However, the independence of irrelevant alternatives in the Nash game is replaced by the property of montonicity.

where V is k's (or l's) indirect utility functions obtained by inserting into k's (or l's) utility function the demand functions from the dictatorial solution in which k (or l) is dominant. The resulting demand functions have different properties from the classical demands, except that the equal-income effect constraint still holds. If the threat points vary, the demand functions will be completely different from the classical demands.

APPENDIX H

CONSTRAINED ESTIMATES OF THE WIFE'S LABOR SUPPLY MODEL IN BANGKOK AND NON-BANGKOK AREAS: RESULTS FROM THE GAME THEORY MODEL

EQUATIONS	BANGKOK				NON-BANGKOK			
	Husband's Hours CLM		Wife's Hours CLF		Husband's Hours CLM		Wife's Hours CLF	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
INTERCEPT	-3.218	-0.50	-1.361	-0.22	13.771	1.28	32.741	3.71
CWM	1.008	3.17	1.311	2.90	1.545	2.60	1.905	3.27
CWF	1.311	2.75	2.254	3.21	1.905	2.88	4.469	2.41
CHI	-0.021	-3.23	-0.029	-3.04	-0.028	-3.55	-0.041	-2.71
CWI	-0.021	-3.23	-0.029	-3.04	-0.028	-3.55	-0.041	-2.71
C	-1.243	-2.68	-1.904	-3.27	-0.434	-0.70	-1.279	-1.94
EDM	-0.110	-0.65			-0.144	-0.55		
MIGM	3.085	2.35						
AGEM	-0.169	-0.60			-0.371	-0.79		
SQAGEM	0.002	0.68			0.004	0.66		
OCPM	-2.309	-2.47			-6.210	-3.65		
GOVM	-7.170	-8.67			-8.078	-5.42		

APPENDIX H (continued), CONSTRAINED ESTIMATES OF THE WIFE'S LABOR SUPPLY MODEL IN BANGKOK AND NON-BANGKOK AREAS: RESULTS FROM THE GAME THEORY

EQUATIONS	BANGKOK				NON-BANGKOK			
	Husband's Hours CLM		Wife's Hours CLF		Husband's Hours CLM		Wife's Hours CLF	
VARIABLES	β	'z'	β	'z'	β	'z'	β	'z'
EDF			-0.325	-1.83			-0.433	-1.18
AGEF			-0.366	-1.20			-1.548	-3.48
SQAGEF			0.005	1.08			0.020	3.27
OCPF			-2.626	-2.46			-8.573	-4.94
GOVF			-4.383	-5.86			-5.975	-3.29
UN	1.894	1.61	1.931	1.73	-0.229	-0.56	-0.268	-0.75
FSIZE	1.293	2.90	2.001	3.11	0.789	1.76	1.792	2.79
R^2	0.0930		0.0266		0.1796		0.1300	
F*	133.3900		--		25.5600		--	

*We test the hypothesis of three linear restrictions simultaneously, i.e. CHI = CWI in the CLM and the CLF functions, and CWF in CLM = CWM in CLF.

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